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1.1 SHIP/STRUCTURE DESCRIPTION

2016020251

Imbari unveils ‘eco-mega’ containership.  
*The Motor Ship*, v 96 n 1130, October 2015, p 40  
Pike, D.  
English

Japanese shipyard Imbari Shipbuilding Co has completed the first in a new series of advanced containership designs that are aimed at giving improved efficiency for this class of vessel. The 'eco-mega' ship incorporates a number of innovative features that together the yard claims will lead to significant fuel savings. The first eco-mega ship, the MILLAU BRIDGE is currently operating on the Asia to Europe routes and the construction of this vessel is being followed by a further four vessels of the same design in this contract. The ships are designed with a container capacity of 14,000 TEU and have a deadweight capacity of 145,000dwt. The designers of MILLAU BRIDGE carried out extensive wind tunnel tests to develop a bow cover shape that would add minimum weight to the hull structure whilst at the same time reducing the wind resistance. The result is a relatively low structure that extends upwards to about the level of the container guides on deck but which the tests have shown is adequate to deflect the wind upwards and over the container stack. The wind tunnel tests demonstrated that this design of bow cover reduced the wind resistance by up to 5% and there is no sacrifice in container capacity.

Containerships  
Vessel descriptions

2016020252

North America LNG first for Québec ferry.  
*The Motor Ship*, v 96 n 1130, October 2015, p 42  
Tinsley, D.  
English

This article describes the recently delivered St Lawrence ferry FA GAUTHIER, engineered to run on LNG fuel and designed to maintain vital, year-round services across the lower reaches of the ice-prone St Lawrence River. Arranged to carry 800 passengers and 180 vehicles, FA GAUTHIER denotes a milestone in the industry’s uptake of alternative fuels as the first LNG-powered ferry in North America. The vessel was built by Fincantieri, Italy for Société des traversiers du Québec. The dual-fuel plant employed in the 16,200gt ferry ensures compatibility with the sulphur cap when running in gas mode, while safeguarding service dependability by allowing operation on marine diesel oil if there is a hold up in road delivered-LNG bunkers due the rigours of the winter.

Ferries  
Vessel descriptions

2016020253

First of ten for next-generation PSV design.  
*International Tug & OSV*, v 20 n 5, September/ October 2015, p 29 [2 p, 1 fig]  
https://www.tugandosv.com/about_the_magazine.php  
No author given  
English

Dutch Shipyard De Hoop has delivered the first in a series of ten platform supply vessels (PSVs) to Esnaad, the operating company of the Abu Dhabi National Oil Company. The vessel, named ESNAAD 221, measures 70.4m x 16.77m with a summer draft of 4.85m. The hull with its specially developed bulbous bow is optimised to reduce wave resistance. Testament to the maximization or cargo volume at the given hull shape is the resulting impressive deadweight of 2,050 tons at a restricted draft of 4.84m.

Offshore service vessels  
Vessel descriptions

2016020254

METAL SHARK 45’ pilot boat: Bespoke low-noise newbuild for Florida.  
http://www.rina.org.uk/sigsmallships.html  
No author given  
English

Specially built for the Canaveral Pilots Association, Florida, at Metal Shark's Louisiana shipyard, the 14.6m x 4m Metal Shark 45’ Pilot Boat (referred to by the aforementioned association as simply 'Boat 3') comprises a welded aluminium vessel which uses the weight of a single, bow-mounted 485kW diesel engine and an extremely sharp forward entry to slice levelly through waves, instead of riding over the top of the crests and then dropping into the troughs. With enhanced stability a prime
consideration in her design, the boat was developed specifically for operations in heavy seas, including those common to Florida's Atlantic coastline. A list of technical particulars and a general arrangement drawing are included in this article.

Pilot boats
Vessel descriptions

2016020255

MIKOTAHI: Self-righting pilot and offshore transfer boat with customised fendering.
http://www.rina.org.uk/sigsmallships.html
No author given
English
This article describes MIKOTAHI, developed primarily to function as a pilot boat, but also to manage personnel transfers between New Zealand's Port Taranaki and the Pohokura gas platform, situated 4km offshore in water depth of approximately 3Sm. The vessel can accommodate two crew members and up to seven pilots. A propulsive arrangement comprising twin Scania Di 16 662kW engines, coupled to ZF 500 gearboxes which drive Hamilton HM461 waterjets, provides a high degree of manoeuvrability and gifts the boat the ability to achieve a sprint speed of 30knots. A general arrangement drawing is given.

Pilot boats
Vessel descriptions

2016020256

MUNIN S1200: Prototype patrol/intervention vessel built for extreme speed and in-situ combat.
http://www.rina.org.uk/sigsmallships.html
No author given
English
The prototype version of Norsafe’s new customisable Munin S1200 concept has been developed to fulfil a wide range of security-and safety-related duties, including SAR, dive support, seaborne ambulance capabilities and border patrols. This demonstration unit has been constructed with a length of 11.7m, a beam of 3.5m and a depth of 3.2m, and can accommodate up to 20 persons. When fully laden, carrying a range of operation-specific equipment, the craft weighs approximately 6.5tonnes. A general arrangement drawing is included in this article.

Patrol craft
Vessel descriptions

2016020257

NH 1816: High-capacity, high-comfort newcomer to the KNRM's lifeboat fleet.
http://www.rina.org.uk/sigsmallships.html
No author given
English
This article describes the Royal Netherlands Sea Rescue Institution’s (KNRM) largest and most technically advanced lifeboat to date, the first-in-class NH 1816. Intended as a replacement for the KNRM’s 18.8m Arie Visser class, which made its debut in 1999 and is now gradually being phased out, the NH 1816 class was developed to rectify some of the Arie Visser’s weaker points, especially those related to exhaust emissions control, noise and vibration and onboard comfort. NH 1816 features increased capacity for survivors, more efficient fuel consumption and emissions control and enhanced ergonomics. The vessel can accommodate up to 120 survivors externally, with another 25 located inside the lifeboat and has a top speed of 31 knots and a bollard pull of 7tonnes. A general arrangement drawing is given.

Lifeboats
Vessel descriptions

2016020258

PACIFIC LEADER: IBC Code-compliant offshore supply vessel.
http://www.rina.org.uk/sigsmallships.html
No author given
English
PACIFIC LEADER is the first in a series of L class platform supply vessels ordered by Swire Pacific Offshore Operations, and built by Japan Marine United Corporation. The 97.29m PSV
design incorporates fuel-efficient pods, a four-engine diesel-electric power plant, significant cargo-carrying capacity and a bulk cargo system. A general arrangement drawing is included in this article.

Offshore service vessels
Vessel descriptions

2016020259

SEACAT INTREPID: Improved hull form for next-gen turbine transfer boat.
http://www.rina.org.uk/sigsmallships.html
No author given
English
This article describes SEACAT INTREPID, a 26m aluminium offshore wind farm crew transfer vessel built by South Boats IOW, UK for UK operator Seacat Services Ltd. A general arrangement drawing is given. See also abstract no. 2015020253.

Crew boats
Workboats
Vessel descriptions

2016020260

SMV 1: Multipurpose crew transfer vessel, designed for operations 150nm from shore.
http://www.rina.org.uk/sigsmallships.html
No author given
English
Delivered to UK wind farm support vessel operator Windwave Workboats in June 2014, the 19.7m loa SUSIE S is the first in Netherlands-headquartered builder Damen's new Fast Crew Supplier (FCS) 2008 series of crew transfer craft. The FCS 2008 incorporates Damen's Twin Axe hull design, features of which include decreased resistance and superior motion behaviour. Damen estimates that the optimised nature of the Twin Axe can reduce overall vessel fuel consumption (as well as subsequent emissions) by approximately 20. The vessel has a service speed of 23knots, increasing to a sprint speed of 26knots, and 10tonnes of bollard push when pushing onto wind farm turbines. A general arrangement drawing is included in this article.

Crew boats
Vessel descriptions

2016020262

THAIYAK: Moored police and rescue station off Australia's Ashmore Reef.
http://www.rina.org.uk/sigsmallships.html
No author given
English
Intended to function as a mobile 'floating police station', the 40m loa THAIYAK was developed to be moored for lengthy periods (of up to 120 days) at Ashmore Reef, an external territory of Australia situated in the Indian Ocean. The vessel was built by Strategic Marine, Vietnam for the Australian Customs
THAIYAK has the ability to accommodate 17 members of crew, and 25 passengers/detainees. A general arrangement drawing is included in this article.

**Rescue vessels**

**Special vessels**

**Vessel descriptions**

2016020263

**THE NEXT EPISODE: Luxury debutante in new Continental III superyacht range.**


[http://www.rina.org.uk/sigsmallships.html](http://www.rina.org.uk/sigsmallships.html)

No author given

English

This article describes the 27.2m x 6m motor yacht THE NEXT EPISODE the first of Guido de Groot’s new Continental III superyacht series. The vessel was constructed with a lightweight aluminium semi-displacement hull, and she deploys Volvo Penta IPS drive technology, for enhanced steering behaviour and to facilitate manoeuvrability. Noise levels are kept to a minimum courtesy of the vessel's underwater exhausts and shaft alignment elimination. A general arrangement drawing is given.

**Motor yachts**

**Vessel descriptions**

2016020264

**THEA: First-in-class auxiliary survey boat for shallow water missions.**


[http://www.rina.org.uk/sigsmallships.html](http://www.rina.org.uk/sigsmallships.html)

No author given

English

Designed for operations in shallow and medium waters, the survey boat THEA, built to the specifications of Almarninte's Wavetrain 800 catamaran class, has been delivered to, and installed aboard her mother ship, the 54m x 12m survey vessel Fugro Proteus. Measuring just below 9m in length, THEA is powered by a pair of Steyr MO 144M38 engines driving Alamarin 245 waterjets, and can achieve a speed of 15knots in lightweight mode. THEA is launched and recovered from and to Fugro Proteus by means of a Henriksen painter hook and a stern ramp deployment system. With respect to her activities in shallow waters and confined spaces, she has also been fitted with radar, depth sounder, VHF and GPS capabilities, enabling her to be self-sufficient while she is on duty away from her mother ship. A general arrangement drawing is included in this article.

**Pilot boats**

**Vessel descriptions**

2016020266

**SIKULIAQ.**

*Work Boat World, v 34 n 1, April 2015, p 26 [1 p, 3 fig]*


No author given

English

A brief description of the research vessel SIKULIAQ is given. The 80m vessel was built by Fincantieri for the US's National Science Foundation. SIKULIAQ will bring scientists to the ice-filled waters of Alaska and arctic regions. A reinforced double hull, 2
rotating thrusters, and scalloped propeller blades enable the vessel to break ice up to 0.8m thick.

Ice transiting vessels
Research vessels
Vessel descriptions

2016020267

PACIFIC LIBERTY.
Work Boat World, v 34 n 1, April 2015, p 27 [1 p, 1 fig]
No author given
English
Swire Pacific Offshore has taken delivery of its fourth and final L-class platform supply vessel (PSV), PACIFIC LIBERY, built by Japan Marine United. The 5,252 tonne vessel has a fuel-efficient modern design, a large cargo carrying capacity and bulk cargo system and features fuel efficient propulsion pods. It also has a four-engine diesel electric power plant. The bulbous bow design takes into consideration varying operating speed, draughts and sea states that OSVs typically operate in.

Offshore service vessels
Vessel descriptions

1.2 DESIGN

2016020268

Hydrodynamic hull form design space exploration of large medium-speed catamarans using full-scale CFD.
Haase, M., Binns, J.R., Et al
English
Large medium-speed catamarans are a new class of vessel currently under development as fuel-efficient ferries for sustainable fast sea transportation. Appropriate data to derive design guidelines for such vessels are not available and therefore a wide range of demi-hull slenderness ratios were studied to investigate the design space for fuel-efficient operation. Computational fluid dynamics for viscous free-surface flow simulations were utilised to investigate resistance properties of different catamaran configurations having a similar deadweight at light displacement, but with lengths ranging from 110 m to 190 m. The simulations were conducted at full-scale Reynolds numbers (log(Re) = 8.9 9.6) and Froude numbers ranged from Fr = 0.25 to 0.49. Hulls of 130 m and below had high transport efficiency below 26 knots and in light loading conditions while hulls of 150 m and 170 m showed benefits for heavier displacement cases and speeds up to 35 knots. Furthermore, the study concluded that the lowest drag was achieved with demi-hull slenderness ratios between 11 and 13.

Catamarans
Computational fluid dynamics
Hull form
Ship hydrodynamics

2016020269

Hull-form optimisation of semi-submersible FPU considering seakeeping capability and structural weight.
Ocean Engineering, v 104, 1 August 2015, pp 714-724
Park, Y., Jan, B-S., Kim, J.D.
English
Minimization of the motion response of a floating offshore structure is a critical issue, since it is directly related to operation time. In this paper, a fully automated procedure for hull-form optimisation of a semi-submersible floating production unit (FPU) is introduced. As a preliminary step to optimisation, three modules are developed: panel generation, mass estimation, and condition setting. In the first module, 10 geometric parameters are defined to represent the hull form. Once the values of those parameters are determined, the panel model for the motion analysis is automatically generated. The second module for mass estimation determines weight and centre of gravity. Mass is divided into several components, which are estimated based on the surface area and volume of the hull. By applying the simulated annealing (SA) method, multi-objective optimisation is performed. Objectives for minimization are the 3-h heave most probable extreme value (MPEV) and the structural weight. Each objective is weighted. Then, according to the different values of the two weighting
factors, four optimal solutions are obtained. Based on those solutions, it is found that the total hull height is proportional to the structural weight and inversely proportional to the heave motion.

Floating production systems
Hull form
Optimisation
Seakeeping
Semisubmersibles

2016020270

Numerical estimation for submersible drift forces evaluated by experimental tests.
http://www.isope.org/publications/publications.htm
Silva Junior, H.C. da, Kogoshi, A.M., Et al
English

This paper presents a numerical estimation method applied for axisymmetric hulls considering the fineness ratio as parameter. Four models with the following ratios were adopted, 7.0, 8.6, 10.5 and 12.0. The first model is the Series 58, model no.4164 (Landweber and Gertler, 1950), the second model is the DARPA SUBOFF (Groves et al., 1989) and the last two models are ‘general hull form’ (Heberley, 2011). Well established formulations were applied aiming to estimate lift force and yawing moment. The formulations are from Allen and Perkins (1951), Safel et al. (1971), Finck (1978) and Granlund (2009). For the 58 Series and DARPA SUBOFF hulls, experimental results are presented. The objective of this work is to present numerical and experimental results intended to be helpful in the early stages of submersible design, avoiding computation costs of CFD codes.

Axisymmetric bodies
Drag
Hull form
Lift
Submersibles

2016020271

Parameter investigation and multi-speed automatic optimisation of fishing vessel's bulb bow based on the response surface.
Chinese Journal of Ship Research, v 10 n 4, 2015, p 46 [9 p, 16 ref, 9 tab, 20 fig]
Liu, C., Mao, X., Et al
Chinese

The pelagic tuna purse seiner is a medium-high speed fishery vessel. To reduce its wave resistance, an optimised bulbous bow is usually installed. In order to effectively investigate the bulb bow effect on the wave resistance, a bulb bow transformation method is developed in this paper, through which the bulb bow offsets are transformed into length, breadth, height, and fore-point height parameters and directly used in CFD calculation. The wave resistance is then solved with the Rankine source panel method. Using the method of experimental design, a response surface model of bulb bow parameter effect on wave resistance is generated. The response surface model indicates that the influences are rather complex, coupled and irregular, and the exact rules differ with speed. Finally, a fast optimisation method based on the response surface is applied into the bulb bow optimisation, and it is noticed that the optimal solution for the design speed could yield worse resistance performance under service speed, while the multi-speed optimisation method is more effective for the resistance reduction and energy saving under both design speed and service speed.

Bulbous bows
Fishing vessels
Optimisation
Wave resistance

2016020272

Analytical solution of basic ship hydrostatics integrals using polynomial radial basis functions.
Brodogradnja, v 66 n 3, September 2015, p 15 [23 p, 9 ref, 1 tab, 6 fig]
http://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=215161
Ban, D., Bašić, J.
English

One of the main tasks of ship's computational geometry is calculation of basic integrals of ship's hydrostatics. In order to enable direct computation of those integrals it is necessary to describe geometry using analytical methods, like description using radial
basis functions (RBF) with L1 norm. Moreover, using the composition of cubic and linear Polynomial radial basis functions, it is possible to give analytical solution of general global 2D description of ship geometry with discontinuities in the form of polynomials, thus enabling direct calculation of basic integrals of ship hydrostatics.

Hydrostatics
Mathematical analysis

2016020273

Analysis of the energy efficiency design index with a proposal for improvement.
Brodogradnja, v 66 n 3, September 2015, p 49 [11 p, 9 ref, 1 tab, 7 fig]
http://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=215163
Čudina, P.
English
This paper presents the actual method for the calculation of Energy Efficiency Deign Index and analyses the influence of particular variables on the resulted EEDI. Perceived inconsistencies of the actual method of calculation of the attained EEDI are presented with explanation of the influence that the actual calculation has on the design of new ships. Objections are clearly demonstrated on the example of conceptual design of Handy Bulk Carrier. Alternative proposals for improvement of calculation of attained EEDI are introduced. Suggested alterations eliminate observed deficiencies of the existing calculation.

Efficiency
Energy
Ship design

2016020274

Design strategy of battery powered boat and its evaluation.
http://www.isope.org/publications/publications.htm
Umeda, A., Shimizu, E., Oode, T.
English
A new category of All Electric Ship (AES) that combines traditional shipbuilding practice together with power electronics technology is expected to produce a green propulsion solution in the form of the Battery Powered Boat (BPB). Key components of the propulsion system are still under development, particularly the electric motor drive and battery system, and have immature performance characteristics in applications for boats. In this paper, a design strategy that describes the key factors to select and determine the specifications of components for the BPB is presented. Furthermore, the evaluation of several working prototypes based on the strategy is demonstrated.

Electric batteries
Electric drives
Motors
Ship design

2016020275

Development of skeg-type trawl boat in numerical and experimental approach.
http://www.isope.org/publications/publications.htm
Qin, J., Chen, K., Et al
English
This paper introduces the approach to develop a trawl boat with skeg. RANS solution was adopted to predict the powering performance of the trawl boat numerically, also self-propulsion tests of the hull with skeg were performed in towing tank to verify the numerical results and evaluate the approach in skeg-type hull development and improvement, which shows feasibility of those numerical approach during ship hull development, and some conclusions are acquired during design a hull form with skeg.

Hull form
Propulsive performance
Skegs
Trawlers
Hull form optimisation for reduced drag and improved seakeeping using a surrogate-based method.
http://www.isope.org/publications/publications.htm
Huang, F., Wang, L., Yang, C.
English

In this study, a CFD-based ship hydrodynamic optimisation tool has been further developed by integrating a surrogate based method to the optimisation module to optimise hull forms for reduced drag and improved seakeeping performance. Specifically, a radial basis function (RBF) based surrogate model is developed to approximate the objective functions (the drag and seakeeping performance) in the CFD-based hydrodynamic optimisation of ship hull forms. In order to construct the RBF-based surrogate model, a practical steady ship flow solver based on the Neumann-Michell theory and a ship motion program based on the strip theory are employed to evaluate the drag and the seakeeping performance of the sampling hull forms, respectively. For the purpose of illustration, the developed tool is applied to the optimisation of the Series 60 hull, where the original Series 60 hull with an added bulbous bow is taken as an initial hull to be optimised by minimizing the drag, the heave motion and the pitch motion when the ship advances at a constant forward speed in head seas. Numerical results show that the present computational tool can be used to optimise ship hull forms for reduced drag and improved seakeeping performance, and the developed RBF-based surrogate model can reduce computational costs associated with the CFD runs.

Computational fluid dynamics
Drag
Hull form
Optimisation
Seakeeping

An inductive learning-based intelligent optimisation technology of hull form.
http://www.isope.org/publications/publications.htm
Feng, B., Dong, S., Liu, Z.
English

A simulation-based design approach helps to reduce design costs, improve optimisation accuracy, and better understand the design space. It has become an important means of hull form optimisation. However, the design space and dimensions are large, the objective function is not explicitly expressed, and the search space is not continuous. Therefore it is difficult to perform optimisation based on numerical simulation to obtain global optimal solution. The non-gradient optimisation methods such as genetic algorithm and simulated annealing method require a considerable amount of simulation time. An optimisation method based on induction knowledge of numerical simulation is proposed for hull form optimisation, which is based on inductive learning method in artificial intelligence. The authors perform a design of experiment to obtain sample points of the hull form. CFD numerical simulation is performed to obtain ship performance of each of the sample points. The simulation data is discretized and attribute reduction is performed using rough set theory. Finally, design sub-spaces where the optimal solutions belong are derived using rough set theory. The results show that: the proposed method can significantly improve hull form optimisation efficiency and quality. It is an effective way to solve the current problems in hull form optimisation.

Hull form
Intelligence
Knowledge
Optimisation
Research of reliability enhancement by module division application to ship machinery system design.


http://www.isope.org/publications/publications.htm

Nishijima, T., Shintaku, E., Et al

English

Marine engineering systems utilize a wide variety of equipment and subsystems to supply engine thrust, electric power, and heating or cooling throughout a seagoing vessel. Therefore, system redundancy is important to ensure a ship can operate independently over long distances, and stringent effluent control is required to prevent environmental pollution. In Japanese shipyards, when a marine engineering system is designed and built, the normal practice is for the shipyard to determine the specifications and composition of the entire system, purchase all the equipment and components that satisfy those specifications from marine system manufacturers, and then fabricate systems and assemble everything from scratch within the shipyard itself. In contrast, automobile manufacturers cooperate with auto parts suppliers to jointly develop products. One example of this can be found in modularization, which is being incorporated into the design and construction processes of a number of industries. Modularization divides a complex product into a group of functionally complete modules that can be produced independently and then assembled to create a finished product. When modularization is applied to marine engine system design, an important consideration is the division method used. When a system is divided into functional modules instead of using a conventional block shipbuilding design process, the value of each function is easily identifiable. This study introduces the modularization approach adopted by the Engine Design Division of Tsuneishi Shipbuilding, and shows how reliability is enhanced by applying modular fabrication techniques to the marine engine system design. To accomplish this, first a marine diesel engine support system is divided into functional modules, and then failure mode and effect analysis (FMEA) of each module is carried out. Then, a risk index was introduced to evaluate the reliability of each module. In the fuel oil supply module, which shows the highest risk level, the risk of main engine stoppage occurrence was calculated. Based on this and other study results, the authors believe that modular design usage offers an effective method to enhance marine engine system design.

Engine design
Machinery
Modules
Reliability
Shipboard systems

Design of flat-type river-sea-going multi-purpose ship.


http://www.isope.org/publications/publications.htm

Pei, Z., Zhu, Z., Wu, W.

English

Flat-type river-sea-going multi-purpose ship with large block coefficient is designed to satisfy the requirement of the shipping market. The key technologies of safety, energy saving and green ship for flat type and shallow draft ship are solved in this research. Through the economic analysis, seaworthy analysis, and structural safety analysis and considering the natural environmental condition of the navigation route, a river-sea-going multi-purpose ship is developed which has larger capacity, lighter structural weight, lower fuel consumption and excellent performance.

Flatness
Multipurpose vessels
Oceangoing river vessels
Shallow draft
Ship design
A new Parametric Mesh Transformation Method (PMTM), which is used for structure shape optimisation of the hull, is proposed in this paper. The purpose of PMTM is to realize dimension-driven of the FEM model for hull structure, without calling mesh generator as the traditional parametric method doing. In this method, the plate is split into quadrilaterals with the concept of N-Sided region modelling technology. Then create a Coons surface that interpolates four edges for each quadrilateral. Get the dimensionless parameters for all nodes of the mesh within each Coons patch by surface reverse calculation method. A combined reverse calculation method, which takes into account of both efficiency and generality, is developed and used in calculation of dimensionless parameters. When the structure is changed, all the Coon surfaces are changed accordingly. Then substitute the dimensionless parameters of each node into the surface equations of the corresponding Coons surface, and a new point is obtained. The new created point is the new location of the node. Calculate new location for each node with the above procedure, and the new finite element model according to the new structure is obtained. This method is applied to the shape optimisation of a 300 ft. jack-up rig compared with the traditional method. The result shows that PMTM is able to realize dimension-driven of FEM model. It is also proved that when the parameters of the parametric structure model changed gradually, the structure stresses change smoothly with PMTM. That is an important advantage which the tradition methods do not have, and it could improve the efficiency as well as quality of hull structure shape optimisation.

**Finite element method**

**Hull form**

**Optimisation**

Designing ships for open water and ice requires a suitable design method to account for the distinct challenges in open water and ice. Ships with multi-environment capabilities are of high complexity as a result of design-coupling, which is illustrated by design matrices. In this context, this article presents a method that includes a ship performance evaluation method based on the Ship Merit Factor (SMF). The method combines the SMF with a route specific ship-dependent productivity and allows comparison of the techno-economic performance of ships operating in open water and ice. Consequently, the method is applied to a case study comparing the performance of different ship designs operating along the route Rotterdam to Yokohama through the Suez Canal and the Northern Sea Route. The resulting design approach indicates the necessity to include and develop novel simulation-based methods for the reliable assessment of ice-capable ships is discussed.

**Ice transiting vessels**

**Ship design**

Assessing air emissions for uncertain life-cycle scenarios via responsive systems comparison method.

Designing ships for open water and ice requires a suitable design method to account for the distinct challenges in open water and ice. Ships with multi-environment capabilities are of high complexity as a result of design-coupling, which is illustrated by design matrices. In this context, this article presents a method that includes a ship performance evaluation method based on the Ship Merit Factor (SMF). The method combines the SMF with a route specific ship-dependent productivity and allows comparison of the techno-economic performance of ships operating in open water and ice. Consequently, the method is applied to a case study comparing the performance of different ship designs operating along the route Rotterdam to Yokohama through the Suez Canal and the Northern Sea Route. The resulting design approach indicates the necessity to include and develop novel simulation-based methods for the reliable assessment of ice-capable ships is discussed.
possible realizations of uncertain operational life-cycle scenarios using the responsive systems comparison method. This complex systems engineering method includes a strong emphasis on the structural and behavioral aspects of complexity, by mapping of function and form via machinery configuration variables and performance attributes. However, it also has the capacity to handle additional complexity aspects, discretizing the context into epoch variables, time into epochs and eras, and perception into utilities through the life cycle. A theoretical example related to the design of a general cargo container is presented. The study illustrates the challenge in striking the correct balance between minimizing the emissions for an initial scenario, while providing additional performance capabilities to be efficient in the uncertainty of future market requirements.

Emissions
Life (durability)
Ship design

2016020283

Study provides insight into optimal weight, size for FLNG vessels.
Offshore, v 75 n 10, October 2015, p 58 [4 p, 2 tab, 5 fig]
White, N.
English

The first floating liquefied natural gas (FLNG) projects are nearing completion and will soon enter operation. A review of the information available in the public domain on these projects has been undertaken as part of an effort to identify the underlying trends. From this data, correlations were developed for estimating the size and weight of an FLNG vessel. A high-level model was developed from these correlations, and studies were performed to provide insights into the key weight drivers for the FLNG vessel topsides and hull. Also included in this analysis were a breakdown of FLNG weight; FLNG economies of scale; and the limits on ultimate FLNG capacity.

Dimensions
Floating production systems
Liquefied natural gas
Weight

2016020284

VISTA (Virtual sea trial by simulating complex marine operations): Assessing vessel operability at the design stage.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [18 p, 9 ref, 3 tab, 10 fig]
http://www.researchgate.net/publication/276949197_VISTA_Virtual_sea_trial_by_simulating_complex_marine_operations_Assessing_vessel_operability_at_the_design_stage
Erikstad, S.O., Grimstad, A., Et al
English

This paper presents an industry project aimed at developing an innovative, integrated design and verification workbench that exploits synergies across multiple disciplines to empower the designer with the ability to accurately and rapidly benchmark the performance of the complete ship system over its operational lifecycle. The VISTA workbench will be based on the detailed simulation of ship logistics and marine operations in demanding physical environments, and enable the designer to perform a “virtual sea trial” that captures the specific customer-defined missions for the vessel over extended periods of time.

Sea trials
Ship design
Simulation

2016020285

Calculation of the dynamic positioning capability in time domain in early design stages.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [13 p, 15 ref, 1 tab, 12 fig]
Lübecke, A., Krüger, S., Christiansen, J.
English

The capability of a vessel to automatically keep its position in open water is so called Dynamic Positioning (DP). Such systems are able to compensate the counteracting environmental forces caused by wind, waves and current. To comply with required conditions, it is necessary to consider this aspect in the early ship design stage. In order to
predict the limiting environmental condition a calculation method has been developed by the authors. First, a static calculation is presented in the paper, in which the equilibrium of forces and moments of the environmental load and the thrust of the propulsion systems are solved by using an optimisation algorithm. Based on these results a time domain calculation is started afterwards to consider the dynamic effects of wind and waves. Therefore the fluctuating influence of these environmental parameters is modelled by equivalent forces in time domain simulation. The wind forces are determined based on the wind speed, lateral area and the drag coefficients depending on the wind direction. The fluctuation of the wind speed and direction is calculated by a spectrum which is common practice. A similar approach is made for the current forces but the current speed is assumed to be constant. An existing diffraction-radiation seakeeping method is used to account the time varying wave drift forces. The calculation method is intended for each type of vessel and any kind of propulsion plants, such as azimuth thrusters or conventional twin screw configurations.

Dynamic positioning
Ship design
Stationkeeping

2016020286

Energy efficient safe ship operation (SHOPERA).
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [29 p, 77 ref, 13 tab, 28 fig]
http://www.researchgate.net/publication/275891030
ENERGY EFFICIENT SAFE SHIP OPERATION (SHOPERA)
Papanikolaou, A., Zaraphonitis, G., Et al
English

The 2012 guidelines on the method of calculation of the attained Energy Efficiency Design Index (EEDI) for new ships, MEPC.212(63), as updated by MEPC 245 (66) in April 2014, represent a major step forward in implementing energy efficiency regulations for ships through the introduction of the EEDI limits for various types of ships. There are, however, serious concerns regarding the sufficiency of propulsion power and steering devices to maintain manoeuvrability of ships in adverse conditions, hence regarding the safety of ships, if the EEDI requirements are achieved by simply reducing the installed engine power. This was the rationale for a new EU funded research project with the acronym SHOPERA (2013-2016), aiming at developing suitable methods, tools and guidelines to effectively address the above concerns. The paper discusses the background of the ongoing research in project SHOPERA, presents early and intermediate results of the project and discusses certain fundamental issues regarding the formulation of proper criteria for ship’s manoeuvrability and safety under adverse conditions.

Energy conservation
Manoeuvrability
Optimisation
Propulsive efficiency
Ship design

2016020287

Alternative design of shipboard electrical distribution energy systems for passenger ships.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [10 p, 10 ref, 3 tab, 6 fig]
http://www.researchgate.net/publication/277321343
Alternative design of shipboard electrical distribution energy systems for passenger ships
Konstantinos, S., Dracos, V.
English

To date, safety is not of such importance for electric power distribution systems designers and is not taken directly into consideration in a quantifiable and verifiable way. Therefore, the systems may be vulnerable, a large number of redundant units may be necessary and, consequently, the investment cost is escalating. In the paper, quantitative availability of an alternative shipboard electrical power distribution systems design of a RoPax vessel is presented, under applied statistical damages from SOLAS 2009, and compared with a conventional ship design that complies with SOLAS ’90 regulations.

Electric power distribution
Passenger ships
Ship design
Shipboard systems
Quantifying value robustness of OSV designs taking into consideration medium to long term stakeholders’ expectations.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [13 p, 16 ref, 11 tab, 6 fig]
http://www.researchgate.net/publication/276950342_Quantifying_value_robustness_of_OSV_designs_taking_into_consideration_medium_to_long_term_stakeholders_expectations
Gaspar, H.M., Brett, P.O., Et al
English
This work presents an evaluation of the robustness of Offshore Support Vessels (OSVs) based on offshore market forecast using epoch-era analysis. Designing the right vessel for the right mission over time requires more than immediate matching of owners’ requirements and vessel capabilities. Temporal and future uncertainties adds a critical aspect of complexity to the design process, since what constitutes a good mission performance may change over time due to changes of markets, regulations, players and site related circumstances. A possible (but costly) solution is to invest in a high-capability vessel, able to perform across a wide range of missions during its lifetime. Alternatively, one may invest in a low capability vessel, able to perform to a specific mission, with an option to upgrade the vessel in case of significant operational context changes. This paper presents a set of feasible options, which can deal with such uncertainty and fluctuating mission requirements during concept design, and evaluate their robustness in terms of low initial investment versus high initial investment and still possibility to perform well under different epochs. The proposition is that stakeholders’ expectations can be parsed into design and epoch variables, and a robustness value can be evaluated in each design compared to a trade space benchmark, according to the return of investment of each solution. The formulation starts from a simple two-option case for a PSV, with an additional study case on Ulstein’s PX121 family and the flexibility option of the Blue Ship case.

Decision making
Offshore service vessels
Ship design

The influence of shallow water and a hull form variation on inland ship resistance.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [17 p, 9 ref, 4 tab, 19 fig]
http://www.researchgate.net/publication/278301006_The_Influence_of_Shallow_Water_and_Hull_Form_Variations_on_Inland_Ship_Resistance
Rotteveel, E., Hekkenberg, R.G.
English
In order to improve the hull form design knowledge related to inland ships, a Dutch Joint-Industry Project named Top Ships was initiated. The project studies the effects of various hull form variations on an inland ship's propulsion power, resistance and propeller efficiency. This paper presents the effects of a hull form variation and shallow water on a 110-meter inland ship as preliminary results of this project. The results show that the adaptation of an inland ship hull form to a certain water depth is of great importance.

Computational fluid dynamics
Hull form
Inland waterways vessels
Resistance
Ship design

Design study of floating crane vessels for lifting operations in the offshore wind industry.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [13 p, 10 ref, 3 tab, 12 fig]
Vorhölter, H., Hatecke, H., Feder, D-F.
English
In this paper a design study for different floating crane vessels is presented. Designs of crane vessels in a range from converted conventional heavy-lift carriers over offshore construction class vessels to crane derrick barges with crane capacities of up to 3000 t are compared to each other by simulating lifting operations typical for the offshore wind industry. The lifting operations are simulated with non-linear sea-keeping tools, which have been
developed in the joined R&D project “HoOK”. The motion of the free hanging load is computed for operational setups. The results from these analyses will be used to derive recommendations both with regard to operational limits of existing crane vessels and for the design of future crane vessels.

Design
Floating cranes
Heavy lift operations
Heavy lift vessels
Seakeeping

2016020291
Hydrodynamic shape optimisation of a container ship transom using Navier-Stokes analysis.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSSAOE. [14 p, 21 ref, 5 tab, 21 fig]
http://www.researchgate.net/publication/277143096_Hydrodynamic_Shape_Optimisation_of_a_Container_Ship_Transom_using_Navier-Stokes_Analysis
Trong, N.D., Takanori, H.

English
The main objective of this paper is to describe the development of an effective method for the transom shape optimisation of a container ship based on a nonlinear programming method and a Navier-Stokes analysis. The flow solver which solves the three-dimensional RANS equations for incompressible flows is used for evaluating an objective function and analysing flow field around a ship hull. The SQP (Sequential Quadratic Programming) is utilized as an optimiser which automatically determines values of the design variables in such a way that the objective function is minimized subject to the given constraints. Design variables are selected so that the modified transom shapes are created efficiently throughout the optimisation process. To demonstrate the applicability of the present method, a transom shape of a container ship is optimised to reduce pressure resistance at a given speed. In addition, effects of the different initial values of the design variables on the final optimal results are also presented in this paper. The optimisation results show that the present optimisation system is able to determine a proper transom shape which decreases the pressure resistance.

Containerships
Navier-Stokes equations
Optimisation
Transom sterns

2016020292
A Markov decision process framework for analysing LNG as fuel in the face of uncertainty.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [12 p, 31 ref, 7 tab, 13 fig]
Kana, A.A., Knight, J.T., Et al

English
A Markov decision process (MDP) framework is presented for analysing temporal design and decision pathways involving the impact of evolving Emission Control Areas (ECAs) on the design and operation considerations of a notional 13,000 TEU containership. The major decision is between converting to a dual fuel liquefied natural gas (LNG) engine or continue alternating between marine diesel oil (MDO) in the ECA zones and heavy fuel oil (HFO) otherwise. The current low cost of LNG makes converting an attractive option; however, uncertainties with fuel prices, fuel supply chain risks, the regulatory framework, conversion costs, and lost revenue, due to reduced TEU capacity, make the decision less obvious. The effect of lost revenue due to LNG fuel tanks, variations in economic discount rates, and fuel supply chain risks are examined in detail over a range of speeds.

Emissions
Liquefied natural gas
Markov processes
Ship design
Assessment of the effect of uncertainties in design parameters on the design of arctic ships.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [15 p, 16 ref, 6 tab, 11 fig]
http://www.researchgate.net/publication/276950470_Assessment_of_the_effect_of_uncertainties_in_design_parameters_on_the_design_of_arctic_ships
Bergstrom, M., Erikstad, S.O., Ehlers, S.

When designing an arctic cargo ship, it is necessary to consider a large number of uncertain design parameters. These include environmental parameters (e.g. future sea ice conditions), vessel parameters (e.g. ice loads and resistance), operational parameters (e.g. availability of icebreaker support), and financial parameters (e.g. future icebreaker fees and fuel prices). In addition, it is necessary to make modelling assumptions. This paper investigates how such parameter uncertainties and assumptions can influence decision-making during the design process. The outcome of the study indicates that seemingly small variations in design parameter values and assumptions can have a profound effect on the outcome of the design process. These findings highlight the need for more accurate tools and data for performance assessment of arctic ships.

Ice transiting vessels
Risk analysis
Ship design
Uncertainty

Handling uncertainty in marine systems design - state-of-the-art and need for research.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [19 p, 31 ref, 2 tab, 33 fig]
http://www.researchgate.net/publication/276950650_Handling_uncertainty_in_marine_systems_design_-_state-of-the-art_and_need_for_research
Erikstad, S.O., Rehn, C.F.

This paper provides a state-of-the-art review of methods and strategies for handling design stage uncertainty related to marine systems design. The methods surveyed include Monte Carlo simulations, decision tree building methodologies and stochastic programming. Other methods are also introduced, such as financial concepts including value-at-risk, stochastic processes, scenario generation and sensitivity analysis. Additionally, systems engineering approaches are discussed, with a focus on “-ilities” such as flexibility, changeability, adaptability and robustness. The framework for deriving a quantitative value of design flexibility is linked to real options. Of the methods surveyed, Monte Carlo simulation was found to be an easily accessible method for pricing real options in marine systems. For large, more complex design problems involving important, non-trivial second stage decisions for exercising flexibility, stochastic programming is of particular relevance. A selection of methods has been applied to a RoRo design case for illustration and comparison. Generally, though there are multiple methodological approaches for handling flexibility in design, there is still a considerable gap to be covered by future research between theoretical models and practical, industry-relevant applications.

Design
Uncertainty

Nonlinear ship waves and computational fluid dynamics.
Proceedings Japan Academy, Series B, v 90 n 8, 2014, p 278 [23 p, 43 ref, 2 tab, 33 fig]
https://www.jstage.jst.go.jp/article/pjab/90/8/90_PJA9008B-01/_pdf
Miyata, H., Orihara, H., Sato, Y.

Research work undertaken in the first author’s laboratory at the University of Tokyo over the past 30 years is highlighted. Finding of the occurrence of nonlinear waves (named Free-Surface Shock Waves) in the vicinity of a ship advancing at constant speed provided the start-line for the progress of innovative technologies in the ship hull-form design. Based on these findings, a multitude of the Computational Fluid Dynamic (CFD) techniques have been developed over this period, and are highlighted in this paper. The TUMMAC code has been developed for wave problems, based on a rectangular grid system, while the WISDAM code treats both wave and viscous flow problems in the framework of a boundary-fitted grid system. These two techniques are able to cope with almost all fluid dynamical problems relating to ships, including the resistance, ship’s motion and ride-comfort issues. Consequently,
the two codes have contributed significantly to the progress in the technology of ship design, and now form an integral part of the ship-designing process.

*Computational fluid dynamics*
*Hull form*
*Ship waves*
*Shock waves*

### 1.3 SHIPBUILDING TECHNOLOGY

#### CONSTRUCTIONAL TECHNIQUES

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<td><strong>A study on remaining efficiency of thermal straightening after block lifting.</strong></td>
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<tr>
<td><em>Journal of Advanced Research in Ocean Engineering, v 1 n 3, p 149</em></td>
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<tr>
<td><strong>Ha, Y., Yi, M.</strong></td>
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<td>English</td>
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The deck of ship blocks are mainly made of thin plates. A main reason of using thin plates is that deck plates do not need to support large structural loads and moments. While using thin plates for deck construction, various deformation problems occur during production process. In particular, out-of-plane deformations between stiffeners are frequent. These deformations are usually straightened by thermal straightening such as flame heating method. After thermal straightening, the blocks are lifted and moved by cranes to assemble it at dry-dock stage. After this lifting process, out-of-plane deformation again happens frequently. And then, they continuously cause quality and accuracy problems in the final dry-dock process. So, it takes more time for repair and correction working. According to preceding research, the lifting process by cranes would offset the effect on thermal straightening. This study finds out the remained efficiency of thermal straightening when tensional loads are added to corrected parts by a lifting. Inherent strains were used in calculating the efficiency and established the methodology, where the positions for carlings are. This process makes progress by using thermal straightening analysis based on FEA (Finite Element Analysis) and it is possible to predict this phenomenon. For getting more accurate positions, besides the structural lifting analysis, welding deformation analysis with upper block and measured data from a serial ship are also referenced.

*Deformation*
*Flame straightening*
*Shipbuilding*

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<tr>
<td><strong>Peculiarities of welding technical requirements for Arctic applications.</strong></td>
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<tr>
<td><strong>Kah, P., Layus, P., Martikainen, J.</strong></td>
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<td>English</td>
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In recent decades, the Arctic has been a focus of interest primarily because of its vast natural resources. Most structures utilized for oil and gas production are offshore structures and vessels. This paper overviews a range of difficulties connected with operation in the Arctic region and concentrates them on three primary problems. Limited experience of Arctic oil and gas projects has meant unclear standard prerequisites for materials and assembling techniques. Not only deficient information on the climate and its variability, but also uncertainty about operational conditions demands high reliability from operations in the Arctic. Economic feasibility of oil and gas tasks is a critical issue, which calls for more effective materials and manufacture processes. Difficulties in each aspect are evaluated with points of interest and conceivable arrangements are suggested.

*Arctic environment*
*Heat affected zone*
*Offshore structures*
*Shipbuilding*
*Welding*
2016020298

Heap-model-based scheduling of ship building lines for tandem construction of a pair of ships.
Journal of the Japan Society of Naval Architects and Ocean Engineers, v 21, 2015, p 83 [9 p, 6 ref, 5 tab, 22 fig]  
https://www.jstage.jst.go.jp/article/jiasnaoe/21/0/21_83/_pdf  
Iwashita, T., Kajiwara, H.
Japanese

This paper aims to develop further the authors’ previous work, which is concerned with a just-in-time scheduling problem of block-assembly lines in a shipyard. The blocks fabricated are stocked for prefitting and painting works and they are provided to the pre-election area. The authors proposed a new method called as Max-Plus Method to solve the problem. In some cases, however, this method can’t satisfy a synchronization constraint that pre-sub-blocks must be fabricated before the specific sub-blocks are fabricated. Also it can’t manage the stockyard very well except the utilization of round-robin type. In the paper, another new method called as Heap Method is proposed, which is inspired from the Heap Model in the field of Max-Plus algebra. It is shown that the above unsolved problems can be solved.

Assembling  
Scheduling  
Shipbuilding

2016020299

Multi-physics framework for advanced simulation in shipbuilding.
http://www.isope.org/publications/publications.htm  
Ham, S-H., Hong, J-W., Et al
English

So far, existing dynamics engines for simulation are not suitable for application to various targets in shipyards because it should be combined by two or more physical theories. Therefore, a multi-physics framework for advanced simulation in shipbuilding is proposed in this study. The multi-physics framework is composed of 4 layers such as dynamics core layer, interface layer, multi-physics components layer and service layer. Finally, to evaluate the effectiveness and applicability of the proposed framework, it is applied to the block lifting with equalizers and load-out operation by modular transporters.

Shipbuilding  
Simulation

2016020300

Co-simulation of multibody system dynamics and moving particle semi-implicit method for heavy load lifting operations in shipyards.
http://www.isope.org/publications/publications.htm  
Ha, S., Kim, K-S., Et al
English

Since various existing simulation tools based on multibody system dynamics (MSD) focus on conventional mechanical systems, such as machinery, cars, and spacecraft, there are some problems with the application of such simulation tools to shipbuilding domains due to the absence of specific items in the field of naval architecture and ocean engineering, such as hydrostatics and hydrodynamics. Thus, this paper describes how to simulate heavy load lifting operations in shipyards by using multibody system dynamics and moving particle semi-implicit method. The crane systems in shipyards are all multibody systems in which the multiple rigid bodies are jointed together, so the multibody system dynamic was used to analyse its dynamic response. The moving particle semi-implicit method was applied to compute nonlinear motions of a floating vessel. Co-simulation with these two methods was applied to actual operations in shipyards.

Dynamic analysis  
Heavy lift operations  
Multibody systems  
Shipyards  
Simulation
2016020301

Development of production plan assessment system for productivity improvement using AHP method.
http://www.isope.org/publications/publications.htm
Nam, S-H., Back, M-G., Et al
English

A scheduling problem in the shipbuilding industry is much different from the same problem in any other transportation industry. The reason for this is that the production process in the shipbuilding industry is considered one-of-a-kind. A shipbuilding production plan is generally established in the following order: production plan, long-term plan, mid-term plan, and execution schedule. Each plan and schedule differs in its planning scope and degree of specification, especially if the planning scope of the production plan is more than 3 years. Additionally, the shipyard’s orders and sales are affected by the production plan. However, due to the lack of detailed information, it is difficult to evaluate a production plan in the planning stage. Therefore, the authors suggest using the analytic hierarchy process to solve this problem. The standards for assessment are suggested by the sales of the shipyard, delay interest, penalty, and activity type.

Production planning
Scheduling
Shipbuilding

2016020302

A study of data qualification for shipyard manufacturing scheduling simulation.
http://www.isope.org/publications/publications.htm
Lee, P., Lee, J-H., Et al
English

For shipyard production simulation, the process of taking the production information in possession of the shipyard and converting it to fit the simulation is necessary. Because the shipyard legacy information to be converted wasn’t created for production simulation, information needed for a simulation may be omitted or it may be changed in the conversion process to not be consistent with the original purpose. This paper presents a methodology for converting the shipyard legacy information to fit production simulation and quantitatively analysing the quality of the information collected as the result of the conversion. Actual shipyard legacy information was used to judge the practicality of the methodology.

Data conversion
Manufacturing
Scheduling
Shipbuilding
Simulation

2016020303

Numerical investigation on interruption in the welding process used in shipbuilding.
http://www.ingentaconnect.com/content/sname/jspd/2015/00000031/00000004/art00002
Podder, D., Kenno, S., Et al
English

Interruptions in the welding process in shipbuilding are unavoidable because of complex geometry and human fatigue. This article presents an uncoupled three-dimensional finite element (FE) modeling technique for bead-on-plate welding and an interruption in the welding process for low carbon and high notch toughness steel plate typically used in shipbuilding. The goal of the FE model was to successfully predict the effect of various time delays in the welding interruption on the residual stress distributions. The FE results are compared with the experimental results for the validation of the model. The experimental work was completed using the neutron diffraction method. The element birth-and-death algorithm was used in ANSYS® to simulate the filler metal deposition. A double ellipsoid heat source was used to simulate the heat source of the weld pool. The FE model considers the temperature-dependent nonlinear material properties and uses the temperature-dependent combined coefficient of heat loss. The study found that weld interruptions in the welding process change the residual stress patterns and cause an increase in the maximum longitudinal tensile residual stresses. However, the maximum longitudinal compressive stress reduces as a result of interruptions in the weld process. This study found that a weld interruption duration of approximately 2 minutes is optimum for both fatigue and buckling strength. This study also analysed the effect of preheat on longitudinal residual stress distribution...
and concluded that a suitable short time lag without any preheat is equivalent to preheat after a long welding interval.

Delay
Finite element method
Residual stress
Time
Welding

2016020304

Research on the assembly sequence of a ship block based on the disassembly interference matrix.
http://www.ingentaconnect.com/content/sname/jspd/2015/00000031/00000004/art00003
Li, P., Cui, J., Et al
English
Reasonable optimised block assembly sequence has vital practical significance for ship construction, and the research has been done in this article at the aim of obtaining optimal assembly sequence. First, taking a double-bottom block as the object of study, by analyzing the connection relationship between each part, a disassembly network diagram and disassembly interference matrix can be generated by applying the demolition method. Based on the disassembly interference matrix, disassembly sequence can be generated according to certain rules, then the assembly sequence is the invert of disassembly sequence; next, considering comprehensively the part's physical attribute affecting the assembly sequence, the final assembly sequence can be obtained for two assembly ways using the analytic hierarchy process; lastly, DELMIA software is applied to implement the virtual simulation of the assembly process in accordance with the assembly sequence. The work of the article is of certain guidance significance to parts assembly in ship production and can lay a good foundation for realizing the ship block's digital assembly.

Assembling
Double bottoms
Planning
Sequencing
Shipbuilding

2016020305

Variation simulation of compliant metal plate assemblies considering welding distortion.
Journal of Manufacturing Science and Engineering, v 137 n 3, June 2015 [9 p]
http://manufacturingscience.asmedigitalcollection.asme.org/article.aspx?articleID=2111019
Choi, W., Chung, H.
English
The shipbuilding industry employs numerous cutting and joining processes to build the ship and offshore structure. Welding, as the primary joining process, inherently causes distortion and accounts for most of the major geometrical variation in the intermediate products (IPs), thus adversely affecting the downstream assembly processes. Because of the welding process, the variation analysis of compliant assemblies in shipbuilding is clearly different from that of the automobile and aerospace industries, where the distortion during the joining process is negligible. This paper proposes a variation simulation model including the effects of joining process distortion for ships and offshore structures. The proposed model extends the concepts of the sources of variation and the method of influence coefficient (MIC) for a compliant mechanical assembly to include the welding distortions. The proposed model utilizes welding distortion patterns and a transformation matrix to efficiently model the deformation due to the joining process. Also the welding distortions are represented as stochastic values due to its randomness. The model is verified by case study simulation and by a comparison with welding experimental results.

Assembling
Distortion
Plates
Simulation
Welding

2016020306

Research and application of technique for building 200ft jack-up on horizontal skidway.
http://www.isope.org/publications/publications.htm
Zhang, W., Gu, H., Et al
English
Building Jack-up on a shipway or drydock is a
common method for most shipyards. However COOEC (Qingdao) has built and delivered four of 200ft Jack-ups successfully, Hai Yang Shi You 921-924. Two of them were built on horizontal skidway, others on drydock. This paper illustrates and summarizes the technique developed and successfully applied to HYSY 921-922 which building on horizontal skidway. Through practices and application in the whole project, it proves that building 200ft Jack-up on horizontal skidway is a feasible and efficient method compared with building on a shipway or drydock.

Construction
Jackup platforms

2.1 POWER SOURCES AND FUELS

2016020307

New-technology shipboard system converts heat from engine jacket water into electrical power.
Calnetix Technologies, Cerritos, CA, US; White Paper, 2015 [7 p, 1 tab, 4 fig]
No author given
English

Calnetix Technologies, working in close cooperation with Mitsubishi Heavy Industries Marine Machinery and Engine Company (MHI-MME) has developed a system called Hydrocurrent™, which uses an Organic Rankine Cycle (ORC) heat transfer process and a patented turbo-generator power conversion system to convert thermal energy from heat in the engine’s jacket water into mechanical power to generate electricity. It can produce up to 125 kW of electrical power from a temperature source as low as 80°C, saving up to 200 tons of bunker fuel and reducing carbon monoxide emissions by 18 tons per year by reducing the load on the ship’s bunker-burning diesel generators. The Hydrocurrent™ system has been approved by Class NK and Lloyd’s Register following extensive tests and inspections of the system’s turbo-generator, electrical, piping, controls and ORC components. This White Paper provides a detailed description of the system components and how they work, followed by a summary of test procedures and results.

Electric power
Heat recovery
Shipboard systems

2016020308

Growing niche for battery power.
The Naval Architect, Marine Power & Propulsion Supplement, 2015, p 8 [4 p, 5 fig]
http://www.rina.org.uk/tna.html
No author given
English

This article discusses marine battery power. An increasing number of owners and operators are looking to meet the challenges posed by more stringent emissions regulations through prudent recourse to energy storage systems in the form of banks of batteries, generally as part of a hybrid power configuration. Moreover, the flexibility and opportunity offered by hybrid systems to save fuel by drawing on power stored in the batteries at certain points in a vessel’s operating profile, be it harbour or when holding position, gives economic merit to the use of batteries in the energy mix.

Electric batteries
Hybrid propulsion

2016020309

Wärtsilä sets new benchmark in four-stroke design.
http://www.rina.org.uk/tna.html
Tinsley, D.
English

This article describes the new Wärtsilä 31 engine which sets a new industry standard in four-stroke efficiency and is also exceptional in providing a concurrent design platform for three distinct products, in diesel, gas-only and dual-fuel variants. The diesel version of the W31 offers the highest power output in its class, at 610kW per cylinder, and is claimed to return an average 8-10g per kWh lower fuel consumption rate than that of its closest contender. At its optimum point, the fuel burn can go as low as 165g/kWh. The engine series is pitched at various types of vessel in the offshore, cruise, ferry, short-sea and special purpose categories requiring unit powers from 4,200kW to 9,800kW. Multi-fuel flexibility is among the design’s strongpoints, as it spans heavy fuel oil (HFO), marine diesel oil (MDO), low-viscosity or low-sulphur fuels, LNG, ethane gas (LEG) and petroleum gas (LPG), by way of three
alternative versions of the engine, namely diesel, dual-fuel (DF) or spark-ignited gas (SG). The DF variant enables automatic switchover to gas when entering Tier III waters.

Engine descriptions
Four stroke engines
Medium speed diesels

2016020310

Hyundai raises the stakes in dual fuel segment.
The Naval Architect, Marine Power & Propulsion Supplement, 2015, p 26 [1 p, 1 fig]
http://www.rina.org.uk/tna.html
No author given
English
Hyundai Heavy Industries has augmented its home-grown HiMSEN four-stroke portfolio with a new dual fuel engine, the H27DF, targeted at propulsion applications in the smaller classes of vessel, as well as the genset market. The new series will span four in-line models, in 6-9 cylinder configurations, although the offering will be wider by virtue of the availability of the design at different running speeds of 720/750rpm and 900/1,000rpm. NOx emissions are curtailed to within the IMO Tier II level in diesel mode, while compliance with the Tier III limit is met when running in gas mode, without the need for after treatment plant.

Engine descriptions
Multifuel engines

2016020311

Effect of fuel temperature on heavy fuel oil spray characteristics in a common-rail fuel injection system for marine engines.
Ocean Engineering, v 104, 1 August 2015, pp 580-589
Park, J., Hwan, J., Park, S.
English
This study was conducted to investigate the effects of fuel properties on the spray characteristics of a common-rail type marine diesel injector. Spray characteristics are highly influential in determining engine performance and emission characteristics in direct-injection engine systems containing marine diesel engines. Thus, the relationship between the physical properties of HFO fuel and its spray characteristics is investigated via an analysis of HFO and spray experiments. Data from physical property measurements (e.g., fuel density, dynamic viscosity, and surface tension) are used to derive empirical equations between fuel temperatures and physical properties, and the results follow the common tendencies of temperature–property curves for general liquid substances. In spray experiments, injection quantity measurements, injection rate profiles, and spray visualization were conducted under various injection pressures, energizing durations, and ambient pressures. The test temperatures of HFO were set from the results of physical property measurements. Experimental data reveal that spray characteristics are affected by fuel properties in terms of injection delays, injection profiles, and spray development speed. The injection quantity increased proportionally with fuel densities and the onset of injection was delayed with increased dynamic viscosity. Spray tip penetration decreased with increased fuel temperature.

Diesel engines
Fuel injectors
Heavy fuel oils
Sprays

2016020312

An experimental study of emission and combustion characteristics of marine diesel engine in case of cylinder valves leakage.
Polish Maritime Research, v 22 n 3, 2015, p 90 [9 p, 31 ref, 1 tab, 6 fig]
Kowalski, J.
English
The paper shows the results of laboratory tests on the relationship between throttling of both air intake duct and exhaust gas duct and a gaseous emission from the marine engine. The object of the research is a laboratory, four-stroke, DI diesel engine, operated at loads from 50 kW to 250 kW at a constant speed equal to 750 rpm. During the laboratory tests over 50 parameters of the engine were measured with its technical condition recognized as “working properly” and with simulated leakage of both air intake valve and exhaust gas valve on the second cylinder. The results of this laboratory research confirm that the leakage of cylinder valves causes no significant changes of the thermodynamic parameters of the engine. Simulated leakages through the inlet and exhaust valve caused a significant increase in fuel consumption of the engine. Valve leakages cause an increase of the exhaust gas temperature behind the
cylinder with leakage and behind other cylinders. The exhaust gas temperature increase is relatively small and clearly visible only at low loads of the engine. The increase of the temperature and pressure of the charging air behind the intercooler were observed too. Charging air temperature is significantly higher during the engine operation with inlet valve leakage. The study results show significant increases of the CO, NOx and CO2 emission for all the mentioned malfunctions. The conclusion is that the results of measurements of the composition of the exhaust gas may contain valuable diagnostic information about the technical condition of the air intake duct and the exhaust gas duct of the marine engine.

Diesel engines
Emissions
Engine cylinders
Leakage
Valves

2016020314
Overview of alternative fuels with emphasis on the potential of liquefied natural gas as future marine fuel.
http://pim.sagepub.com/content/229/4/365.abstract
Elgohary, M.M., Seddiek, I.S., Salem, A.M.
English
Economic and population growths are the most important drivers of growing global energy demand. They led to a rapid development of international seaborne trade and an increase in the number of global vessels. Air pollution from these ships is of great concern and regulations are currently enforced since May 2005 by the International Maritime Organization to limit such pollution. In this study, the authors first review the current global energy demand and its driving forces over next decades, second evaluate the existing alternative fuels that can be used as a bunker fuel to reach sustainability with relatively small changes in the existing marine propulsion options and finally focus on near-term solution, which has the potential for large-scale use. The different alternative fuels were compared in terms of several parameters such as availability, renewability, safety, cost, performance, economy and compliance with emission regulations. This comparison revealed that liquefied natural gas could be considered as the future replacement to the current marine bunker fuel. This conclusion has been further verified by comparing diesel engine with different powers when using both heavy fuel oil and liquefied natural gas. The engines were compared against fuel consumption, cost saving as well as emissions. Liquefied natural gas has proved to be better than heavy fuel oil due to fuel cost reduction by about 31% per year and decrease in emissions of SOx, NOx, CO2 and particulate matter by about 98%, 86%, 11% and 96%, respectively. The resulted emissions from using liquefied natural gas were found to comply with the current International Maritime Organization regulations. Moreover, this article highlights the latest rules and regulations that govern the use of liquefied natural gas as marine fuel onboard ships.

Alternative fuels
Emissions
Liquefied natural gas

2016020313
Reliability evaluation of marine propulsion shaft system using stress-strength interference theory.
http://www.isope.org/publications/publications.htm
Yuan, C., Bai, X., Dong, C.
English
This study aims at studying the reliability evaluation for the marine propulsion shaft system under the severe sea conditions. The variations of the contact stress between the bearings and the marine propulsion shaft under the severe sea conditions are analysed using the finite element simulation. The stress-strength interference theory is used to evaluate the reliability of the marine propulsion shafting system. The simulation experiments of the marine propulsion shaft system under typical severe sea conditions are conducted to validate the stress-strength interference evaluation model.

Evaluation
Propeller shafts
Reliability
Waste heat recovery in a cruise vessel in the Baltic Sea by using an organic Rankine cycle: a case study.
Journal of Engineering for Gas Turbines and Power, v 138 n 1, January 2016 [10 p]
http://gasturbinespower.asmedigitalcollection.asme.org/article.aspx?articleID=2422380
Ahlgren, F., Modejar, M.E., Et al
English

Maritime transportation is a significant contributor to SOx, NOx, and particle matter (PM) emissions, and to a lesser extent, of CO2. Recently, new regulations are being enforced in special geographical areas to limit the amount of emissions from the ships. This fact, together with the high fuel prices, is driving the marine industry toward the improvement of the energy efficiency of ships. Although more sophisticated and complex engine designs can improve significantly of the energy systems on ships, waste heat recovery arises as the most effective technique for the reduction of the energy consumption. In this sense, it is estimated that around 50% of the total energy from the fuel consumed in a ship is wasted and rejected through liquid and gas streams. The primary heat sources for waste heat recovery are the engine exhaust and coolant. In this work, the authors present a study on the integration of an organic Rankine cycle (ORC) in an existing ship, for the recovery of the main and auxiliary engines (AE) exhaust heat. Experimental data from the engines on the cruise ship M/S Birka Stockholm were logged during a port-to-port cruise from Stockholm to Mariehamn, over a period of 4 weeks. The ship has four main engines (ME) Wärtsilä 5850 kW for propulsion, and four AE 2760 kW which are used for electrical generation. Six engine load conditions were identified depending on the ship's speed. The speed range from 12 to 14 kn was considered as the design condition for the ORC, as it was present during more than 34% of the time. In this study, the average values of the engines exhaust temperatures and mass flow rates, for each load case, were used as inputs for a model of an ORC. The main parameters of the ORC, including working fluid and turbine configuration, were optimised based on the criteria of maximum net power output and compactness of the installation components. Results from the study showed that an ORC with internal regeneration using benzene as working fluid would yield the greatest average net power output over the operating time. For this situation, the power production of the ORC would represent about 22% of the total electricity consumption on board. These data confirmed the ORC as a feasible and promising technology for the reduction of fuel consumption and CO2 emissions of existing ships.

Cruise ships
Fuel conservation
Heat recovery
Rankine cycle

Energy and exergy analysis of ship energy systems – the case study of a chemical tanker.
International Journal of Thermodynamics, v 18 n 2, June 2015, p 82 [12 p, 30 ref, 12 tab, 5 fig]
http://manufacturingscience.asmedigitalcollection.asme.org/journal.aspx
Baldi, F., Johnson, H., Et al
English

Shipping is already a relevant contributor to global carbon dioxide emissions, and its share is expected to grow together with global trade in the coming years. At the same time, bunker prices are increasing and companies start to feel the pressure of growing fuel bills in their balance sheet. In order to address both challenges, it is important to improve the understanding of how ship energy consumption is generated, through a detailed analysis of its energy systems. In this paper, a method for the analysis of ship energy systems is proposed and applied on one year of operations of a chemical tanker, for which both measurements and mechanistic knowledge of ship systems were available. Energy analysis applied to the case-study vessel allowed comparing different energy flows and therefore identifying system components and interactions critical for ship energy consumption. Exergy analysis allowed instead identifying main inefficiencies and evaluating waste flows. This last information was then processed in order to estimate the potential for waste energy recovery under different conditions. Results showed that propulsion is the main contributor to ship energy consumption (70%), but that also auxiliary heat (16.5%) and power (13.5%) needs are relevant sources of energy consumption. The potential for waste heat recovery is relevant, especially in the exhaust gas, which contains an exergy flow sized 18% of engine power output.

Chemical tankers
Energy consumption
Propulsive efficiency
Particulate matter in marine diesel engines exhausts: Emissions and control strategies.
Transportation Research Part D: Transport and Environment, v 40, October 2015, pp 166-191
Di Natale, F., Carotenuto, C.

English

Marine diesel engines emit particles that have a complex nature, being composed by carbonaceous particles, with size spanning from few nanometres to less than one micron, and inorganic particles of micron size mainly made by ashes and sulphates. On a global scale, international shipping is responsible for few percentages of the particulate matter emissions, which also affect climate, but the regional distribution of naval traffic suggests the insurgence of significant exposure risk for population living along the coastal areas, due to chronic exposure effects. Specific strategies should be implemented to reduce the emissions of all the components of particulate matter. This paper aims to present a survey on the current and innovative strategies to remove particles from marine diesel engine exhausts, along with a critical review of the most recent findings on ships emitted particles. Evidences on physical–chemical properties, toxicology and emission factors of the particles were reported. This survey indicates that several strategies can provide a significant reduction of particulate matter emissions from ships and integration between innovative after-treatment systems, ships design and operation procedures can potentially lead to overall reduction of more than 99% even with parallel fuel savings.

Diesel engines
Emissions
Particulates

2.2 EQUIPMENT AND INSTALLATIONS

A review of vertical motion heave compensation systems.
Ocean Engineering, v 104, 1 August 2015, pp 140-154
Woodacre, J.K., Bauer, R.J., Irani, R.A.

English

This paper provides a comprehensive review of vertical heave motion compensation systems used on ocean vessels from the early 1970s up to, and including, modern systems. Specifically, this review provides details on passive heave compensation, active heave compensation, hybrid active–passive heave compensation systems, and wave synchronization systems along with detailed explanations of the most common motion actuation methods, control schemes, and heave motion decoupling potential found with each. Based on the results of this review, it is recommended that more experimental work be carried out on real-world systems to experimentally validate the active heave compensation controllers being designed and simulated in literature. It is also suggested that future work involving model-predictive control may be used to further improve upon the performance of the current active heave compensation systems.

Active systems
Control systems
Heaving
Motion compensation
Passive systems

Tank gauging goes digital.
Jones, M.

English

The increasing complexity of vessel and their tank usage demands maximum flexibility. This article looks at how modern digital tank gauging systems can help deliver operational efficiency while keeping older vessels in service for longer.

Digital systems
Tank gauging

Paradigm lift.
The Naval Architect, October 2015, p 34 [5 p, 6 fig]
http://www.rina.org.uk/tna.html
No author given

English

LNG cargo tanks have, up until now, been the domain of either Moss or GTT in the larger sizes with more competition seen in the small to medium sized vessel market. That is about to change with the development of Brevik Technology’s new cylindrical tank solution, which the company says will offer the...
industry an easy to build, competitive alternative. The key to this unique design is the patented support structure, which leaves the tank detached from the ship hull structure. This allows the tank to expand and contract in all directions without imposing stress to the hull, and at the same time allows the hull itself to deflect without imposing stress to the tank structure. This makes the design extremely resistant to large temperature variations.

LNG carriers
LNG tanks

2016020321
Adaptive fuzzy controller design for dynamic positioning system of vessels.  
*Applied Ocean Research, v 53, October 2015, pp 46-53*
Hu, X., Du, J., Shi, J.
English

This paper develops an adaptive fuzzy controller for the dynamic positioning (DP) system of vessels with unknown dynamic model parameters and unknown time-varying environmental disturbances. The controller is designed by combining the adaptive fuzzy system with the vectorial backstepping method. An adaptive fuzzy system is employed to approximate the uncertain term induced by unknown dynamic model parameters and unknown time-varying environmental disturbances. It is theoretically proved that the proposed adaptive fuzzy DP controller can make the vessel be maintained at the desired values of its position and heading with arbitrary accuracy, while guaranteeing the uniform ultimate boundedness of all signals in the closed-loop DP control system of vessels. Simulation studies with comparisons on a supply vessel are carried out, and the results illustrate the effectiveness of the proposed control scheme.

Control
Dynamic positioning
Fuzzy systems

2016020322
A feasibility analysis of waste heat recovery systems for marine applications.  
*Energy, v 80, 1 February 2015, pp 654-665*
Baldi, F.
English

The shipping sector is today facing challenges which require a larger focus on energy efficiency and fuel consumption. In this article, a methodology for performing a feasibility analysis of the installation of a WHR (waste heat recovery) system on a vessel is described and applied to a case study vessel. The method proposes to calculate the amount of energy and exergy available for the WHR systems and to compare it with the propulsion and auxiliary power needs based on available data for ship operational profile. The expected exergy efficiency of the WHR system is used as an independent variable, thus allowing estimating the expected fuel savings when a detailed design of the WHR system is not yet available. The use of the proposed method can guide in the choice of the installation depending on the requirements of the owner in terms of payback time and capital investment. The results of the application of this method to the case study ship suggest that fuel savings of 5%-15% can realistically be expected, depending on the sources of waste heat used and on the expected efficiency of the WHR system.

Feasibility
Fuel conservation
Heat recovery
Propulsion systems
Propulsive efficiency

2016020323
A preliminary study on the application of thermal storage to merchant ships.  
*Energy Procedia, v 75, August 2015, pp 2169-2174*
Baldi, F., Gabrielli, C., Et al
English

The shipping industry is focusing more and more on reducing fuel consumption and greenhouse gas emissions. A non-negligible amount of fuel is consumed while ships are in port, waiting for loading or unloading, for heating up accommodation spaces and fuel tanks, while when at sea waste heat from engines exhaust is under-used because of low demand. This paper proposes the use of thermal
energy storage as a solution for the mismatch between heat availability and demand. A simplified system is proposed and the influence of design parameters (storage size, heat exchangers surface, secondary fluid mass flow rate, storage temperature) on the performance of the system is analysed. The results of the application of a thermal energy storage system to a case study ship show that the installation of a storage tank of 1000 m$^3$ could reduce the fuel consumption from the boilers by 80%, which would lead to yearly savings of $268,000$ USD. This preliminary analysis shows that there is potential of both economic and environmental benefits from the application of thermal energy storage to merchant vessels.

Energy
Heat transfer
Storage

2.3 MAINTENANCE, REPAIR AND CONVERSION

2016020324
Managing Ageing FPSO structures: effective management of inspection data.
https://www.onepetro.org/conference-paper/SPE-175483-MS
MacLean, C., Lewin, M.

This paper explores the challenge of gathering, assessing and usefully managing large quantities of hull inspection data so that this can provide useful information. It will address assessment of the data to ensure that it is possible to clearly understand what is important today, what might be an issue tomorrow and to identify trends and evaluate inspection / repair burdens in the future. As an FPSO hull structure ages, the routine structural inspection activities produce increasing volumes of data as time progresses. In the initial years of production this does not present a major issue to manage as the number of structural deficiencies will (hopefully) be small. Beyond 10 – 15 years on-station, where inspections are carried out there are often significant numbers of inspection findings reported (>1500 per year). It is important that data is captured accurately at the time of inspection, whilst the personnel and access are available. In the early years of asset life, where the number of findings may be only 1 or 2 per day of inspection, efficient handling of the data and assessment isn’t a high priority. During busy inspection campaigns during the later life of the asset, good quality reporting and efficient data handling become critical factors as it is possible to have 3 inspection teams on an asset producing upwards of 60 inspection findings per day, 7 days per week. Failure to effectively keep up with the processing of the inspection findings under these conditions will result in inaccuracies in the data and a failure to correctly assess criticality and the necessary actions arising. Based on Marine Technical Limits extensive experience of managing significant volumes of hull inspection data for various FPSOs over the previous 10 years, this paper details the key criteria and an effective approach for handling, processing, assessing and using hull inspection data to produce useful information.

Ageing (metallurgy)
Data management
FPSOs
Hull inspection

2016020325
Outlining a provident initial design approach with regard to cruise ship conversions.
IMDC 2015, 12th International Marine Design Conference; 11-14 May 2015; Tokyo, Japan. Organised by University of Tokyo, Yokohama National University & JSNAOE. [12 p, 112 ref, 1 tab, 5 fig]
http://www.researchgate.net/publication/276061414_Outlining_a_Provident_Initial_Design_Approach_with_regard_to_Cruise_Ship_Conversions
Champion, J.B., Ahola, M., Kujala, P.

With cruise ship conversions evolving in both magnitude and scope, methods to improve the efficiency of such projects were studied as part of the Cruise and Ferry Experience Program at Aalto University. The primary aim of this paper is to summarize the findings and outline what can be done during a newbuilding’s initial design stage to reduce the length, planning, and cost of future conversions. Current conversion trends are investigated and common cases identified. A rules based approach is used to identify technical challenges and design
solutions that can be implemented in the preliminary design phases. Closing remarks highlight future considerations and implications of the study.

Cruise ships
Refurbishing
Ship conversion

2.4 CARGOES AND CARGO HANDLING

2016020326

Intermodal terminal cargo handling simulation using Petri nets with predicates.
http://pim.sagepub.com/content/229/4/323.abstract
Silva, C.A., Guedes Soares, C., Signoret, J.P.

This article describes the modelling of a container terminal using Petri nets with predicates. It starts by describing this extension of the basic Petri net theory and demonstrates its applicability and adequacy to solving complex logistic processes and reliability problems more intuitively and easily than the basic Petri net theory. The developed computational model allows the evaluation of different configurations and combinations of transport equipment, providing a very complete port system’s simulation. Such simulation, based on an estimated container flow, allows the calculation of several waiting times, time in port, attendant time, queuing time, equipment and resource occupation and so on. Changing the internal configuration of the terminal or the external conditions will result in different costs and profits to the terminal, making it possible to perform a terminal optimisation based on the study of long-term performance indicators under different conditions. This systematic approach is implemented in a specific case study related to the operational cargo handling procedures of a container terminal. The study will be made considering verified operation performance over some months where the mean values of the variables considered are representative of the ‘typical’ operation of that particular terminal, which allows a validation of the model.

Cargo handling
Container terminals
Intermodal terminals

2.5 PORTS AND WATERWAYS

2016020327

Value creation in the port: opening the boundaries to the market.
Maritime Policy & Management, v 42 n 7, 2015, pp 712-728
http://www.tandfonline.com/doi/full/10.1080/03088839.2015.1078010
Simkins, Z.S., Stewart, R.D.

In the era of fierce competition among ports as elements of value chain systems, the opening of the boundaries to the market represents a crucial challenge that port authority has to cope with, in order to guarantee a lasting economic and social development of the port and its hinterland. The authors propose a theoretical framework to analyse value creation in the port and its hinterland through two core concepts: resource allocation and interaction. Such framework is illustrated with the case of the port of Naples and, specifically, the contribution of the port authority and other port business operators to the value creation process of Garofalo, an export-oriented firm located in its hinterland. A discussion and suggestions for future research are provided in the last section.

Port authorities
Port planning and development
Value engineering

2016020328

Measuring port effectiveness: what really determines cargo interests’ evaluations of port service delivery?
Maritime Policy & Management, v 42 n 7, 2015, pp 699-711
http://www.tandfonline.com/doi/full/10.1080/03088839.2015.1077282
Brooks, M.R., Schellinck, T.

For port managers seeking to serve the needs of the beneficial cargo owners, understanding the factors critical to their evaluation of the port’s customer service delivery is of critical importance. This research examined service delivery effectiveness as perceived by cargo owners and agents in seven North American container ports, with more than 250 000 TEUs (20-foot equivalent units) in volume. Using an Internet survey instrument, the study finds negligible differences in stated requirements of ports between
cargo owners and cargo agents (as indicated by importance scores) but significant differences between the two segments in the influence that the individual criterion has on the performance scores ports receive and on the size and nature of performance gaps. Importance-performance gap (I-P Gap) analysis provides slightly different guidance than does that of determinant analysis, indicating that there is a need for both approaches and a method for reconciling different outcomes.

Port management
Port performance

2016020329

Container ship size and the implications on port call workload.

International Journal of Shipping and Transport Logistics, v 7 n 5, 2015, pp 553-569

Martin, J., Martin, S., Petit, S.

English

As the TEU capacity of container ships has risen, there has been an increase in the workload experienced by container terminals during a ship call. This study quantifies the changes in berth and quay workload resulting from increased ship size and the impact on ship-to-shore service levels of North European terminals. First trends in TEUs per ship metre length since 1975 are presented, then, accounting for changes in the TEU Ratio, this is converted into ship-to-shore moves to calculate a Berth Workload Index. Given the bay configurations of each ship, a Quay Crane Workload Index is then developed to determine the extent to which terminals have met these changes by deploying additional quay cranes or by improving quay crane performance. The study concludes by examining the impact of Maersk's Triple E Class container ship on the workload of a berth and quay crane.

Container terminals
Containerships
Port capacity
Port performance
Ship size

2016020330

Port management and multiple-criteria decision making under uncertainty.

Ocean Engineering, v 104, 1 August 2015, pp 31-39

García-Morales, R.M., Baquerizo, A., Ángel Losada, M.A.

English

The methodology for port management in this study takes into account the stochastic nature of climate as well as of use and exploitation agents. It provides a probabilistic characterization of the performance of different alternatives in terms of a set of indicators that reflect the potential benefits for different interest groups. The joint distribution functions thus obtained for a set of pre-defined management alternatives are used to compare strategies and to make decisions, based on stochastic multi-criteria analysis. This method, which also addresses the uncertainty of decision-maker preferences, ranked the strategies, and at the same time, specified the typical decision-maker preferences for each strategy. In the analysis of a hypothetical port, four alternatives were designed as solutions for port congestion. The criteria selected were the service quality provided to vessels, the total goods handled and the profits accrued by the Port Authority. The criteria measuring the performance of each strategy were statistically analysed first. Then, assuming the uniform distribution of decision-maker preferences, the alternatives were ranked, and the relative importance of each criterion in the decision-making process was obtained.

Decision making
Port management
Port operations
Risk analysis

2016020331

Methods for optimisation of sea waterway systems and their application.

Polish Maritime Research, v 22 n 3, 2015, p 14 [6 p, 9 ref, 5 fig]

Gucma, S., Ślączka, W.

English

This paper presents developed optimisation methods for sea waterway systems. The objective function of optimisation of sea waterway systems has been formulated and its detail form for fairways has been determined. Three probabilistic methods for
determining safe bed-breadth of the fairway are described. Limitations of the presented methods are also discussed. The developed optimisation methods for sea waterway systems have been applied to determine parameters of a modernized fairway between Świnoujście and Szczecin as well as its navigation systems.

**Abstracts**

**Navigation channels**

**Optimisation**

**Waterways**

2016020332

**Smart port: Exploiting renewable energy and storage potential of moored boats.**

*OCEANS ’15 MTS/IEEE Genova; 18-21 May 2015; Genova, Italy. Published by IEEE [3 p]*

This paper presents a statistical and techno-economic feasibility study for the exploitation of renewable energy generators and energy storage devices typically installed onboard pleasure boats to transform harbours and ports in energy districts able to exchange energy with the grid. In Europe about 48 million citizens regularly participate in recreational marine activities (36 million of whom are boaters), as well as countless numbers of tourists. Over 6 million boats are kept in European waters while 4,500 marinas provide 1.75 million berths both inland and in coastal areas. Thanks to the proposed Smart Port concept, this scenario could be considered as an energy resource to improve renewable energy penetration and enlarge European grid storage capacity with negligible investments by exploiting existing facilities. Starting from statistics assessment of ports and boats present on the Mediterranean Shore (particularly in Liguria region) and considering data related to the Italian national electric market (daily spread between minimum and maximum price of electricity, daily renewable energy production and their impact on the price, different scenarios are analysed according to different kind of generators (photovoltaics, wind) and storage technologies (batteries, hydrogen) commonly used in the nautical sector in order to study the most profitable solutions. A case study in Italy is presented and the expected impacts in terms of yearly renewable deliverable energy, storage capacity, CO2 emission savings and money savings for boat owners and port managers are shown. This framework is analysed at the present conditions and looking throughout future scenario that will include an increase of the number of electrical boats, a variable price of electricity and a decreasing price of batteries and hydrogen equipment as storage technologies. Considering the number of boats actually moored in the Italian marinas and equipped with renewable generator, relevant installation capital costs could be saved while the structural improvements that should be made to the ports are limited to the electrical connections and the smart control systems transforming it in an energy district able to interact with the electrical market through the national grid as a renewable generator or an energy buffer useful to the grid balance. The first required investment for the port will be the installation of bidirectional POD (point of delivery) and energy-meters, in order to make boats able to exchange energy with the grid while they are moored. It is important to underline that smart controls have to be investigated in order to guarantee a relevant state of charge of boats batteries. Suitable Business models enabling the exploitation of this new concept are shown. These models take into account the compensation rules to refund boat owners and other stakeholders, allowing sufficient profit margin to ports which would become actors in the energy market, interacting with the national grid as a RES producer, consumers and an electrical storages.

**Abstracts**

**Energy**

**Generators**

**Pleasure craft**

**Ports**

**Storage**

2016020333

**Collision risk analysis of Chittagong Port in Bangladesh by using collision frequency calculation models with modified BBN model.**


An updated accident database with 789 overall waterway accidents from 1981-2013 at Chittagong Port (CP) in Bangladesh shows around 48% accidents were collision. In this paper, collision risk in CP is analysed by constructing collision frequency calculation models that are solved using IWRAP.
Mk2, software for maritime risk assessment modelling. Causation Probability is evaluated by a localized Bayesian Belief Network (BBN) model on HUGIN Researcher software and used as a direct input of IWRAP Mk2. Suggestion about modification of BBN model’s output is given based on sensitivity analysis followed by an assessment of influence of a newly installed Risk Control Option (RCO) i.e., Vessel Traffic and Management Information System (VTMIS) on probability of collision. The validity of the developed model is shown by comparing between predicted collision probability and historical data. Close proximity between the database data and obtained value has been found regarding collision frequency, vessel types in collision accident, accident prone zones etc. that can be used as a reference for future decision making on safety standard upgrade of CP. Such analysis can be carried out on different ports and channels worldwide to calculate collision risk and ensure safety.

Collision risk
Port safety

2016020334

An analysis of bases for defining level of the port machinery flexibility in a multipurpose seaport.
Djelovic, D.
English

The decision on which port machinery to select in a multipurpose seaport is very complex and under influence of a broad range of factors. According to the most relevant recommended selection methodologies, basic influential factors that have to be taken into account can be classified into five major classes: port development factors, equipment costs, factors related to equipment maintenance, manning requirements and operating factors. The level of the port machinery flexibility (both main components: technological and positional flexibility), as an element of the class of influential factors titled “operating factors” has high importance in a multipurpose seaport due to intensive variations in volume and characters of port customers’ demands over the time. After some general considerations related to system flexibility, this paper is focused on general aspects of the port machinery selection process and, than, port machinery flexibility is analysed in details. Special attention is given to structuring a methodology for defining optimal level of the port machinery flexibility. Some of the presented concrete data are referred to the port machinery in the Port of Bar as a multipurpose seaport.

Flexibility
Machinery
Seaports

2016020335

Modelling containers throughput in Port of Koper.
Twardy, E., Batista, M.
English

The global container transport increase of 8 to10% on a yearly basis and reach over 601,8 million TEU in 2012 (1). The growth was stopped in 2008 when the global financial and economic recession started to have full effect in ports and maritime industry. The ports North Adriatic did not followed the average of increase of container transport in the last 20 years (they had an increase of 7% on yearly base) and the decline in container transport in this ports in the years 2008 to 2009 was minimal. In this condition the fastest growth of container throughput was recorded at the Port of Koper, at an average of 14% per year, and reached 600.441 TEU in year 2013. The growth of container transport in the Port of Koper as well as the beginning of construction on the new container terminal has made the reconstruction and extension of the current container terminal an absolute priority. The extension is in line with the estimated growth of traffic as well as with the exploitation of present and future terminal capacities. This paper presents dynamic models that help us to forecast a container throughput in port of Koper. The models are prepared in the base of available data and include model of
growth, model of share and model of growth-share. As the port of Koper is limited with the capacity it is important to know the situation and to prepare the resources.

Container operations
Container terminals
Port performance

2.6 COASTAL/OFFSHORE ENGINEERING AND MARINE RENEWABLE ENERGY

2016020336
An analytical solution for regular progressive water waves.
Journal of Advanced Research in Ocean Engineering, v 1 n 3, p 157
http://www.jaroe.org/sub/issues/issues.html?icode=21
Shin, J-R.
English
In order to provide simple and accurate wave theory in design of offshore structure, an analytical approximation is introduced in this paper. The solution is limited to flat bottom having a constant water depth. Water is considered as inviscid, incompressible and irrotational. The solution satisfies the continuity equation, bottom boundary condition and non-linear kinematic free surface boundary condition exactly. Error for dynamic condition is quite small. The solution is suitable in description of breaking waves. The solution is presented with closed form and dispersion relation is also presented with closed form. In the last century, there have been two main approaches to the nonlinear problems. One of these is the perturbation method. Stokes wave and Cnoidal wave are based on the method. The other is numerical method. Dean’s stream function theory is based on the method. In this paper, power series method was considered. The power series method can be applied to certain nonlinear differential equations (initial value problems). The series coefficients are specified by a nonlinear recurrence inherited from the differential equation. Because the non-linear wave problem is a boundary value problem, the power series method cannot be applied to the problem in general. But finite number of coefficients is necessary to describe the wave profile, truncated power series is enough. Therefore the power series method can be applied to the problem. In this case, the series coefficients are specified by a set of equations instead of recurrence. By using the set of equations, the nonlinear wave problem has been solved in this paper.

Approximation
Breaking waves
Water waves

2016020337
Delayed adaptive output feedback sliding mode control for offshore platforms subject to nonlinear wave-induced force.
Ocean Engineering, v 104, 1 August 2015, pp 1-9
Nourisola, H., Ahmadi, B., Tavakoli, S.
English
In this paper the control problem for an offshore steel jacket platform subject to nonlinear wave-induced force is investigated by introducing several new types of adaptive sliding mode controllers. Three control schemes are presented to reduce the oscillation amplitudes of the offshore platform. The first scheme is named an adaptive output feedback integral sliding mode controller, which has a better performance in comparison with an integral sliding mode controller. By introducing an intentional time delay into the control channel, an adaptive output feedback integral sliding mode controller is proposed as the second scheme. This controller is called a delayed adaptive output feedback integral sliding mode controller. It shows a good performance in reduction of the internal oscillations and control force. In the third scheme, a combination of current states and delayed states is used in the sliding surface and control law. This control scheme is named a combinational delayed adaptive output feedback integral sliding mode controller. One advantage of this scheme is that it provides an appropriate response by increasing the time delay. According to the simulation results, the proposed control schemes can effectively improve the control performance of the offshore platform in comparison with several existing control schemes.

Control
Offshore platforms
Wave forces on structures
Experimental and numerical comparisons of self-reacting point absorber wave energy converters in regular waves.

Ocean Engineering, v 104, 1 August 2015, pp 370-386

Beatty, S.J., Hal, M., Et al

English

An experimental and numerical comparison of the performance of two self-reacting point absorber wave energy converter designs is undertaken for heave motions. The designs are either currently, or have recently been, under development for commercialization. The experiments consist of a series of 1:25 scale model tests. The physical model features a re-configurable reacting body shape, a feedback controlled power take-off, and a heave motion constraint apparatus. Detailed descriptions of the reconfigurable model design, the analysis/test methodologies, and power capture are given. An extension of Budal's theoretical upper bound on power capture for application to self-reacting point absorbers is proposed. A quantitative comparison is made of the two self-reacting point absorber designs in terms of displacement, power take-off force requirements, and power capture in typical (non-extreme) operating conditions with reference to theoretical upper bounds. The design implications of a reactive power take-off control scheme and relative motion constraints on the wave energy converters are investigated using an experimentally validated numerical dynamics model.

Frequency domain method
Model tests
Wave energy conversion

Generation of multiple equivalent regular waves for preliminary analyses of floating production systems.

http://www.isope.org/publications/publications.htm

Brandão, C.S., Correa, F.N., Jacob, B.P.

English

This work describes a simplified analysis procedure, intended for preliminary design stages of risers connected to floating production systems (FPS). The procedure may be seen as an extension of the “equivalent regular wave” approach proposed in some design codes, where the amplitude of a single regular wave (equivalent to a given irregular sea state) is determined taking the motion RAO for a given D.O.F. of the platform assumed to be the most critical for the riser response (usually the heave motions). Here, an extension of this procedure is considered where an ensemble of six regular waves is generated, one for each rigid-body D.O.F. This wave ensemble could then be employed for the dynamic analyses, allowing shorter simulation times (since the loading is deterministic), and leading to reasonable results with substantial reduction in CPU times. Case studies are presented to assess the proposed procedure, comparing its results with those provided by the full spectral irregular sea state approach.

Floating production systems
Regular waves
Wave models

Transient effects of an FPSO with a broken mooring line.

http://www.isope.org/publications/publications.htm

Girón, A.R.C., Kim, B.W., Et al

English

Breaking of mooring lines is a topic that must be analysed during the design process of a floating production system. In current design codes this subject is treated as an accidental case. Nevertheless, transient effects after breaking of a line are not considered as relevant. In this paper an analysis of the relevance of the transient effects, in taut leg mooring line systems made of chain-polyester-chain in an FPSO with ultra-deep depth under severe storm conditions, is considered. Several coupled analysis in time domain in two ways were performed: 1) When a mooring line is absent since the beginning of simulation (with no transient effects); 2) Breaking a line during simulation (with transient effects).

Deepwater
Failure
FPSOs
Mooring lines
Transient response
Experimental research on wind loads on an FPSO.

Yi, C., Li, D., Et al

When an FPSO is operating in a given oilfield, the environment loads including wind, wave and current force will act on it. The wind force is a constant force which will drag the hull away from the original position. It is very important to calculate the wind force correctly in FPSO mooring system and motion analysis. The calculation is usually carried out according to OCIMF or API rules. The OCIMF is a rule established for oil tankers and it is usually also used for FPSOs, but oil tanker arrangements are different from FPSOs. There are living quarters, pipelines and passageway on the deck of an oil tanker, and there is more equipment such as the process utilities, flare booms and power stations on the deck of FPSOs. Thus, it should be argued deductively whether it is right to calculate the FPSO wind force using the method described in OCIMF. API rules are worked out for offshore floating systems. The method to obtain the wind force is also widely used. Its theory is to get the wind force by summing all the facilities on the FPSO topside. Aiming at the wind loads on the FPSO, the model test is carried out in a wind tunnel and typical curves of wind loads on FPSOs are obtained. The test results are compared with the data from OCIMF and API formula calculations. The differences among those results are presented, and suggestions to obtain the FPSO wind force are also given. The results can be used for the FPSO wind force calculation and can be a valuable reference in the design and research of FPSOs.

FPSOs
Wind loads on structures
Wind tunnel tests

Near-optimal control of a wave energy device in irregular waves with deterministic-model driven incident wave prediction.

Korde, U.A.

This paper investigates wave-by-wave control of a wave energy converter using incident wave prediction based on up-wave surface elevation measurement. The goal of control is to approach the hydrodynamic optimum velocity leading to optimum power absorption. This work aims to study the gains in energy conversion from a deterministic wave propagation model that accounts for a range of group velocities in deriving the prediction. The up-wave measurement distance is assumed to be small enough to allow a deterministic propagation model, and further, both wave propagation and device response are assumed to be linear. For deep water conditions and long-crested waves, the propagation process is also described using an impulse response function. Approximate low and high frequency limits for realistic band-limited spectra are used to compute the corresponding group velocity limits. The prediction time into the future is based on the device impulse response function needed for the evaluation of the control force. The up-wave distance and the duration of measurement are then determined using the group velocity limits above. A 2-body axisymmetric heaving device is considered, for which power capture is through the relative heave oscillation between the two co-axial bodies. The power take-off is assumed to be linear and ideal as well as capable of applying the necessary resistive and reactive load components on the relative heave oscillation. The predicted wave profile is used along with device impulse response functions to compute the actuator force components at each instant. Calculations are carried out in irregular waves generated using a number of uni-modal wave spectra over a range of energy periods and significant wave heights. Results
are compared with previous studies based on the use of instantaneous up-wave wave-profile measurements, both without and with oscillation constraints imposed. Considerable improvements in power capture are observed with the present approach over the range of wave conditions studied.

Control
Irregular waves
Time domain
Wave energy conversion

2016020343

The effect of some uncertainties associated to the environmental contour lines definition on the extreme response of an FPSO under hurricane conditions.

Applied Ocean Research, v 53, October 2015, pp 190-199
Silva-González, F.L., Vázquez-Hernández, A.O., Et al

The environmental contour concept, in conjunction with the Inverse First Order Reliability Method, is often used to determine the extreme response of marine structural systems. This technique is a powerful option to determine the extreme response associated to a probability of exceedance without the need to perform a long-term analysis, where a large number of short-term simulations are needed. However, there are significant uncertainties involved in its determination, such as the uncertainties related with the probabilistic model used for the environmental variables, as well as the ones related with the threshold selection when the peaks over threshold (POT) method is applied. This paper shows the results of a comparative analysis of the extreme tension of the most loaded mooring line of an FPSO subjected to environmental conditions in deep water, derived from environmental contour lines which were defined with different probabilistic models to represent the significant wave height and different criteria to establish the threshold for the POT methodology. The results showed that the probabilistic model has an important effect on the extreme response of the FPSO and this epistemic uncertainty should be accounted for in the calibration of the design safety factors.

Environmental conditions
Extreme waves
FPSOs
Hurricanes
Wave data

2016020344

Uncertainties in extreme value modelling of wave data in a climate change perspective.

Vanem, E.

English
The extreme values of wave climate data are of great interest in a number of different applications, including the design and operation of ships and offshore structures, marine energy generation, aquaculture and coastal installations. Typically, the return values of certain met-ocean parameters such as significant wave height are of particular importance.

In a climate change perspective, projections of such return values to a future climate are of great importance for risk management and adaptation purposes. However, there are various ways of estimating the required return values, which introduce additional uncertainties in extreme weather and climate variables pertaining to both current and future climates. Many of these approaches are investigated in this paper by applying different methods to particular data sets of significant wave height, corresponding to the historic climate and two future projections of the climate assuming different forcing scenarios. In this way, the uncertainty due to the extreme value analysis can also be compared to the uncertainty due to a changing climate. The different approaches that are considered in this paper are the initial distribution approach, the block maxima approach, the peak over threshold approach and the average conditional exceedance rate method. Furthermore, the effect of different modelling choices
within each of the approaches will be explored. Thus, a range of different return value estimates for the different data sets is obtained. This exercise reveals that the uncertainty due to the extreme value analysis method is notable and, as expected, the variability of the estimates increases for higher return periods. Moreover, even though the variability due to the extreme value analysis is greater than the climate variability, a shift towards higher extremes in a future wave climate can clearly be discerned in the particular datasets that have been analysed.

Change
Climate
Environmental loads
Extreme values
Wave climate

2016020345

Investigation on cutting stability of jacket in decommissioning process.
China Ocean Engineering, v 29 n 5, October 2015, pp 649-661

Li, M-q., Duan, M-l., Huang, Y.

English

The jacket cutting operation is one of the most complicated and high risk operations in the process of decommissioning offshore piled platforms, the security and stability of which must be assured. In this paper, the current research on offshore structure removal and jacket cutting is introduced, on the basis of which the types of load along with the load calculation method are determined. The main influences on the stability of a jacket in cutting are analysed. The experiment test plan is drawn by using orthogonal testing method, and the formula of critical load during the cutting procedure is deduced by differential evolution algorithm. To verify the method and results of this paper, an offshore piled platform to be decommissioned in the South China Sea is taken for an example, and the detailed schedule for jacket cutting is made with the three-dimensional finite element model of the jacket established. The natural frequency, stress, strain and stability of the jacket during cutting process are calculated, which indicates that the results of finite element analysis agree well with that of the deduced formula. The result provides the scientific reference for guaranteeing the safety of jacket in cutting operation.

Cutting
Jacket structures
Platform removal
Stability

2016020346

Offshore wind farm layout optimisation – state of the art.
Journal of Ocean and Wind Energy, v 1 n 1, February 2014, p 23 [7 p, 33 ref, 2 tab, 2 fig]
http://www.isope.org/publications/publications.htm

Muskulus, M., Schafhirt, S.

English

Offshore wind is one of the most promising renewable energy sources, but the cost is still too high to be competitive. Optimising the layout of a wind farm may help to improve the competitiveness, but it presents a significant engineering challenge. This paper presents the state of the art of offshore wind farm layout and identifies the main criteria used for its optimisation with respect to a number of parameters such as the cost of energy and annual energy production. Used methodologies in farm design, as well as key aspects of a wind farm that are subject to optimisation, are analysed. Available commercial software for wind farm design is also presented and characterized and their limitations identified. The paper concludes with suggestions for further investigation.

Layout
Offshore
Optimisation
Wind turbines

2016020347

Offshore wind turbine jacket substructure: a comparison study between four-legged and three-legged designs.
Journal of Ocean and Wind Energy, v 1 n 2, May 2014, p 74 [8 p, 18 ref, 4 tab, 14 fig]
http://www.isope.org/publications/publications.htm

Chew, K.H., Ng, E.Y.K., Et al

English

A comparison study was conducted between a conventional four-legged and a newly-developed three-legged bottom fixed jacket substructure for offshore wind applications. Fatigue and ultimate limit
state analyses were performed, and results show that the three-legged concept is feasible as an interesting alternative to the four-legged design, while potentially more cost-efficient, with a 17-percent reduction of structural mass and a 25-percent reduction in the number of welded joints. Further analyses were carried out to evaluate the sensitivity of the dynamic performance with respect to different load cases, loading directionality, and wind-wave misalignment effects. Results show that both designs are highly susceptible to the change-of-load direction, therefore recommending a finer incident angle resolution (a gap of 15 degrees or less) to be used in the analysis. The overall wind-wave misalignment effect is comparably smaller, but could contribute to a significant impact if the joints are close to being critical.

Comparison
Jacket structures
Offshore structures
Wind turbines

2016020348
Numerical study of the decoupled aero-
hydrodynamic properties of an oscillating water
column and their systematic coupling under nonlinear wave excitation.  
Gkikas, G.D.
English
This work investigates the separate effect of the hydrodynamic and thermodynamic parts of the physical modeling of an onshore Oscillating Water Column-Wave Energy Converter (OWC-WEC) under selected monochromatic excitations, and then presents an alternative systemic way to combine these sub-models. The hydrodynamic modeling of the OWC is formulated on the basis of 2-D linear water wave theory by employing the technique of matched Eigen function expansions, while for the thermodynamic modelling, a nonlinear two-degree-of-freedom dynamical equation set is derived from basic principles of open system thermodynamics. Subsequently, advanced nonlinear system identification methods are set to obtain accurate and computationally efficient systemic equivalents in order to facilitate the modeling of the overall aerohydromechanic performance of the OWC-WEC under any nonlinear sea wave excitation.

Aerodynamics
Hydrodynamics
Numerical analysis
Wave energy conversion

2016020349
Wave energy absorption in irregular waves by a floating body equipped with interior rotating electric-power generator.  
Takaramoto, R., Kashiwagi, M., Sakai, K.
English
To realize a wave-power absorption apparatus in actual seas, we should consider the absorption efficiency of wave power in irregular waves and how it can be enhanced. For that purpose, first a theoretical study is made on how the maximum wave-energy absorption can be achieved in irregular waves by using the Fourier transform from the results in the frequency domain, and taking account of the causality relations. It is shown that, if the maximum conditions are satisfied in the time domain, we can improve the wave-power absorption efficiency in irregular waves. Then based on the results of theoretical study, numerical computations are performed for a floating body, inside which an electric-power generator is supposed to rotate without sliding along the interior circular surface of a symmetric floating body. However, since the maximum conditions in the time domain do not satisfy causality in the present study, this problem needs to be resolved for further improvement.

Energy absorption
Irregular waves
Wave energy

2016020350
Response analysis of a spar-type floating offshore wind turbine under atmospheric icing.  
Etemaddar, M., Hansen, M.O.L., Moan, T.
English
One of the challenges for the development of wind
energy in offshore cold-climate regions is atmospheric icing. This paper examines the effects of atmospheric icing on power production, overall performance, and extreme loads of a 5-MW spar-type floating offshore wind turbine during power production, normal and emergency rotor shutdown, extreme gusts, and survival conditions. Atmospheric icing is simulated by using the ice accretion simulation code LEWICE. A CFD method is used to estimate the blade aerodynamic degradation due to icing. The effects of icing on one, two, or three blades are compared, as are the effects of atmospheric icing on land-based and offshore wind turbines.

Floating structures
Ice conditions
Responses
Wind turbines

2016020351
Improvements on the normal mode decomposition method used in harbour resonance.
http://pim.sagepub.com/content/229/4/397.abstract
Gao, J., Ma, X., Et al
English

In the article by Sobey (2006), the author proposed a normal mode decomposition method to calculate the Eigen frequencies, the Eigen modes and the response amplitudes of different resonant modes in natural harbours that are subjected to storm tides and tsunamis. However, the numerical method to address the no-flow boundary condition in that article is imprecise, which would lead to inexact Eigen frequencies and Eigen modes. In this article, the mirror-image method was proposed to improve this handling process. The accuracy of the improved normal mode decomposition method was verified using three verification tests. With a set of numerical experiments, it was determined that during the process of decomposing the response amplitudes of different resonant modes, the numerical fitting error between the simulated free surfaces and the corresponding fitted ones gradually increases with the wave nonlinearity inside the harbour. This article seeks to identify the critical wave condition under which the normal mode decomposition method can accurately decompose the response amplitudes of different modes.

Eigenvalues
Harbour oscillations
Numerical analysis

2016020352
Innovative assessments for selecting offshore-platform-decommissioning alternatives.
Oil and Gas Facilities, v 4 n 5, October 2015, p 47
[9 p, 29 ref, 3 tab, 6 fig]
Truchon, S.P., Brzuzy, L.P., Et al
English

Hard substrates associated with offshore oil and gas platforms can contribute to the productivity of marine ecosystems, thereby generating local and regional economic benefits. These benefits form the basis for incorporating the platform into a rigs-to-reefs program when it is retired or for selecting some other type of removal option. There are many options for reefing platforms, each differing in environmental impact associated with dismantling and transport of the platform structure (deck, jacket, and other subsea structures). The use of science-based decision making in exploring platform-removal options can be beneficial for all stakeholders in the context of regulatory environment, complex ecosystem, and human interactions across multiple scales. Accommodating these complexities in a decision making process is the foundation of an ecosystem-based-management (EBM) approach. EBM is an environmental-management approach that recognizes the full array of interactions within an ecosystem, including humans, rather than considering single issues, species, or ecosystem services in isolation. The focus of this study is on one of Shell's former deepwater assets in the Gulf of Mexico. The fixed-jacket platform has been in operation for more than 35 years and extends to more than 1,000 ft of water depth off the coast of Louisiana. Few studies have been published on the ecology of marine life inhabiting deepwater platforms such as these. To begin to understand the specific contribution of this platform as an artificial reef, a stratified (across depth down the platform) study was performed by use of routinely collected remotely-operated-vessel (ROV) video footage to assess fish and sessile biotic communities. The ROV study revealed clear depth-related patterns of visually conspicuous epibiota
(surface-dwelling organisms such as Lophelia pertusa) and numerous species of reef and pelagic fishes. These data were used to construct a matrix to rank the ecosystem services of several decommissioning alternatives, including complete removal of the deck and jacket; removal of the deck, topping the jacket 85 ft below the waterline, and leaving the remainder in place; and removal of the deck and transfer of the entire jacket to a rigs-to-reef location. This portion of the assessment provided a strategic framework for identifying and evaluating sensitive ecosystem services in association with both human and environmental drivers to provide realistic (actionable) guidance in the selection of these decommissioning options. The preliminary ranking illustrated that a high level of ecosystem services could be maintained by decommissioning alternatives that leave the jacket in place or transfer the jacket elsewhere as part of a rigs-to-reefs program.

2016020353

Feasibility analysis and application for cantilever beam extension of self-elevating drilling unit.
http://www.isope.org/publications/publications.htm

Wang, J., Dong, W., Et al
English

The operation capacity of some self-elevating drilling units can’t satisfy the development requirement of production wells in Bohai Bay, China. COSL conducted cantilever extension feasibility analysis to upgrade the capacity of some types of jack-up. The requirement of the cantilever beam extension was to be increased from 40ft to 60ft, and the minimum drill load was 150mt at the maximum outreach & transverse shift (60ft outreach and 12ft shift to port). The research introduced several extension methods, and two of which were adopted. The first one was to install removable extension parts on the bow of cantilever, and the original beam would be strengthened together with hull, stern, hold down, jacking and holding system. The second method was to install a set of supporting units between cantilever beam stern and the production rig, and the supporting force could be adjustable automatically. By investigating the structural strength with environmental data, it is concluded that the extended cantilever has sufficient strength, and the drilling unit has sufficient elevated stability, preload capacity and holding system to satisfy the requirement of Rules for the Classification and Construction of MODU. By now, the removable extension parts have been installed on rig of HYSY9*, and 3 wells have been drilled at the maximum outreach of the cantilever.

Cantilever beams
Drilling rigs
Self elevation

2016020354

A wave basin model test study for a jackup moored on the dock.
http://www.isope.org/publications/publications.htm

Liu, L., Yuan, H., Et al
English

Offshore platforms under construction are normally moored on the dock during the outfitting stage. The safety of the platforms must be guaranteed during the whole stage of outfitting which may last for several months. This paper presents a wave basin model test study of a jackup moored on the dock in Shanghai Waigaoqiao shipyard in China. In the model test, the jackup and the sea states were scaled based on the Froude similarity law. The dynamic responses of the system, including the six degrees of freedom (6DOF) motions of the jackup and the barge, tensions on the mooring lines and the collision forces on the fenders, were measured in various sea states. Meanwhile, the current-and-wind only sea states were simulated and the dynamic responses were measured for comparison with those in the wave conditions. The mooring line tensions were found to exceed the strength of the lines in offshore wind conditions. And this phenomenon may be attributed to the decrease of the jackup’s yaw motion stiffness. In addition, several suggestions are proposed for optimising the mooring system performance.

Building docks
Dynamic response
Jackup platforms
Model tests
Moored structures
Preloading process analysis of jack-up based on ALE algorithm.
http://www.isope.org/publications/publications.htm
Zhang, Z.D., Zhang, X.

The finite element method (FEM) is widely used in the study of soil mechanical problems, while traditional FEM is difficult to solve the high mesh distortion for large deformation. The preload process of jack-up based on the Arbitrary Lagrangian Eulerian (ALE) algorithm is studied. An axisymmetric model with layered seabed is established according to ZUOYE-5 jack-up. And the seabed is simulated with the Mohr-Coulomb elastoplasticity constitutive model. The ALE method can accurately simulate the large deformation of spudcan penetration, the ultimate bearing capacity of foundation and the soil flow-back mechanism.

Jacket structures
Launching

Optimisation for jacket buoyancy tank on launching and upending stage.
http://www.isope.org/publications/publications.htm
Choi, W-H., Baik, Y-S., Kim, J-T.

This paper presents the CPP jacket launching, self-upending analysis and lowering as a part of the Field Development project during FV stage. The analyses have been performed to simulate the behaviour of the jacket for different phases of the launching and self-upending process and to ensure that the jacket structure can be launched from the barge with sufficient mudline clearance during its dive. CPP jacket strength during launching and lowering phases has also been carefully reviewed. The jacket will be launched into the open sea from a generic barge of 198.12m length x 51.82m/42.06m breadth x 12.20m depth. The analyses have been accomplished with assumption of being in a calm environment with no presence of significant wind, wave and current. Design water depth for assessment of the bottom clearance is considered as 75.90m (Launching) and 76.0m (Lowering). An optimisation study to determine the number and size of buoyancy tanks, which initially proposed by four (4) tanks with 4,600mm OD x 25mm Thickness x 52.00m. In addition, the capacity of derrick crane barge and the installation cost are investigated as per the capacity of buoyancy tanks as well as adjustment of sling length. The barge stability and strength checks and the effect of the environment during the jacket launching and self-upending are not discussed in this paper.

Jacket structures
Launching

Research on the formation mechanism of suction force during uplift of jackup.
http://www.isope.org/publications/publications.htm
Tan, R., Duan, M., Wang, Z.

For the problem where the suction force forms at the bottom of the spudcan during uplift operations for jack-ups, based on correlative soil mechanics and permeation fluid mechanics computational theories and methods, the law and formation mechanism of the suction force at the bottom of spudcan was studied by numerical analysis on the suction force at the bottom of the spudcan in the different soils. The result showed that the suction force at the bottom of the spudcan of a jack-up increased with decrease of permeability and the suction force got to the maximum when the separation between the spudcan and soil appeared. The suction force resulted from the negative pore water pressure which decreased first and then increased from center to outer edge and the distribution area of the minimum of negative pore pressure is concluded. The above study results
demonstrated the essentiality of nozzle arrangement of jetting system and it provides a theoretical guidance for rational nozzle arrangement of jetting system.

Jackup platforms
Lifting tasks
Suction

2.7 SAFETY AT SEA

2016020358
A target information display for visualising collision avoidance manoeuvres in various visibility conditions.
http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=9985948&fulltextType=RA&fileId=S0373463315000296
Sziapczynski, R., Sziapczynska, J.
English
The paper introduces a new approach to displaying information on targets. The proposed display visualises three types of information: targets' motion parameters (typical for target tracking), combinations of own course and speed which collide with those targets (typical for Collision Threat Parameters Area display by Lenart (1983)) and combinations of own course and speed which are not compliant with COLREGS in this case (based on ships' motion parameters and visibility conditions). A superposition of the last two types of data enables a navigator to quickly choose a collision avoidance manoeuvre which is both sufficient and COLREGS-compliant. Additionally, the displayed data may be filtered based on the remaining Time To Collision (TTC) so that navigators can concentrate on direct threats. The paper includes a description of the proposed visualisation technique as well as examples of visualised data for some encounter situations.

Collision avoidance manoeuvres
Collision risk
Radar displays
Restricted visibility

2016020359
Impact of navigational safety levels on seaport fairway capacity.
Journal of Navigation, v 68 n 6, November 2015, pp 1120-1132
http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=9986044&fulltextType=RA&fileId=S0373463315000387
Wang, W., Peng, Y., Et al
English
In this paper, the definition of seaport fairway capacity, considering port service level, is given by referring to both road and inland waterway capacity combined with the features of coastal fairways. In view of the navigation environment and ships' behaviour, the safety distance of ships entering and leaving a seaport is chosen as an overall index to evaluate the navigational safety level of a fairway. Based on the ship-following theory, an Arena-based seaport operating system simulation model is constructed to analyse the impact of safety level on seaport fairway capacity. For different navigational safety levels (i.e., minimum, general and adequate), seaport fairway capacity corresponding to different service levels and navigation durations is obtained. The results show that fairway capacity varies with safety level for a given port service level, and the lower the safety level is, the higher the fairway capacity is. Finally, a recommended navigational safety level and its associated fairway capacity are given to provide a theoretical foundation for fairway design and management.

Navigation channels
Navigational safety
Seaports
Traffic capacity

2016020360
Probabilistic fire risk analysis and structural safety assessment of FPSO topside module.
Ocean Engineering, v 104, 1 August 2015, pp 725-737
Jin, Y., Jang, B-S.
English
An offshore platform normally is exposed to flammable oil and gas in the course of its operation. Uncontrolled hydrocarbon leaks or accumulated flammable gas clouds present very dire threats, due to the probability of resultant fire and explosion. Fire accident represents a major part of the total risk to
offshore platforms. Nevertheless, existing procedures of fire risk analysis (FRA) are still not comprehensive enough to systematically evaluate the risks to topside structure safety. As reported in this paper, a new FRA procedure is established to overcome the deficiencies of existing ones. Prior to introducing the new FRA procedure, this paper reviews two types of existing FRA procedures and points out a common problem, namely the difficult application of design accidental loads (DALs) to structural consequence analysis. In this regard, the new procedure includes an extended structural consequence analysis rather than follow the conventional means of determining specific DALs. Moreover, the new procedure offers a new concept of cumulative failure frequency for assessment of topside module structure safety. The role of cumulative failure frequency is to probabilistically identify failed members of objective structures. The key advantages of the new FRA procedure are twofold: first, effective structural consequence analysis without the need for DALs, and second, probabilistic safety assessment of topside structure subjected to a certain number of prescribed fire-accident scenarios. The cumulative failure frequency, in fact, becomes useful information for determination of risk mitigation measures (e.g. passive fire protection (PFP), deluge systems, etc.). This paper not only presents a detailed description of the new FRA procedure but also demonstrates an example using a real FPSO separation module.

Prentice, D., Peiris, W., Brown, N.
English
Stricken ships in danger of breaking up, sinking, capsizing or losing their fuel or cargo need expert help to be rescued. This article discusses Lloyd’s Register’s Ship Emergency Response Service (SERS) which was set up to provide this support. SERS is a team of naval experts who can offer advice and make recommendations, providing rapid and continuing contact worldwide from a dedicated response centre onshore.

Bai, X., Qin, W., Luo, X.
English
With the development of ocean Technology, accidents on offshore floating platforms caused by occasional disasters (such as fire, crash, explosion) are increasing, which not only causes casualties and heavy economic losses, but also gives rise to...
pollution and destruction to the marine eco-system. Recently, researchers have focused on risk identification, risk assessment, risk predication, risk control and so on, and it is merely confined to the causes and influencing factors, which lead to the insufficiency of risk evolution. Risk of occasional disaster is an open network of dynamic evolution which contains randomness and regularity. In this paper, the risk evolution model based on complex networks for fire risk of offshore floating platforms is presented. Firstly, risk factors of fire hazards are identified according to the characteristics of offshore floating platforms. Secondly, the basic theory of complex networks is expounded and the compositions of derivative disasters group evolution for risk hazards are analysed. Finally, the risk evolution model for fire risk of offshore floating platforms is built and the characteristics of fire risk evolution model are analysed. The key of disconnect links are put forward in risk control. This paper applies Complex Networks Theory to risk analysis of offshore floating platforms; the work will improve the risk management and control of offshore engineering.

Fire safety  
Offshore platforms  
Risk analysis

2016020364

Risk evaluation against main accident events for a semi-submersible drilling rig.  
http://www.isope.org/publications/publications.htm  
Yoo, S-J., Lim, W-R., Et al  
English

Risk assessment is one of the main issues for all offshore units operating on Norwegian Continental Shelf (NCS). The risk assessment is required to fulfill Petroleum Safety Authority (PSA)/Norwegian Maritime Authority (NMA) regulations and the requirements of the classification societies. This paper discusses risk evaluations for a semi-submersible drilling rig operating on NCS that is classified as a Mobile Offshore Drilling Unit (MODU). Four accidental events are used for the risk evaluation such as fire, explosion, ship collision and dropped objects. Dimensioning/design accidental loads from the accidental events are introduced and verified through Accidental Limit State (ALS) assessments. A simple method and finite elements analysis are adopted to show the current designs can sustain the accidental loads. The paper also described how the risks are evaluated based on the principle of As Low As Reasonable Practicable (ALARP).

Platform accidents  
Risk analysis  
Semisubmersible rigs

2016020365

Ship security challenges in high-risk areas: manageable or insurmountable?  
WMU Journal of Maritime Affairs, v 14 n 2, October 2015, p 201 [17 p, 53 ref, 5 fig]  
http://link.springer.com/article/10.1007/s13437-014-0066-9  
Liwång, H., Sörenson, K., Österman, C.  
English

Piracy can lead to risks so high that they, according to the International Maritime Organization, are tolerable only if risk reduction is not practicable or is disproportionate to the benefits achieved. Therefore, there is a need for reducing ship security risks in relation to antagonistic threats such as piracy. The aim of this study is to identify challenges for ship operators when developing their ship security management. Furthermore, this study also investigates two central aspects in the analysis: understanding the threat and understanding how a security threat affects the crew and operation of the ship. It is clear from the analysis that the importance of subjective aspects beyond a ship operators’ direct control is high. This seems to be the fact for all aspects of the risk management process. The situation is also dynamic as the security risk, as well as the risk perception, can change dramatically even though there are no actual operational changes. As a result, the ship security management process is highly iterative and depends on situations on board as well as conditions out of the ship operator’s control. In order to make ship security manageable, the risk management has to put particular focus on methodological understanding, relevant system understanding and well-defined risk acceptance criteria as well as on including all levels of the organization in the risk reduction implementation and on a continuous monitoring.

Human factors  
Risk management  
Security
Wave modelling with data assimilation to support the navigation in the Black Sea close to the Romanian ports.

Butunoiu, D., Rusu, E.

The objective of this work is to develop a reliable wave prediction system, based on numerical models, in the Black Sea in order to support the navigation and the harbour operations in the Romanian nearshore. This system focuses, in a multilevel computational scheme, on the Romanian coastal environment. The SWAN model was implemented and calibrated for the entire sea basin against satellite data. Nevertheless, in some particular cases, as for example the extreme storm conditions, the numerical predictions might be less accurate and such behavior is sometimes even more accentuated in the sea environment than in the ocean. For these reasons, data assimilation techniques are considered to combine the measured wave parameters with those predicted by the numerical models in order to derive better estimations of the sea states. In this work, the wave measurements from the Gloria drilling unit have been considered for the assimilation procedure. A scheme based on the successive corrections method has been implemented to perform the assimilation in both the geographical and spectral spaces. In this way, the model predictions in the Romanian nearshore are improved and the wave modeling system developed can provide a better real time support to coastal navigation and harbour operations. Finally, the extension of this scheme to the forecast products is also considered.

Black Sea
Navigational safety
Numerical models
Wave models

2.8 ENVIRONMENTAL PROTECTION

Development of a prototype tool for ballast water risk management using a combination of hydrodynamic models and agent-based modelling.

Hansen, F.T., Potthoff, M., Et al

This article reports on the development of a prototype tool for modelling the risks of spreading of non-indigenous invasive species via ballast water. The tool constitutes of two types of models: a 3D hydrodynamic model calculates the currents in the North Sea and Danish Straits, and an agent-based model estimates the dispersal of selected model organisms with the prevailing currents calculated by the 3D hydrodynamic model. The analysis is concluded by a post-processing activity, where scenarios of dispersal are combined into an interim estimate of connectivity within the study area. The latter can be used for assessment of potential risk associated with intentional or unintentional discharges of ballast water. The paper discusses how this prototype tool can be used for ballast water risk management and outlines other functions and uses, e.g., in regard to ecosystem-based management and the implementation of the EU Marine Strategy Framework Directive.

Ballast water
Environmental effects
Risk management

Application of hydrodynamic cavitation in ballast water treatment.

Čvetković, M., Kompare, B., Klemenčič, A.K.

Ballast water is, together with hull fouling and aquaculture, considered the most important factor of the worldwide transfer of invasive non-indigenous organisms in aquatic ecosystems and the most important factor in European Union. With the aim of preventing and halting the spread of the transfer of
invasive organisms in aquatic ecosystems and also in accordance with IMO’s International Convention for the Control and Management of Ships Ballast Water and Sediments, the systems for ballast water treatment, whose work includes, e.g. chemical treatment, ozonation and filtration, are used. Although hydrodynamic cavitation (HC) is used in many different areas, such as science and engineering, implied acoustics, biomedicine, botany, chemistry and hydraulics, the application of HC in ballast water treatment area remains insufficiently researched. This paper presents the first literature review that studies lab- and large-scale setups for ballast water treatment together with the type-approved systems currently available on the market that use HC as a step in their operation. This paper deals with the possible advantages and disadvantages of such systems, as well as their influence on the crew and marine environment. It also analyses perspectives on the further development and application of HC in ballast water treatment.

Ballast water
Water treatment

2016020369

Fuzzy multi-criteria decision-making method for technology selection for emissions reduction from shipping under uncertainties.
Transportation Research Part D: Transport and Environment, v 40, October 2015, pp 43-60
Ren, J., Lützen, M.
English

This paper describes a methodology for the application of Multi-Criteria Decision-Making (MCDM) on the technology selection for emissions reduction from shipping under uncertainties and incomplete information. Nine criteria in four aspects, including technological (maturity), economic (capital cost and operation cost), environmental (effects of SOx, NOx, GHG, and PM reduction), and social–political aspects (government support and social acceptability), were used for the sustainability assessment. The study aims at developing the methodology for technology selection for emissions reduction from shipping by combining Fuzzy Analytic Hierarchy Process (AHP) and VIKOR. Fuzzy AHP was used to determine the weights of the evaluation criteria and the relative performance of the alternatives with respect to each evaluation criterion, and VIKOR was used to prioritize the alternative technologies. The two methods of VIKOR and the traditional AHP were combined to validate the proposed methodology. Three alternative technologies of low sulphur fuel, scrubber and LNG were studied using the proposed model, and the results indicate that the proposed methodology is capable of assisting the decision-makers to select the most sustainable technology for emissions reduction from shipping under uncertainties and incomplete information.

Decision making
Emissions
Fuzzy sets
Reduction
Shipping

2.9 GENERAL OPERATION

2016020370

Review of legislation on noise and vibration regulations in merchant ships.
Fernández Zacarías, F., Hernández Molina, R., Et al
English

This paper aims to describe the evolution of noise regulations for merchant ships over the last four decades, analysing the most important aspects with respect to crew, passengers and exposed populations in cities, in line with the requirements of the European Union to reduce the environmental impact of transport. The paper also analyses the changes in regulations aimed at not only regulating noise and vibration inside the ship, but also noise emitted to the port and underwater radiated noise. Classification Societies are also included, given the importance of their standards in ensuring increasing levels of comfort on board ship.

Noise
Legislation
Regulations
Vibration
2016020371

Anomaly detection in vessel tracking a Bayesian networks (Bns) approach.
Handayani, D., Sediono, W., Shah, A.
English

The paper describes the supervised method approach to identifying vessel anomaly behaviour. The vessel anomaly behaviour is determined by learning from self-reporting maritime systems based on the Automatic Identification System (AIS). The AIS is a real world vessel reporting data system, which has been recently made compulsory by the International Convention for the Safety of Life and Sea (SOLAS) for vessels over 300 gross tons and most commercial vessels such as cargo ships, passenger vessels, tankers, etc. This paper describes the use of Bayesian networks (BNs) approach to identify the behaviour of the vessel of interest. The BNs is a machine learning technique based on probabilistic theory that represents a set of random variables and their conditional independencies via directed acyclic graph (DAG). Previous studies showed that the BNs have important advantages compared to other machine learning techniques. Among them are that expert knowledge can be included in the BNs model, and that humans can understand and interpret the BNs model more readily. This work proves that the BNs technique is applicable to the identification of vessel anomaly behaviour.

Irregularities
Probabilistic methods
Ship identification
Ship tracking

2016020372

Determinants of slow steaming and implications on service patterns.
Maritime Policy & Management, v 42 n 7, 2015, pp 653-668
http://www.tandfonline.com/doi/full/10.1080/03088839.2015.1078509
Ferrari, C., Parola, F., Tei, A.
English

The research focuses on the impact of the shipping strategy to decrease the commercial speed of container vessels, in order to reduce the bunker costs, on current service patterns. In this regard, the study also hypothesizes potential development trends in the near future. The reduction of the commercial speed, commonly referred to as “slow steaming,” has been introduced to mitigate the negative effects of the recent economic crisis by cutting navigation costs and reducing the capacity supplied in order to assure a more efficient fleet deployment. Nowadays, this practice provokes a strong impact on maritime services and inter-port competition, as it leads to differentiate the offer of shipping services, combining fast and direct services among main hubs and cheaper and slower services also calling on small ports. The paper addresses the impact of slow steaming in the major shipping services and discusses the effects on service patterns between Asia and Europe, bringing practical insights for ocean carriers and ports.

Cost reduction
Liner shipping
Slow steaming

2016020373

Development of Motorways of the Sea in the Adriatic region.
Maritime Policy & Management, v 42 n 7, 2015, pp 653-668
http://www.tandfonline.com/doi/full/10.1080/03088839.2015.1078509
Tsamboulas, D., Lekka, A-M., Rentiziou, A.
English

Freight volumes are increasing worldwide, following almost the same growth rate as the Gross Domestic Product (GDP). This has resulted in congested sections of the road system and increase of traffic accidents. Consequently, several governments in Europe are promoting alternative modes of transport. Besides the use of railways, the European Union is promoting the use of maritime transport for short distances. This initiative, ‘Motorways of the Sea (MoS)’, aims at the establishment of more efficient and competitive maritime services between different countries. This paper analyses the development of an MoS network in the East Adriatic area, linking the Greek Ports of Igoumenitsa and Patras in the Ionian Sea. This is done by identifying financially viable MoS corridors, servicing the freight and passenger demand of the area. Initially, the freight and passenger flows of MoS in the East Adriatic/Ionian Seas region, based on the application of the four-step methodology for transport planning, are estimated. Then, the financial viability of each MoS is elaborated, based on the estimated flows. Hence, the
network of MoS services is determined for the area. Thus, the paper provides a useful tool to maritime operators, port authorities and policy makers to investigate the financial viability of an MoS network.

Adriatic Sea
Economic analysis
Short sea trades

2016020374

Modelling of marine traffic flow complexity.
Ocean Engineering, v 104, 1 August 2015, pp500-510
Wen, Y., Huang, Y., Et al
English

Recent increases in the number of high-speed, large-scale, and heavy-load vessels have made marine traffic more complex. Traffic situations are more difficult to manage as a result because of the rapid increase in the traffic density and the development of ship encounter situations. This article introduces a marine traffic complexity model to evaluate the status of traffic situation, use the complexity to investigate the degree of crowding and risk of collision, and support mariners and traffic controllers to get the traffic situation awareness. The traffic unit complexity model is constructed using pair-wise ship traffic characteristics such as the relative distance, relative speed, and intersecting trajectory. This model is extended to an area traffic complexity model through interpolation post-processing. It is shown that a higher complexity corresponds to more crowding and dangerous traffic in which the traffic situation should be carefully managed. Simulated data from the Shenzhen West Sea are employed to demonstrate the model and construct a map of the spatial distribution of the marine traffic complexity. The complexity model is shown to be effective in indicating different traffic situations.

Traffic density
Traffic management
Vessel traffic

2016020375

Effect of ocean currents on ship navigation in the east China sea.
Ocean Engineering, v 104, 1 August 2015, pp 283-293
Chen, C., Shiotani, S., Sasa, K.
English

Weather and ocean states such as ocean winds, ocean waves, and ocean currents can significantly affect ship navigation. To fully understand current effects on navigational fuel and time costs, especially in the case of strong western boundary currents such as the Kuroshio Current, an in-depth examination of how the Kuroshio Current quantitatively affects ships is needed. This article presents simulations, based on the Princeton Ocean Model (POM), in the North Pacific Ocean and focuses on the ocean surface current in the East China Sea (ECS). Then, several numerical simulations of ship navigation are conducted by utilizing a ship-maneuvering model known as the Mathematical Maneuving Group (MMG). The results show that the POM model can generate a high-quality Kuroshio Current distribution that can be applied to conduct numerical simulations of ship navigation.

Mathematical models
Navigation
Ocean currents
Passage planning

2016020376

Evaluation of ship performance in international maritime transportation using an onboard measurement system - in case of a bulk carrier in international voyages.
Ocean Engineering, v 104, 1 August 2015, pp 294-309
Sasa, K., Terada, D., Et al
English

The present global society has made the development of a safe and efficient maritime transportation system more imperative than ever before. Of particular impetus is the steep rise in the price of crude oil, which has required shipping companies to minimize the fuel consumption of their ships. Moreover, the emission of carbon dioxide has been restricted by the EEDI (Energy Efficiency Design Index) issued by the IMO (International Maritime Organization). Weather
Routing services have become more important to shipping companies. However, there are accuracy deficiencies in the numerical models employed by such services for purposes such as weather forecast and the ship speed loss phenomenon. Moreover, the development of weather routing models has been hampered by insufficient accumulation of continuous data on ship motions, and the navigation, engine, and weather parameters. The data used for this study was collected over one year from a 20,000 DWT class bulk carrier on worldwide voyages. Some new relationships regarding ship motions, speed loss, and wave conditions were developed, which were verified by experimental data and numerical simulations of the frequency response of the ship motion and of the weather and ocean.

**Bulk carriers**  
**Measurement**  
**Seakeeping**  
**Ship performance**  
**Weather routing**

**2016020377**  
**Variability of underwater radiated ship noise measured using two hydrophone arrays.**  
*OCEANS '15 MTS/IEEE Genova; 18-21 May 2015; Genova, Italy. Published by IEEE [10 p]*  
http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=7271383&filter%3DAND(p_Publication_Number%3A7227859)%26pageNumber%3D3  
**Humphrey, V., Brooker, A., Et al**  
**English**

The impacts of man-made underwater noise on the marine environment have received increased attention over recent years, primarily resulting from recognition of the increased pressures placed on the oceans by human activities. Underwater noise from shipping has long been acknowledged as a major contributor to overall ambient sea noise levels. Furthermore, recent evidence from long term measurements at a deep water location suggest that the increase in global merchant shipping has led to an increase in ambient noise levels in the oceans (although it should be noted that the data also show that this trend may be levelling off). To date, measurements of radiated noise from ships have been carried out primarily at fixed noise ranges. However, in recent years researchers have increasingly used other systems, most commonly portable measurement systems deployed from support vessels. The use of various bespoke or proprietary measurement systems and the various ways of reporting the data in the literature has prompted the recent publication of national and international standards covering measurement and data processing methodologies. These standards cover in detail many aspects of full scale ship radiated noise measurements including the measurement system specification, target vessel operating sequence and trials location requirements as well as the processing, analysis and reporting of the data. The objective of this paper is to present some analysis of measured radiated underwater noise data from a small vessel operating under realistic test conditions at sea in shallow water undertaken as part of the SONIC project. The measurements followed the requirements of the published standards as closely as possible although it was not possible to meet all of the criteria. Two multiple hydrophone arrays operated by two of the project partners, CETENA and the University of Southampton, were deployed from the same moored support vessel over a period of several days. The comparison of the data from these two systems provides an opportunity to investigate the typical variability and repeatability of radiated underwater noise from ships using mobile arrays.

**Measurement**  
**Noise**  
**Underwater**

**2016020378**  
**Long-term prediction of ship responses considering operation to avoid sea conditions of higher wave height.**  
*Journal of the Japan Society of Naval Architects and Ocean Engineers, v 21, 2015, p 1 [9 p, 19 ref, 4 tab, 15 fig]*  
https://www.jstage.jst.go.jp/article/jjasnaoe/21/0/21_1/pdf  
**Miyake, S., Minoura, M.**  
**Japanese**

Distribution characteristics of wave occurrence probability influence long-term prediction results that have estimated by using short-term ship responses and a wave scattering table. Because the observation volume of data and methods of analysing wave data in each scattering table of significant wave height and mean wave period are different, long-term prediction results depend on the scattering table to apply. Especially, the difference of the frequency count of higher wave height in the scattering table strongly affects the results. When a ship encounters a severe wave condition, the ship speed decreases (nominal speed loss). When the wave condition becomes more severe, the captain judges the deceleration and the change of the course to avoid the danger of the damage of the ship. A long-term prediction method
that has modelled the nominal speed loss and the ship handling is necessary to obtain a realistic prediction value. In this paper, the characteristics of a higher wave height for variety of scattering tables are investigated. Additionally, this paper proposes a long-term prediction method that models a situation when a ship is operated in such a way so as to avoid higher waves. Finally, this paper investigates the influence on a long-term prediction when the occurrence probability of a higher wave height is changed.

Predictions
Ship response
Wave height
Speed loss

2016020379

The evaluation of investments efficiency of SOx scrubber installation.
Transportation Research Part D: Transport and Environment, v 40, October 2015, pp 87-96

Panasiuk, I., Turkina, L.
English

The article analyses the investments efficiency of sulphur oxide (SOx) scrubber installation to comply with the requirements of MARPOL 73/78 Annex VI, which sets 0.1% SOx limits in 2015 in Emission Control Area (ECA) and 0.5% in 2020 globally. There are two most realistic technologies to reduce SOx emission suitable for existing fleet: low sulphur fuel; scrubber. Mentioned technologies are compared and economic issues of each are analysed in the article. The comparison of the technologies shows that no matter which technology will be selected each will require the additional costs: capital and operating costs, loss of profits due to the reduce of cargo capacity. That is why the technology introduction will be considered as investments in the article. Each of mentioned technology has certain specific of the investments. Therefore, the evaluation of the investments efficiency should be carried out by comparing the different technologies (in our case scrubber and low sulphur fuel) that meet the requirements of MARPOL 73/78. Investments efficiency in technology will be evaluated by cash flow modelling during the billing period covering the time interval from the technology introduction to the completion of use. The concept of cash flow allows forming a systematic view of funding and determining the dynamics of the financial effects at the each stage of technology introduction. In turn, a comparative analysis of technologies will identify the best option of investment applying to a particular ship.

Economic analysis
Investment
Scrubbers

3.1 GENERAL HYDRODYNAMICS, HYDRAULICS AND OCEANOGRAPHY

2016020380

Wash waves generated by high speed displacement ships.
China Ocean Engineering, v 29 n 5, October 2015, pp 757-770

Zhou, L-l., Gao, G., Huijsmans, R.H.M.
English

It is difficult to compute far-field waves in a relative large area by using one wave generation model when a large calculation domain is needed because of large dimensions of the waterway and long distance of the required computing points. Variation of waterway bathymetry and nonlinearity in the far field cannot be included in a ship fixed process either. A coupled method combining a wave generation model and wave propagation model is then used in this paper to simulate the wash waves generated by the passing ship. A NURBS-based higher order panel method is adopted as the stationary wave generation model; a wave spectrum method and Boussinesq-type equation wave model are used as the wave propagation model for the constant water depth condition and variable water depth condition, respectively. The waves calculated by the NURBS-based higher order panel method in the near field are used as the input for the wave spectrum method and the Boussinesq-type equation wave model to obtain the far-field waves. With this approach it is possible to simulate the ship wash waves including the effects of water depth and waterway bathymetry. Parts of the calculated results are validated experimentally, and the agreement is demonstrated. The effects of ship wash waves on the
moored ship are discussed by using a diffraction theory method. The results indicate that the prediction of the ship induced waves by coupling models is feasible.

Displacement hulls
High speed vessels
Ship waves
Wave models

2016020381

Numerical simulation of cavitating flows using OpenFOAM.
NuTTS '15, 18th Numerical Towing Tank Symposium; 28-30 September 2015; Cortona, Italy. Organised by INSEAN, Rome, Italy. [6 p, 10 ref, 6 fig]
https://www.uni-due.de/imperia/md/content/ist/nutts_18_2015_cortona.pdf
Asnaghi, A., Feymark, A., Bensow, R.

In this study, interPhaseChangeFoam solver of OpenFOAM is used to simulate cavitating flows where previously proposed modifications are implemented and analysed in further details. Cavitating flows around NACA0009 and NACA66MOD hydrofoils are simulated to firstly validate the capability of the solver in prediction of cavitation in different operating conditions and secondly to highlight the positive impacts of the proposed modifications on the cavitating flow prediction.

Cavitating flow
Computational fluid dynamics

3.2 RESISTANCE AND PROPULSIVE PERFORMANCE

2016020382

Numerical analysis of base-ventilated intercepted supercavitating hydrofoil sections.
Ocean Engineering, v 104, 1 August 2015, pp 63-76
Pearce, B.W., Brandner, P.A.

A numerical analysis of the inviscid flow over a family of base-ventilated intercepted hydrofoils is presented using a low-order, non-linear boundary element formulation. The blunt-based section geometry used is based on the NACA 4-digit modified thickness distribution with the addition of a trailing edge fence (or interceptor) for lift production. An optimum section shape, in terms of stable cavity behaviour, was found to be a trade-off between the leading edge minimum pressure and the trailing edge slope. The former affecting the potential for leading edge cavitation and the latter flow separation from the trailing edge. The maximum hydrodynamic efficiency was obtained with a thin section, a small trailing edge slope and operation at a low cavitation number. For a profile with 15% thickness to chord, at zero incidence and an interceptor height of 1% of the chord length, a maximum lift/drag ratio of around 12 was achieved. The practical realization of this value is likely to be affected by structural limitations, cavity dynamics and serviceability constraints.

Numerical analysis
Supercavitating hydrofoils
Ventilated hydrofoils

2016020383

Numerical study on scale effect of nominal wake of single screw ship.
Ocean Engineering, v 104, 1 August 2015, pp 452-468
Wang, Z-Z., Xiong, Y., Et al

A 4000TEU container ship was studied without considering free surface effect, and the viscous flow fields of ship at different scales were solved numerically by RANS method, numerical uncertainty analysis was employed according to factors of safety method for Richardson extrapolation, scale effect of axial nominal wake field was analysed in detail. It shows that the reciprocal of mean axial wake fraction of propeller disc exhibits a near linear dependence on Reynolds number in logarithmic scale. For the single screw ship without bilge vortex, linear function is fit perfectly for the relationship between the reciprocal of mean axial wake fraction at each radius, reciprocal of amplitude of wake peak right above propeller disc and Reynolds number in logarithmic scales. In inner area of propeller disc, the reciprocal of amplitude of wake peak and valley reveal nearly linear dependence on Reynolds number in logarithmic scales. While in outer area, the amplitude of wake peak and valley decline rapidly to potential wake fraction, and the wake width reveals negative exponent power function dependence on
Reynolds number in logarithmic scales. On this basis, an extrapolated wake field scaling method is proposed.

Computational fluid dynamics
Scale effect
Single screws
Wakes

2016020385

Practical approach to the added resistance of a ship in short waves.
http://www.isope.org/publications/publications.htm
Liu, S., Papanikolaou, A., Zaraphonitis, G.

English

In this paper, various analytical and semi-empirical formulas for calculating the added resistance in short waves are critically revisited and the authors proceed with an improved formula introducing correction factors accounting for ship’s block coefficient, waterline’s flare angle, sectional local draught and Froude number. Extensive validations of the proposed formula were carried out by applications to different types of ships. It is anticipated that the updated formula well captures the added resistance of modern ships in short waves and may be a valuable contribution to ongoing discussions about level 1 and level 2 methods for the estimation of minimum powering in waves in the frame of IMO MEPC.232(65).

Added resistance in waves
Approximation
Short crested waves
Slow speed

2016020386

Experimental investigation of ship wave added resistance in regular head, oblique, beam and following waves.
http://www.isope.org/publications/publications.htm
Valanto, P., Hong, Y-P.

English

Measurements on wave added resistance of a cruise ship model were carried out in regular waves in seven wave directions. The motivation for the investigation is the powering performance of ships in wave conditions. A new towing arrangement allows the ship model practically free motions in oblique seas, but makes it simultaneously possible to measure the towing resistance. The maximum resistance was encountered in bow quartering seas. The
measurements show that practically all ship motion components have a clear effect on the wave added resistance. The wave elevation measured around the ship shows a clear correlation with the measured wave added resistance values.

Added resistance in waves
Model tests
Regular waves

2016020387

Development of an experimental methodology for self-propulsion test with a marine diesel engine simulator, the fourth report: direct measurement of actual ship speed in waves by model tests.
http://www.isope.org/publications/publications.htm
Kitagawa, Y., Tanizawa, K., Tsukada, Y.
English
The authors continued to develop and expand new experimental methodology on tank model test with the Marine Diesel Engine Simulator and the Auxiliary Thruster System, for making evaluation techniques on actual ship performance in waves more sophisticated. In this fourth report, the methodology is so enhanced that measured results of model test can be directly evaluated as the actual ship performance in waves. Here, the details of the newly expanded methodology are introduced, and experimental results measured from the free running model tests in waves with the expanded methodology are validated, even focusing on behaviours of the ship diesel engine.

Free running models
Model tests
Propulsive performance

2016020388

Calculation method of form factor based on energy conservation of ship wave-making.
Journal of Ship Mechanics, n 5, 2015, pp 477-483
http://cbx.cssrc.com.cn/
Wang, W-h., Gu, M-y., Wang, Y-y.
Chinese
In order to expand the applicable measurement speed range of the traditional method which is used to determine the form factor by the ship model test data, this paper presents a calculation method of form factor based on energy conservation of ship wave-making. In this method, from energy conservation of ship wave-making, the theoretical approximation formula of wave-making resistance can be obtained and replace the one used in ITTC (1978) method. New expression of total resistance coefficient can be achieved and used to determine the parameters by using gradient descent algorithm, and then form factor can be acquired. Finally, for a test case of 4250 TEU Container Vessel, by comparing with traditional Prohaska and ITTC (1978) methods, the feasibility and accuracy of proposed method were validated.

Energy conservation
Scale effect
Wave resistance

2016020389

Numerical calculation of pressure field caused by ship moving at supercritical speed in shallow water.
Journal of Ship Mechanics, n 5, 2015, pp 493-500
http://cbx.cssrc.com.cn/
Deng, H., Zhang, Z-h., Et al
Chinese
A mathematical model for pressure field caused by ship moving at supercritical speed in shallow water was established, based on the shallow water wave potential flow theory and slender ship assumption. The pressure field caused by ship moving at supercritical speed in shallow water was calculated by using the finite difference method. The effects of channel wall, depth Froude number and dispersion characteristics on the ship hydrodynamic pressure field were analysed. The computed results were compared with the ones of Fourier integral transform method and experiment. The mathematical model and the calculation method were validated have a good agreement.

Mathematical models
Pressure distribution
Shallow water
Supercritical velocity
2016020390

Numerical and experimental analysis of a ducted propeller designed by a fully automated optimisation process under open water condition. China Ocean Engineering, v 29 n 5, October 2015, pp 733-744
http://link.springer.com/article/10.1007/s13344-015-0051-x
Yu, L., Druckenbrod, M., Et al

English

A fully automated optimisation process is provided for the design of ducted propellers under open water conditions, including 3D geometry modeling, meshing, optimisation algorithm and CFD analysis techniques. The developed process allows the direct integration of a RANSE solver in the design stage. A practical ducted propeller design case study is carried out for validation. Numerical simulations and open water tests are fulfilled and proved that the optimum ducted propeller improves hydrodynamic performance as predicted.

Ducted propellers
Optimisation
Propeller efficiency

2016020391

Numerical prediction of ship resistance and squat in confined waters.
Linde, F., Ouahsine, A., Et al

English

Accurate prediction of hydrodynamic forces opposing a ship displacement in restricted waterways is necessary in order to improve energy efficiency of inland transport. When a ship moves in restricted waterways, a significant increase in ship squat (combination of sinkage and trim) and resistance occurs compared to a movement in open waters. In this paper, a 3D numerical model based on fluid-structure coupling is presented and used to investigate the effect of limited water depth and channel width on ship resistance and squat.

Computational fluid dynamics
Resistance
Restricted waters
Squat

2016020392

Development of an air circulating tank to reduce the frictional resistance of an ultra large container ship.
http://www.isope.org/publications/publications.htm
Sugawa, K., Furuo, A., Et al

English

Performance of an air circulating tank to reduce the frictional resistance of a ship is experimentally investigated. A 20,000TEU container ship with wide breadth and shallow draft is designed for this investigation. The air circulating tank is built in the double bottom of the ship and reduces the wetted surface by 62%. Resistance tests of the scale model show that the tank can reduce the resistance by 25% at low Froude number. As advanced speed of the ship increase, efficiency of resistance reduction rapidly decreases because of air escape from the tank.

Air
Containerships
Frictional resistance
Tanks

2016020393

Development and application of energy saving devices to improve resistance and propulsion performance.
http://www.isope.org/publications/publications.htm
Lee, H.D., Hong, C.B., Et al

English

In 2013, the Energy Efficiency Design Index (EEDI)
entered into force as an international convention to reduce carbon dioxide emissions. The enforcement of EEDI leads shipbuilders to focus on further improvement on ship hydrodynamic performance by developing Energy Saving Devices (EDSs) as well as designing more efficient hull forms and propellers. This study presents the results of the development and application of ESDs designed by Samsung Heavy Industries (SHI) to improve ship resistance and propulsion performance. SHI developed a novel ESD named SAVER Fin (SAmsung Vibration and Energy Reduction Fin), which is a simple fin-shaped appendage attached on the stern bilge area. It produces a series of strong vortical streams, which accelerates retarded flow near the stern region to make the inflow of the propeller more uniformly distributed. Increase of the flow velocity recovers pressure near the stern region more, and thus hull resistance is decreased. Also, more uniformly distributed inflow of the propeller significantly reduces the level of hull vibration induced by the rotating propeller. Power saving by reduction of the hull resistance was confirmed with model tests at both design and ballast draughts. To verify the performance of the SAVER Fin in full scale, sea trial tests were performed for a series of 35K bulk carriers. Two vessels, one equipped with the SAVER Fin and the other with a duct type ESD, were chosen for the sea trial tests to assess the effectiveness of the two different ESDs on fuel consumption and RPM margin. This paper addresses the findings of the two ESDs' performance in power savings based on the model test and the sea trial results.

**Energy conservation**

**Fins**

**Hull appendages**

**Propulsive performance**

**Resistance**

2016020394

**Calculation of added resistance in waves for KVLCC2 and its modified hull form using RANS-based method.**


http://www.isope.org/publications/publications.htm

Kim, Y-C., Kim, K-S., Et al

English

This study provides numerical simulations with the unsteady Reynolds Averaged Navier-Stokes (URANS) methods for the prediction of added resistance performance of hull forms advancing forward in regular waves. Two degrees of freedom motion (pitch and heave) are solved in the non-inertial reference frame in which the effects of the motions are considered as a body force source term in the governing equations. The relative translational and rotational velocities according to the motions of the hull are imposed at all the far-field boundaries.

The computation of the added resistance and 2DOF motions were carried out for KVLCC2 and its modified hull form in which bow shape is sharpened with removing the bow-bulb under thirteen different regular head-wave conditions. The computational results showed good agreement with the experiments and the modified hull form is superior to the original KVLCC2 in added resistance performances.

**Added resistance in waves**

**Computational fluid dynamics**

**Hull form**

**Modification**

2016020395

**CFD analysis of propeller-rudder interaction.**


http://www.isope.org/publications/publications.htm

Di Mascio, A., Dubbioso, G., Et al

English

Interaction of the vortex systems detached from a propeller with a rudder installed in its wake is investigated by CFD. The correct prediction of this phenomenon is of great interest in naval hydrodynamics research, it being the source of irradiated noise and vibratory loads. The phenomenology is addressed by simulating a single bladed propeller (INSEAN E779A) and a rudder characterized by a rectangular plane area and symmetric sectional shape (NACA0020 profiles). The main focus is on the hydro-loads developed by the rudder and their correlation with the different phases of the interaction of the tip vortex with the rudder. The phenomenon is also investigated, through a preliminary computation on a coarser mesh, on the actual propeller geometry (4-bladed).

**Computational fluid dynamics**

**Propeller rudder interaction**
Numerical study of hydrodynamic characteristics of a gliding-hydrofoil craft in steady flow.

Chen, S.L., Wang, Z.D., Ma, Q.W.

A model-scale high-speed gliding-hydrofoil craft (GHC) is studied numerically in steady forward speed in this paper. Resistance, free surface elevation and pressure distribution of the hull and hydrofoil are investigated with different Froude numbers. The numerical results are compared with the experimental results to further investigate the hydrodynamics of GHC.

Numerical analysis
Resistance
Ship hydrodynamics

Numerical analysis of wake structure and performance of two oscillatory mechanisms of a foil: Pure pitching and undulating.

Abbaspoor, M., Ebrahimi, M.

There are various propulsion, manoeuvring, and stabilization mechanisms in nature, which can provide inspiration for similar mechanisms in man-made vehicles. This study aims to elucidate and compare the propulsive vertical vortical signature and performance of a foil in two important natural mechanisms of pure pitching and undulatory oscillations. Governing equations are solved with a pressure-based finite volume method solver, in an arbitrary Lagrangian–Eulerian framework domain containing a NACA 0012 foil moving with prescribed kinematics. The results show that in a given Reynolds number (Re), the undulating mechanism produces thrust at a higher Strouhal number (St) and with smaller growth slope, but mostly higher efficiency, versus St, than pitching mechanism. In addition, vortical structures of these mechanisms have significant differences and also vary considerably with St. One of the distinguishable features of vortical signatures is the presence of the leading-edge vortices for the pitching foil, which are not appearing in the undulating foil’s vortical pattern.

Computational fluid dynamics
Foil propellers
Pitching
Unsteady loads
Wakes

CFD simulations of the Japan bulk carrier test case.

Andersson, J., Hyensjö, M., Et al

This computational fluid dynamics (CFD) validation study is performed as a foundation for further studies with focus on the interaction effects between propulsor and hull. To be able to study the interaction effects, an appropriate CFD methodology need to be established and validated for a bare hull, for the propulsion unit and for the combined system, a self-propelled hull. The work to validate a CFD model is initiated through the use of the JBC, Japan Bulk Carrier, open test case. The JBC test case is developed for the 2015 workshop on CFD in Ship Hydrodynamics. The tested JBC only exists in model scale with scale factor 1:40 (LPP = 7 m). Model ship speed is 1.179 m/s, corresponding to Fn = 0.142 and 14.5 kn, only calm water conditions are tested. There are two variants of the hull, with and without an energy saving device, within this study the one without is used. Test data used for validation of the CFD results are from towing tank experiments at NMRI. The aim of further studies is to study propulsor hull interaction in full scale, but since detailed test data in full scale is limited; all computations will be performed in model scale. The commercial CFD package STAR-CCM+, a finite volume method solver, is employed for all studies. STAR-CCM+ is a general purpose CFD code used for a wide variety of applications. It solves the conservation equations for momentum and mass, turbulence quantities and volume fraction of water.
using a segregated solver based on the SIMPLE-algorithm. A 2nd order upwind discretization scheme in space is used. It is of interest to study how a general purpose code can perform for detailed ship hydrodynamic analyses and which limitations that could be identified.

**Bulk carriers**  
**Computational fluid dynamics**  
**Hull propeller interaction**

### 2016020399

**Assessment of erosion aggressiveness for the cavitating model propeller VP1304 by fully compressible numerical simulation.**  
*NuTTS '15, 18th Numerical Towing Tank Symposium; 28-30 September 2015; Cortona, Italy. Organised by INSEAN, Rome, Italy. [6 p, 10 ref, 2 tab, 7 fig]*  
https://www.uni-due.de/imperia/md/content/ist/nutts_18_2015_cortona.pdf  
**Budich, B., Borrmann, F., Et al**  
**English**  

In this paper, the model propeller VP1304 is investigated numerically, reproducing the Potsdam Propeller Test Case 2011. A homogeneous mixture model, in conjunction with the assumption of inviscid flow and barotropic thermodynamics, is employed. Two-phase compressibility is taken into account and, thus, collapse-induced shock waves as well as pressure fluctuations due to the dynamics of the cavitating flow are resolved. Flow aggressiveness therefore is analysed with the maximum pressure criterion, and by detecting individual collapse events. The location and extent of cavitating regions is in agreement with the experiments and previous numerical studies of the propeller. Comparison of flow aggressiveness for the three operation points shows that the cavitating flow is least aggressive at the design point of the propeller.

**Cavitating flow**  
**Cavitation erosion**  
**Numerical analysis**  
**Propeller cavitation**

### 2016020400

**Performance prediction of a semi-displacement luxury yacht.**  
*NuTTS '15, 18th Numerical Towing Tank Symposium; 28-30 September 2015; Cortona, Italy. Organised by INSEAN, Rome, Italy. [6 p, 15 ref, 1 tab, 7 fig]*  
https://www.uni-due.de/imperia/md/content/ist/nutts_18_2015_cortona.pdf  
**Durante, D., Broglio, R.**  
**English**  

In this paper, the towing of the semi-displacement sailing yacht Azimut Grande 95RPH is simulated. The towing simulations are carried out for Fr spanning from 0.6 to 1.2; sinkage and trim, and resistance curves are evaluated. The numerical computations have been pursued by using the unsteady RANS solver navis, which is a general purpose simulation code developed at CNR-INSEAN.

**Computational fluid dynamics**  
**Motor yachts**  
**Resistance**  
**Sinkage**  
**Trim**

### 2016020401

**A method to perform self-propulsion computations with a simplified body-force propeller model.**  
http://www.isope.org/publications/publications.htm  
**Fu, H., Michael, T.J., Carrica, P.M.**  
**English**  

In order to predict self-propulsion factors, a procedure to obtain the propeller operating point advance coefficient using a non-interactive body force propeller model is developed, allowing computation of propeller rotational speed and the thrust coefficient. The method is intended for quick computations, though it has proven notably accurate. To test the methodology, the viscous free surface flow field around the model-scale KRISO container
ship KCS at the self-propulsion operating point in full scale is numerically simulated with the general CFD code FLUENT. All of the predicted propulsion coefficients are within 3% of the experimental values and the flow details also compare well with experimental data.

Computational fluid dynamics
Self propulsion
Ship hydrodynamics

2016020402

http://www.isope.org/publications/publications.htm
Lopez, D., Hernandez, J., Et al
English

A finite volume model had been developed to simulate the bollard pull test of twin propeller tugboats. The Navier-Stokes equations are solved by using ANSYS FLUENT along with the Reynolds Averaged Navier-Stokes and the SST k-w turbulence model. A study is carried out under the standard test conditions using steady and transient methods. In addition, a study is presented for situations where the test environment cannot comply with the ideal conditions of the test. Thus, the effect of dimensions of the test channel was considered. A validation of the results by comparing with experimental and theoretical data was made with excellent agreement.

Bollard pull
Computational fluid dynamics
Thrust
Tugs

2016020403

http://www.isope.org/publications/publications.htm
Chen, L., He, G., Et al
English

The viscous flow around a M331-based catamaran is simulated based on a computational fluid dynamics (CFD) commercial software FINE/Marine, which is an integrated CFD software environment for numerical simulation of mono-fluid and multi-fluid flows around kinds of vessels. The wave-making resistance on a catamaran and the corresponding wave patterns are studied and illustrated in the paper. Firstly, convergence studies with respect to computational domain size, ramp function, grid number, and time step are performed by the wave-making resistance problem of the catamaran. Then, waves generated by a M331-based catamaran and the corresponding wavemaking resistance on the hull with various traveling speed are simulated. Finally, the ratio of ship-length to its displacement is mainly optimised to obtain a high seakeeping performance with low wavemaking resistance and fast advancing speed. It is confirmed that the FINE/Marine has the capability of prediction of wave-making resistance on the catamaran, and it is also considered to be a promising tool to optimise hull form for high seakeeping performance with fast advancing speed.

Catamarans
Computational fluid dynamics
High speed vessels
Wave resistance

2016020404

http://www.isope.org/publications/publications.htm
Wu, J., Zhang, C., Wan, D.
English

This research applied CFD solver naoe-FOAM-SJTU
and NMShip-SJTU solver which based on the Neumann-Michell theory to forecast the drag, sinkage and trim experienced by several ship hulls that steadily advance along a straight path at constant speeds in infinite calm water. The advantages and disadvantages of the two methods are explored by comparing efficiency and accuracy of the predictions based on the two methods respectively. The comparisons of these hydrodynamic characters between the two method show that the CFD method can yield more accurate results, and is well suited for detail design and evaluation, while the NM method is more efficient, so it is a practical tool for preliminary design and hull optimisation which involve a very large number of alternatives.

Computational fluid dynamics
Drag
Sinkage
Trim

2016020405
An optimisation process for propeller design and its application based on CFD.
http://www.isope.org/publications/publications.htm
Park, J-y., Peric, M., Park, D.
English
In this study, optimisation of propeller geometry for a merchant ship was mainly studied. In this regard, simulations based on RANSequations were conducted to predict the self-propulsion performance. The numerical simulation was automatically performed by JAVA macro using the commercial CFD software, STAR-CCM+. The commercial optimisation software CAESES (former name: FRIENDSHIP-Framework) was integrated with the flow solver STARCCM+ in order to achieve an automatic optimisation process. Through the optimisation study, the relationship between propeller geometry and self-propulsion performance was investigated systematically. Understanding the characteristics of propeller shape based on the view point of self-propulsion provides good chances to establish the new guideline of propeller design.

Computational fluid dynamics
Hull propeller interaction
Optimisation
Propellers

3.3 MOTION, SEAKEEPING AND MANOEUVRING

2016020406
On the stability of fast ferry in damage scenarios.
Acanfora, M., De Luca, F.
English
Ro-ro ships are characterized by a large garage compartment extending from stern to bow. Damage conditions, heavy weather and large floodable spaces could create serious accidents, with the loss of life and goods at sea, both for conventional ferries and fast ferries. The occurred accidents showed the need of a more accurate approach to the damaged ship stability in waves, also in head sea and following sea conditions, because of the great movements of water on the car deck. With this aim a tool for analysing the ship response in waves with damaged compartments has been developed and applied on a typical fast ferry. The ship dynamic is simulated in time domain, including non-linear effects, taking into account critical scenarios on the damaged ship. The applications regard ship grounding, assuming head sea, modelled by regular wave. In addition the particularly critical condition of a transversal wind heeling moment has been applied to compute non symmetrical behaviour. Moreover the stability problems arising from the presence of trapped water in the garage compartment are investigated assuming the same environmental scenarios.

Damage stability
Ferries
High speed vessels
Low Reynolds number performance of a model scale T-foil.

ABSTRACTS


AlaviMehr, J., Davis, M.R., Lavroff, J.

English

Submerged T-foils are an essential forward component of the ride control systems of high speed ferries. A model scale T-foil for a 2.5m towing tank model of a 112m INCAT Tasmania high-speed wave-piercer catamaran has been tested for both static and dynamic lift performance. The tests were carried out using a closed-circuit water tunnel to investigate the lift and drag characteristics as well as frequency response of the T-foil. The model T-foil operates at a Reynolds number of approximately 105, has an aspect ratio of 3.6 and a planform which is strongly tapered from the inboard to outboard end. All of these factors, as well as strut and pivot interference, influence the steady lift curve slope of the model T-foil which was found to be 61% of the value for an ideal aerofoil with elliptic loading. The T-foil dynamic performance was limited primarily by the stepper motor drive system and connection linkage. At the frequency of maximum motion of the 2.5 m catamaran model (about 1.5Hz) the model T-foil has approximately 5% reduction of amplitude and 15 degrees of phase shift relative to the low frequency response. Only very small limitations arose due to the unsteady lift as predicted by the analysis of Theodorsen. It was concluded that the model scale T-foil performed adequately for application to simulation of a ride control system at model scale.

Aerofoils
Control systems
High speed vessels
Reynolds number
Scale models

An experimental investigation on reduction of list angle of a semisubmersible platform in head sea.

Journal of Advanced Research in Ocean Engineering, v 1 n 3, p 1

Kim, N.W., Nam, B.W., Et al

English

This study consists of an experimental investigation of the reduction of the second-order roll motion of a semisubmersible platform in head sea conditions by adding hull damping. The second-order heave drift force and roll drift moment are known to be the main triggers that induce the list angle (Hong et al., 2010). Hong et al. (2013) used numerical calculations to show the possibility of reducing the list angle by changing the pontoon shape and adding a damping device on the hull. One of their findings was that the reduction in the list angle due to the increase in pontoon surface damping was significant. A series of model tests were carried out with a 1:50 scaled model parameters considered comprised bank type (vertical and sloped), ship model (two types), velocity, ship-to-bank distance, and navigation time. Figures and tables were used to present the distribution of ship stern eddy current, flow field pressure, and velocity, and the comparison of centre of mass deviation, sway force, and yaw moment. Results showed that ships navigating along embankments and channels produced asymmetric flows, which drew the bow away from the shore. Larger ships are substantially more influenced by bank effects than smaller ships. Large sway forces and yaw moments are produced in large ships, drifting the bow away from the bank and the stern towards the bank, increasing the risk of collision with the embankment. From the study results, the characteristics of bank effects are understood and can be used for assisting the safe navigation of ships in restricted waters.

Banks (waterways)
Channel navigation
Restricted waters
Wall effects

Vertical and sloped bank effects on different ship types.


Su, D-T.

English

This study employed computer design software to completely draft 3D ship models; then, computational fluid dynamics were used to establish numeric navigation channels and simulate fluid hydrodynamic analysis of ships navigating along shore banks. The
of semi-submersible at the KRISO wave basin. The experiments indicated that adding damping on the hull surface effectively suppressed the list angle.

Model tests
Platform motions
Rolling
Semisubmersibles

2016020410

A time-domain strip theory approach to manoeuvring in a seaway.
Ocean Engineering, v 104, 1 August 2015, pp 107-118
Subramanian, R., Beck, R.F.
English

A time-domain body exact strip theory is developed to predict manoeuvring of a vessel in a seaway. A frame following the instantaneous position of the ship, by translating and rotating in the horizontal plane, is used to set up the boundary value problem (BVP) for the perturbation potentials. A boundary integral technique is used for solving the Laplace equation. Linearized free surface boundary conditions are used for stability and computational efficiency, and exact body boundary conditions are used to capture nonlinear effects. A nonlinear rigid body equation of motion solver is coupled to the hydrodynamic model to predict ship responses. Results are presented for the turning circle manoeuvre of the containership S-175 in calm water and in the presence of regular waves. The results are compared with available experimental results. The simulations are able to capture general qualitative aspects and overall physics of the problem.

Manoeuvring
Seaway (waves)
Time domain
Turning circle manoeuvres

2016020411

Estimating quadratic transfer functions for floating structures using model test data from irregular sea states.
http://www.isopec.org/publications/publications.htm
Jensen, B., Hansen, H.F., Kirkegaard, J.
English

This paper describes and validates a method for estimating quadratic transfer functions (QTF) for floating structures based on model experiments with irregular wave loading. With the QTF for a specific floating moored structure the slow drift forces acting on the structure can be estimated. This serves as input in the design phase of e.g. the mooring system. One method for experimental determination of the QTF involves a large number of bi-chromatic wave conditions in order to cover the two-dimensional frequency space that defines the QTF. This is a time consuming and tedious approach. In the present study, a method based on a time-domain analysis of measurements of forces or motion responses of a floating structure was implemented. The aim is to develop a practical engineering tool that, based on a limited number of irregular sea states, can estimate the QTF for a floating structure. The method was validated by three test cases: 1) a synthetic response signal generated based on a known QTF, 2) a measured force signal on a fixed structure, and 3) a measured surge displacement signal on a floating moored structure. The synthetic test signal showed that the method is capable of reproducing the test QTF. For the real case example where wave force measurements from the fixed structure was applied a good agreement was found between measured forces and those reconstructed based on the estimated QTF. For the floating structure some discrepancies were seen between measured and reconstructed motions. The method was found in general to be applicable for estimating the QTF. It is recommended to apply the
method based on a measured wave force signal on a fixed structure. This requires that a single irregular time series with force measurements on a fixed structure should be incorporated in the experimental test program when the estimation of the QTF is of interest.

Drift forces
Floating structures
Model tests
Transfer functions

2016020412
Review on the technique of the ship motion quiescent period prediction.
Chinese Journal of Ship Research, v 10 n 4, 2015, p 1 [7 p, 35 ref, 2 tab, 3 fig]
Duan, W., Zhang, Y., Et al
Chinese
The ship motion quiescent period is the period during which all ship motion is within acceptable limits to marine operations, such as helicopter landing and UUV handling. In most cases, a short time quiescent period would be sufficient to conduct a specific type of operation. In this paper, the feasibility of the quiescent period prediction through the simulation of ship motion in waves is analysed, and it is concluded that there are three key phases of the quiescent period prediction: the measurement of waves, the measurement of wave propagation, and ship motion prediction. Finally, an outlook of the future of the quiescent period prediction is also provided.

Operations
Ship motions
Wave measurement
Wave propagation

2016020413
Hydrodynamic analysis of semisubmersible platform to operate in deepwater fields in Mexican part of the Gulf of Mexico.
http://www.isope.org/publications/publications.htm
Vazquez-Hernandez, A.O., Cho, S.K., Et al
English
In order to evaluate the feasibility of semi-submersible platform to operate in Mexican oil fields in Gulf of Mexico, the motions and mooring line tensions are analysed by numerical calculations and model tests. The same semi-submersible platform was considered to operate in two different sites under extreme environmental conditions. Model tests were conducted in an ocean engineering basin to measure and analyse the dynamic behaviour of semi-submersible in ultra-deepwater. Environmental conditions under consideration are individual cases of regular and irregular waves for hurricane conditions. This work shows selected results, from which an assessment can be made for the feasibility of the proposed design of the semisubmersible with the given conditions.

Model tests
Mooring lines
Offshore platforms
Platform motions
Semisubmersibles

2016020414
A study on the supplementary towing system for an FPSO using active thrusters.
http://www.isope.org/publications/publications.htm
You, Y., Hur, J., Jung, J.
English
It is ideal to design the best hull shape of an FPSO which meets all performance criteria on the engineering point of view. But in reality, it is difficult to satisfy all the criteria at the same time. If one of the performances cannot meet the criteria, then additional equipment or system are installd to improve the performance. In this paper, when an FPSO cannot
meet the towing stability inherently, it is tried to determine a supplementary towing system. Usage of three active thrusters is chosen as the auxiliary towing system. The improvement of towing stability is verified from the towing model test conducted at MARIN. However, thruster cavitation is raised as a critical problem when using thrusters for a purpose which it is not intended. Thruster cavitation model test is additionally performed in order to check the safety of all thrusters. Based on the results, safe operation region at the extreme condition is confirmed by observing the occurrence of thruster cavitation. The predicted maximum unit total thrust of each thruster is compared with the observed safe operation range. Finally, the effectiveness and safety of the supplementary towing system is verified.

2016020415

**Determination of roll damping coefficients for an FPSO through model tests and CFD analysis.**


http://www.isope.org/publications/publications.htm

Kwon, C.S., Kim, H.J., Et al

English

The purpose of this study is to provide a simple guideline to estimate the damping coefficient for a box-shaped FPSO under various loading conditions and bilge keel heights through model tests and CFD analysis. A series of free roll decay model tests is carried out under various conditions in draft, metacentric height, radius of gyration and bilge keel height. The corresponding CFD simulations are also carried out to compare with the experimental results.

**Computational fluid dynamics**  
**Damping factor**  
**FPSOs**  
**Model tests**  
**Rolling**

2016020416

**Motion response analysis of multi-point moored FPSO.**


http://www.isope.org/publications/publications.htm

Feng, G-q., Jiang, X-y., Et al

English

Firstly, ANSYS software was adopted in modelling and meshing. Then the characteristics of motion response to regular waves has been analysed in frequency domain by using AQWA-LINE. Considering the coupling effect between FPSO and its mooring lines, time history of mooring line tension in time domain has been attained by utilizing AQWA-DRIFT. Then dichotomy was used to search the secure incident angels of joint wave, wind and current which meet both the tension limitations and the motion limitations. Investigations have been made on the impact that the total length of each mooring line has on the maximum tension of mooring line.

**Coupled motion**  
**FPSOs**  
**Spread mooring systems**  
**Tension**

2016020417

**Gangway motion evaluation of an accommodation vessel operating along a turret moored FPSO.**


http://www.isope.org/publications/publications.htm

Li, B., Huang, W., Et al

English

A monohull accommodation vessel (UMS) is going to be designated to service single point turret moored FPSO. A large offshore gangway is employed to connect the FPSO and the UMS, transferring hundreds of people every day. Two challenging issues are identified at the current stage of the feasibility study. The first issue is to ensure adequate DP capacity of UMS to follow up FPSO response and yaw motion in particular, because of the weather vaning mooring system. The second issue, the main objective of this paper, concerns gangway workability and safety, due to the relative motions of two vessels,
by considering the complexities and uncertainties introduced by hydrodynamic interactions between two bodies. Due to the interaction effect, the motion characteristics like heave and roll of the vessels, especially for UMS of smaller displacement are significantly modified and amplified according to the multi-body hydrodynamic analysis, which is a disadvantageous way for gangway operation. Hydrodynamic interactions associated with the relative position of the vessels and different scenarios, other than parallel side-by-side, were studied and predicted hydrodynamics, motions and gangway responses are reported. The spectra analysis was carried out, according to long term wave scatter diagram. After having checked with various criteria, the results indicate that this operation service is feasible and that adequate up-time is achieved. Furthermore, a 1:50 multi-body hydrodynamic model test was conducted and an excellent agreement has been obtained between experiment and numerical simulation. Both simulation and measurement accurately captured extra peaks in motion RAOs besides natural period of motion itself, which reflect the impact of multi-body interaction.

FPSO
Motion
Multibody systems
Walkways

2016020418

Transient response of a ship to an abrupt flooding accounting for the momentum flux.

Journal of Fluids and Structures, v 57, August 2015, pp 108-126

http://www.sciencedirect.com/science/article/pii/S0889974615001310

Manderbacka, T., Mikkola, T., Et al

English

Numerical non-linear time domain simulation method for damaged ship motions is presented. Floodwater motion modelling is based on the lumped mass method with a moving free surface. The ship and floodwater motions are fully coupled. The variation of the floodwater mass is accounted for. A model to account for the flooding ingress transporting the momentum is presented. The experiments of abrupt flooding have shown that the ship may experience the first large roll towards the undamaged side, especially when a large undivided compartment is flooded. The presented time domain model is validated against the experimental data on the roll damping of the flooded ship and transient flooding. Two different initial stability conditions and two different compartment layouts are studied. Viscous dissipation of the floodwater motions is modelled with an equivalent friction coefficient. The impact of the viscous damping is studied. Transient flooding tests show that the inflow momentum has to be accounted for when the undivided compartment is flooded. The simulation model is capable of capturing the impact of the in-flooding jet and the first roll on the opposite side of the damage is reproduced.

Damage stability
Flooding
Time domain
Transient response

2016020419

Model experiments of the transient response to flooding of the box shaped barge

Journal of Fluids and Structures, v 57, August 2015, pp 127-143


Manderbacka, T., Ruponen, P., Et al

English

Coupling of the flooded water and ship motions was studied experimentally. Roll decay tests for one flooded compartment and transient abrupt flooding tests were performed for the box shaped barge model. The tests were conducted to obtain information on the flooding process for the development of numerical tools and to provide validation data. Quantitative values on the effect of flooded water on the roll damping were obtained. Flooded water behaves in a different manner in undivided and divided compartments. Flooded water in divided compartment increases roll damping significantly. In undivided compartment roll damping was high at low amount of flooded water. For higher amounts damping was of the same order as for the intact model. Initial flooding is a complex process where the ship and flooded water motions are coupled. Propagation of the flooding water inside the compartment, at a dam-break type abrupt flooding, was studied by tracking the surface of the flooded water. An image processing algorithm was used to obtain the tracked surface. Flooded water volume and its centre of gravity were estimated from the tracked surface. Different internal layouts of the flooded compartment can lead to a totally different roll response. The in-flooding jet plays an important role
in the response in case of the undivided compartment. While, for a divided compartment, asymmetric flooding due to the obstructions causes high heel angle on the damage side.

Flooding
Model tests
Ship motions
Sloshing
Transient response

2016020420

Bilge keel loads and hull pressures created by bilge keels fitted to a rotating cylinder.

This paper presents bilge keel loads and hull pressure measurements carried out on a rotating cylinder in a free surface water basin. A flat plate bilge keel and one more complex shaped bilge keel were studied to investigate the geometry effect. The draft of the cylinder was varied to study the effect of the vicinity of the free surface on the bilge keel loads and hull pressures. The rotation axis of the cylinder was fixed to define a pure roll experiment (one degree of freedom). The cylinder was subject to forced oscillations of varying amplitude leading to a KC range of 0.3–16. Using Fourier analysis the first three harmonic coefficients representing the normal bilge keel load were derived. The first harmonic drag and inertia coefficients are in good agreement to existing experimental data obtained for wall bounded flat plates fitted in a U-shaped water tunnel as reported by Sarpkaya and O'Keefe (1996). New insight is gained by the fact that the addition of higher harmonic contributions is essential to capture the time varying bilge keel normal force. The pressure measurements next to the bilge keel are compared to measurements reported by Ikeda et al. (1979). Similar findings are obtained, showing that the pressure on the hull in front of the moving bilge keel is KC independent while the vortex system in the wake of the bilge keel leads to KC dependent hull pressure distributions. The hull pressure jump over the bilge keel correlates well to the force coefficient on the bilge keel. The complex nature of the vortex induced hull pressures is manifested. The empirically derived hull pressure distribution by Ikeda et al. (1979) for the time instant of maximum velocity is shown to correlate reasonably well to the measured data with some conservatism in the absolute value. Although a cylinder is very different from a ship-shaped section, the experiments provide essential insight into the physics associated with roll damping and into the factors that should be included in a roll damping prediction method.

Bilge keels
Drag coefficients
Inertia
Model tests
Pressure measurement

2016020421

Simulation of ship’s non-linear roll motion.

Non-linear roll motion is a crucial factor in endangering ship’s security and a hot issue in ship hydrodynamics study. In this paper, ship roll motion in different regular beam sea waves is simulated. The simulation results show good agreement with the tank test results, and the error is less than 10%. The typical phenomena of nonlinear roll-‘multi-amplitude’ and ‘jumping’ are also realized in the simulation. The simulation results show that CFD method can be an effective tool in studying ship’s non-linear motion.

Computational fluid dynamics
Rolling
Seakeeping

2016020422

Numerical and analytical approaches for roll motion analysis in regular longitudinal waves.

In this study numerical and analytical approaches were investigated in terms of the accuracy of their results, practicality of solution and ability to reproduce the main features of the parametric roll phenomenon such as loss of stability and bifurcations in parametric roll motion analysis of ships. In general, the single-degree-of-freedom analytical approach is based on reducing number of degrees of freedom from 3 to 1 by using the quasi-static Froude-Krylov
assumption, incorporating heave and pitch effects by means of a time varying restoring moment. On the other hand, numerical approaches to motion of six and four degrees of freedom are based on three dimensional diffraction/radiation and potential flow theories. In summary, this paper reveals that analytical approaches are sufficiently adequate to obtain accurate practical results for this relatively complex phenomenon.

Mathematical analysis
Numerical analysis
Rolling

2016020423

Fundamental green water study for head, beam and quartering seas for a simplified FPSO geosim using a mixed experimental and numerical approach.
Marine Systems & Ocean Technology, v 10 n 2, June 2015, pp 71-90
Ruggeri, F., Watai, R.A., Et al
English
The prediction of green water events on FPSOs is very important from both the design and operational point of view, requiring the development of a specific methodology regarding the problem. The computation of the loads on structures located on the main deck in the design stage is important to define reinforcements in the equipment to avoid damages. Besides, the freeboard prediction is important to define the operational windows and limit conditions since the deck activities should be interrupted if there is a risk of overtopping. Since it is unfeasible to perform an extensive experimental campaign regarding all the sea states verified in the operational site, the use of numerical methods is often considered. In order to verify the accuracy of the numerical results, an experimental campaign is performed regarding a simplified FPSO geometry and the results are compared with both BEM and FVM computations to validate the numerical results. This article compares the results regarding the captive model test (i.e., body motions are absent) which will be complemented in a next article regarding the floating body in waves.

Deck wetness
FPSOs
Model tests
Numerical analysis

2016020424

Research on damaged ship motion and wave load in finite water.
Journal of Ship Mechanics, n 4, 2015, pp 381-388
http://cblx.cssrc.com.cn/
Feng, Q-d., Hu, J-j., Et al
Chinese
Accidents causing serious damage to ships, such as stranding, usually happen in shallow seas; it is essential to carry out some research on damaged ship motion and wave loads in finite water aiming at reducing accidents. In this paper, by using the free-surface Green function for finite water depth and 3D source distribution method, the motions and wave loads of a bulk carrier damaged in finite depths and flooded in the bow are studied in the frequency domain. Short-term predictions of wave loads are made according to Lloyd’s Register Rules. Numerical results show that the damaged ship’s vertical and horizontal wave loads increase obviously, and the damage influence is more significant in shallow water.

Damage
Green function
Ship motions
Wave loads on ships

2016020425

Towed system motion transfer calculation.
Journal of Ship Mechanics, n 4, 2015, pp 389-396
http://cblx.cssrc.com.cn/
Wang, Z-b., Hou, D-y.
Chinese
The towed system includes towing ship, cable and towed body. The main disturbances come from the towing ship’s heave and pitch motion induced by sea waves and wind. Sea surface disturbances are transferred along the cable to cause towed body inferior performance. The reduced ship motion mathematical model, cable dynamics model, and towed body motion model are initially integrated as a new disturbance propagation model by connection conditions in this paper. A computer program simulates the surface regular wave disturbance propagation property of two part towed system according to the model. The integral method can be used in the design of a sea towed system.

Deck wetness
FPSOs
Model tests
Numerical analysis

Heaving
Pitching
Towing
2016020426

Motion compensation system for a free floating surface effect ship.
19th IFAC World Congress; 24-29 August 2014; Cape Town, South Africa. Published by International Federation of Automatic Control; ISBN 978-3-902823-62-5. Volume 19, Part 1, pp 8819-8824
http://www.ifac-papersonline.net/Detailed/68047.html
Auestad, Ø.F., Gravdahl, J.T., Et al
English

This paper deals with vertical motion compensation, or motion damping, on a free-floating Surface Effect Ship (SES) at zero speed. The Motion Compensation System (MCS) works by varying the air cushion pressure of a Surface Effect Ship (SES) to minimize vertical motion due to sea waves. A control system is presented which guarantees Global Exponential Stability for the closed-loop state space system and ultimately boundedness for the perturbed system. A study of the performance of the control system is demonstrated through model-test results of a 3 meter long SES.

Control systems
Damping
Ship motions
Surface effect ships

2016020427

Real-time heave motion estimation using adaptive filtering techniques.
19th IFAC World Congress; 24-29 August 2014; Cape Town, South Africa. Published by International Federation of Automatic Control; ISBN 978-3-902823-62-5. Volume 19, Part 1, pp 10119-10125
http://www.ifac-papersonline.net/Detailed/68475.html
Richter, M., Schneider, K., Et al
English

Active heave compensation (AHC) systems require an accurate estimate of the vertical vessel motion in order to decouple the offshore crane lift operation from the motion of the vessel. In this work, the heave motion is estimated based on measurements from an inertial measurement unit (IMU) using an adaptive heave filter whose parameters are adapted online. A standard double integrating heave filter introduces large phase errors resulting in large estimation errors for real-time applications. This work presents three modifications of a standard heave filter in order to reduce those phase errors. The error composition of each proposed filter is analysed. The results are used to derive error functions which are minimized in order to obtain the optimal filter parameters. Furthermore, sea state characteristics, such as the mean heave height and the dominant heave frequency are determined online and utilized for parameter adaptation. The real-time estimation accuracy improves significantly when applying the phase correction algorithms to the filters. This is evaluated using measurement results from the Liebherr AHC test bench.

Heaving
Motion compensators

2016020428

A numerical study of the motion and structural responses of interlinked spars in irregular waves.
Kim, Y.H., Hong, S.Y., Et al
English

A numerical analysis has been made of the motion characteristics and structural responses of interlinked spars of three different arrays in irregular waves. The goal of the study is to clarify the behaviour of the interlinked structure as a new type of platform for offshore wind turbines and to establish its design criteria. The numerical model used herein includes the connectors and taut/catenary mooring lines, but aerodynamics and rotor-dynamics are not considered. Both the connectors and the mooring lines are modelled by elastic beams. The minimum energy principle and Lagrange multiplier method are applied to formulate the governing equation for the dynamics of the connectors and mooring lines. Numerical solutions are obtained by using an in-house finite element method (FEM) code. Meanwhile, hydrodynamic coefficients are calculated by using an in-house code based on the nine-node higher-order boundary element method. The performances of three different arrays of the interlinked spars are evaluated and compared in terms of the motion of the structure and the tensile force and bending moment of the connectors. It is found that the three arrays considered in this work show motion behaviour and structural responses similar to those of a single spar. Therefore, the arrayed structures can be considered positively as a new type of offshore wind farm, because the
Arrays
Motion
Numerical analysis
Offshore structures
Structural response

2016020429
Manoeuvrability of Cb-series full hull ships (1st report tank tests).
Journal of the Japan Society of Naval Architects and Ocean Engineers, v 21, 2015, p 11 [12 p, 11 ref, 8 tab, 18 fig]
https://www.jstage.jst.go.jp/article/jjasnaoe/21/0/21_11/_pdf
Yasukawa, H., Sano, M., Et al
Japanese

Tank tests were conducted to capture the ship manoeuvrability using ship models with three different block coefficients Cb =0.81, 0.84 and 0.87 of the same principal dimension ratio such as L/B and B/d. First, free-running model tests are carried out to capture the manoeuvring motions in a square tank, and next captive model tests are conducted to capture the manoeuvring force characteristics using the same ship models. With increase of Cb, turning advance (AD) and tactical diameter (DT) become small in both full and ballast load conditions, and the values of AD and DT satisfy the IMO regulations with sufficient margin. On the other hand, overshoot angles (OSAs) of 10/10 zig-zag manoeuvres become large and the course stability becomes worse with increase of Cb. The value of 1st OSA for a ship with Cb =0.87 is on the critical line of the IMO regulation. Reason why the course stability becomes worse with increase of Cb is mainly due to increase of the absolute values of N′υ and Y′γ - m′ - m′χ terms. The authors investigate the reason why the absolute value of N′υ typically increases with Cb by CFD computations. With increase of Cb, hull lateral force per unit ship length (ΔY) in oblique towing condition becomes large at fore part and just behind the midship position, but small at stern part. As the result, the hull lateral forces (Y) which is obtained by the integration of ΔY become almost the same for three ships due to the cancellation of plus and minus ΔY at fore and stern parts. On the contrary, the yaw moment (N), which is obtained by the integration of product of ΔY and the longitudinal position χ increases with increase of Cb. This feature comes from the effect of negative pressure on the hull surface at face side of the stern part.

Manoeuvrability
Model tests

2016020430
Modelling mean forces and moments due to waves based on RANS simulations.
http://www.isope.org/publications/publications.htm
Uharek, S., Cura-Hochbaum, A.
English

In order to predict ship manoeuvrability in seaways a mathematical model for approximating the hydrodynamic forces acting on the ship has been extended to take into account mean forces and moments due to waves. RANS computations for a twin screw passenger ship in waves of various lengths coming from all directions have been used to determine the coefficients of the mathematical model. The paper shows that a double parametric approach on wave length and encountering angle is capable of reconstructing the mean forces and moments for all considered situations.

Manoeuvrability
Mathematical models
Wave forces

2016020431
IRF – AR model for short-term prediction of ship motion.
http://www.isope.org/publications/publications.htm
Duan, W-Y., Huang, L-m., Et al
English

Reliable short-term prediction of ship motions improves the safety in ship motion related special operations, where autoregressive (AR) model is extensively used as its advantages like convenient in real-time identification and high adaptive nature.
Order selection is the most critical and difficult part in the identification of AR model. Conventionally, the model order is determined by applying Akaike information criterion (AIC), Bayesian information criterion (BIC) or final prediction error (FPE) criterion, which are rather time consuming and sample frequency sensitive. In this paper, a novel order selection approach is developed based on ship impulse response function (IRF) and the AR model using IRF order selection is designated as IRF-AR model. Simulation results of S175 container ship show the superiority of IRF-AR model to conventional model in forecast accuracy, efficiency and algorithm adaptation.

**2016020432**

**Analysis of the manoeuvring prediction of a submarine by CFD effects of stern appendage configuration.**

**NuTTS ’15, 18th Numerical Towing Tank Symposium; 28-30 September 2015; Cortona, Italy. Organised by INSEAN, Rome, Italy. [6 p, 17 ref, 2 tab, 4 fig]**

**https://www.uni-due.de/imperia/md/content/ist/nutts_18_2015_cortona.pdf**

**Dubbioso, G., Broglia, R., Zaghi, S.**

English

The principal aim of this research is to develop a reliable and practical procedure for the analysis of submarine manoeuvring qualities while operating in different operative scenarios (open water, confined motions, escape or emergency manoeuvres). In the paper, results of the free running, turning circle simulations are presented and discussed. Cross rudder and X-rudder configurations, sailing in open water are investigated. Simulations have been carried out using the CNR-INSEAN in-house finite volume solver, $\chi_{navis}$. The effect of the propeller is modelled by an actuator disk.

**Computational fluid dynamics**

**Hull appendages**

**Manoeuvring**

**Submarines**

**2016020433**

**Numerical simulations of viscous flows around a ship while entering a lock with overset grid technique.**


**http://www.isope.org/publications/publications.htm**

**Meng, Q., Wan, D.**

English

By solving the unsteady RANS (Reynolds Averaged Navier–Stokes) equations in combination with the k-\$e$ SST turbulence model, the unsteady viscous flow around a 12000TEU ship model while entering a lock at different speeds is simulated and the hydrodynamic forces and vertical displacement are predicted and analysed. Overset grid technology is used to maintain grid orthogonality. The effects of the free surface are taken into account. A benchmark test case is designed first to validate the capability of the present methods in the prediction of the viscous flow around the ship when manoeuvring into the lock. Accumulation of water in front of the ship during entry into a lock is noticed, which causes the increase of the velocity of the return flow. A set of systematic computations with different ship speed are then carried out to examine the effects of ship speed on the ship-lock hydrodynamic interaction while entering a lock. At higher ship speeds, more water is pushed into the lock and higher velocity of the return flow is shown. Moreover, there will be higher risk for the bottom of the ship to hit the bed.

**Computational fluid dynamics**

**Locks (waterways)**

**Manoeuvres**

**Viscous flow**

**2016020434**

**Analysis of viscosity on the rolling motion of ship transverse section.**


**http://www.isope.org/publications/publications.htm**

**Luo, T., Wan, D.**

English

Ship rolling is a significant factor of ship design with regards to the ship motions. The majority of current
studies are mainly focused on validating the calculations by combining damping coefficients within variable parameters. The analysis of ship motions in viscous fluid is extremely complex, which requires a large amount of computations. At present, most analyses are based on solving RANS equations, while in this paper, the comparisons between different frequencies, amplitudes, shapes of transverse sections are conducted by the solver naoe-FOAM-SJTU, which is developed based on the open source CFD toolbox OpenFOAM. The paper is aiming at figuring out relations between the damping coefficients and distinct parameters. It is demonstrates that the frequency and the amplitude of a roll motion have considerable impacts on the viscous flow field, and circle bilges are conducive to mitigate vortex shedding. In addition, the influences of these parameters on different components of damping coefficient are different.

Computational fluid dynamics
Rolling
Ship motions
Viscous flow

3.4 FLUID STRUCTURE INTERACTION

2016020435
Ocean Engineering, v 104, 1 August 2015, pp 10-30
Zhao, Y., Chen, H-C.
English

The motion induced 3D sloshing flow in partially filled LNG tank was investigated using a new coupled Level-Set and Volume-of-Fluid (CLSVOF) method incorporated into Finite-Analytic Navier–Stokes (FANS) method. In addition to accurately simulating the sloshing pattern inside LNG tank, impact pressures acting upon tank wall were also predicted by the CLSVOF method. Furthermore, the predicted impact pressures were compared with the corresponding experimental data and another numerical data by the pure level set method with global mass conservation scheme. The comparisons showed the CLSVOF method is capable of predicting the accurate sloshing induced impact and capturing the violent sloshing flow including wave breaking, jet formation, gas entrapping and liquid-gas interactions. The CLSVOF method also demonstrated the prominent feature in local and stable mass conservation.

Computational fluid dynamics
LNG tanks
Impact loads
Sloshing

2016020436
Surface velocity and impact pressure of green water flow on a fixed model structure in a large wave basin.
Ocean Engineering, v 104, 1 August 2015, pp 40-51
Song, Y.K., Chang, K-A., Et al
English

This study investigated green water velocities and impact pressures caused by the impact of overtopping waves on a fixed deck structure in a large-scale, three-dimensional deep-water wave basin. Using the bubble image velocimetry technique, detailed two-dimensional surface flow structures on a horizontal plane, including the temporal and spatial distributions of the maximum horizontal velocities, were successfully obtained. Pressure measurements were also obtained along four different vertical positions at three different locations on the horizontal plane. Based on the mean velocity distributions on the deck surface, the most significant spatial variability of the propagating green water flow is the protruding wave front near the centre of the deck during the early stages of the wave overtopping. The maximum front speed of 1.5C was first observed near the midpoint of the deck along the deck centreline with C being the wave phase speed. The flow velocities decreased to below 1C once the wave front passed the rear edge of the deck. Most of the measured pressures showed impulsive impacts characterized by a sudden rise of the pressure peak. The highest pressure was observed as 1.65ρC^2 at a midpoint and a rear edge of the deck with ρ being the water density. Correlations between wave kinetic energy and dynamic pressure were examined to determine the impact coefficients. The phase speed based impact coefficient was found to vary within a narrow range between 0.29 and 1.69 and a practical value of 1.5 may be used in
applications. It appears that the impact pressures on the structures were strongly affected by the changing front shape of the broken wave and the impulsiveness of the impinging wave that contains a considerable amount of air entrainment.

Deck wetness
Fluid structure interaction
Impact loads
Velocity measurement

2016020437

A combined wave-dam-breaking model for rogue wave overtopping.
Ocean Engineering, v 104, 1 August 2015, pp 77-88
Hu, Z., Xue, H., Et al
English

Although great efforts have been devoted to revealing the formation mechanisms of rogue waves, the study of wave–structure interaction such as the green water phenomenon is still not sufficient. Since the traditional Ritter's solution of dam-breaking model gives improper estimations on the rogue wave overtopping, a combined wave-dam-breaking (CWDB) model is proposed. The CWDB model is deduced from the Ritter's solution, by including the influence of the rogue wave propagation as well as the delayed effect of the dam-breaking problem. Various rogue waves, which are based on the Peregrine breather solution of nonlinear Schrödinger (NLS) equation, are generated in a numerical wave flume. The rogue waves impinge onto a horizontal deck placed at the centre part of the tank, creating green water on the deck surface. The CWDB model is validated by making comparisons with both numerical results and existing experimental measurements. Great improvement can be revealed by contrasting the results of the CWDB model with those of the Ritter's solution.

Breaking waves
Deck wetness
Fluid structure interaction
Freak waves

2016020438

Wave diffraction from a truncated cylinder in front of a vertical wall.
Ocean Engineering, v 104, 1 August 2015, pp 329-343
Zheng, S., Zhang, Y.
English

This paper presents an analytical model to predict the three-dimensional wave diffraction of a floating cylinder located in front of a vertical wall at a finite water depth. The model is potentially used to analyse the hydrodynamic behaviour of a floating wave energy device close to a steep shore. The model is based on a linearized velocity potential theory and the image theory. The wave diffraction problem is transformed into the problem of diffraction of bidirectional incident waves from two cylinders. Expressions for velocity potential are obtained by the method of separation of variables, in which unknown coefficients are determined by using the Eigenfunction expansion matching method. Wave elevations and wave excitation forces are calculated directly from the incident and diffracted potentials. The model is validated by comparison of the present results with the numerical ones, and there is a good agreement. The effect of wave incident angle, distance between a cylinder and a vertical wall, cylinder draft and water depth on wave run-up and wave forces is then explored.

Cylindrical bodies
Potential flow
Wall effects
Wave diffraction
Wave forces

2016020439

Bi-directional fluid–structure interaction for large deformation of layered composite propeller blades.
Journal of Fluids and Structures, v 57, August 2015, pp 32-48
Kumar, J., Wurm, F-H.
English

Bi-directional fluid–structure interaction becomes important when viscous flow changes the geometry of the domain significantly because of the pressure load. Large deformation in domain causes numerical convergence problems, which are solved by mesh
smoothing, re-meshing and a time discrete iterative solver algorithm using industrial computational fluid dynamics and finite element analysis code. In this paper, this approach is used for laminated composite propellers considered as mixers. It experiences heavy thrust, which causes large deformations. Each layer of laminate is modelled as a solid element with anisotropic material data. Comparative study is presented between uni-directional and bi-directional fluid–structure interaction for mixer blades. Change in pressure distribution, stress distribution, thrust, torque and pitch angle of the blade are presented in later parts of the paper.

Composite materials  
Fluid structure interaction  
Propeller blades

2016020440

Treatment of hydroelastic impact of flexible wedges.  
Journal of Fluids and Structures, v 57, August 2015, pp 229-246  
Shams, Z., Porfiri, M.  
English

Understanding the role of structural flexibility on the response of lightweight structures to water impact is pivotal for the design of marine vessels and aircraft. While several modelling schemes have been proposed to study hydroelastic slamming of flexible wedges, most of these studies focus on water entry at a constant speed and assume simply supported boundary conditions for the plates forming the wedge. The authors propose a novel modelling framework for the analysis of two-dimensional hydroelastic slamming of flexible wedges entering the water surface in free fall with arbitrary boundary conditions. Euler–Bernoulli beam theory is used to model the wedge kinematics and Wagner theory is adopted to study the flow physics. A mixed boundary value method is utilized to compute the velocity potential as a function of the structural deformation. A Galerkin formulation is derived by projecting the governing equations on a polynomial set of basis functions, which is constructed using the Gram–Schmidt algorithm. The selection of such a polynomial expansion leads to the closed-form computation of all the salient integrals associated with the hydrodynamic loading. A Newmark-type integration scheme is finally used to solve the coupled equations in time. Results are validated through comparison with available semi-analytical, computational, and experimental findings across a wide range of hydroelasticity factors and boundary conditions. The model can be used to gather important insight on the role of structural flexibility on the hydrodynamic loading experienced by the wedge, along with the resulting keel entry depth and structural deformation.

Fluid structure interaction  
Hydroelasticity  
Slamming  
Water entry  
Wedges

2016020441

Comparison of wave load effects on a TLP wind turbine by using computational fluid dynamics and potential flow theory approaches.  
Applied Ocean Research, v 53, October 2015, pp 142-154  
Nematbakhsh, A., Bachynski, E.E., Et al  
English

The Tension Leg Platform (TLP) is one of the concepts which shows promising results during initial studies to carry floating wind turbines. One of the concerns regarding tension leg platform wind turbines (TLPWTs) is the high natural frequencies of the structure that may be excited by nonlinear wave loads. Since Computational Fluid Dynamics (CFD) models are capable of capturing nonlinear wave loads, they can lead to better insight about this concern. In the current study, a CFD model based on immersed boundary method, in combination with a two-body structural model of TLPWT is developed to study wave induced responses of TLPWT in deep water. The results are compared with the results of a potential flow theory-finite element software, SIMO-RIFLEX (SR). First, the CFD based model is described and the potential flow theory based model is briefly introduced. Then, a grid sensitivity study is performed and free decay tests are simulated to determine the natural frequencies of different motion modes of the TLPWT. The responses of the TLPWT to regular waves are studied, and the effects of wave height are investigated. For the studied wave heights which vary from small to medium amplitude (wave height over wavelength less than 0.071), the results predicted by the CFD based model are generally in good agreement with the potential flow theory based model. The only considerable difference is the TLPWT mean surge motion which is predicted higher by the CFD model, possibly because of considering
the nonlinear effects of the wave loads and applying these loads at the TLPWT instantaneous position in the CFD model. This difference does not considerably affect the important TLPWT design driving parameters such as tendons forces and tower base moment, since it only affects the mean dynamic position of TLPWT. In the current study, the incoming wave frequency is set such that third-harmonic wave frequency coincides with the first tower bending mode frequency. However, for the studied wave conditions a significant excitation of tower natural frequency is not observed. The high stiffness of tendons which results in linear pitch motion of TLPWT hull (less than 0.02 degrees) and tower (less than 0.25 degrees) can explain the limited excitation of the tower first bending mode. The good agreement between CFD and potential flow theory based results for small and medium amplitude waves gives confidence to the proposed CFD based model to be further used for hydrodynamic analysis of floating wind turbines in extreme ocean conditions.

Computational fluid dynamics
Potential flow
Tension leg platforms
Wave loads
Wind turbines

2016020443
The validity of the independence principle applied to the vortex-induced vibration of an in inclined cylinder in steady flow.
Applied Ocean Research, v 53, October 2015, pp 155-160
Zhao, M.

The validity of the independence principle applied to the vortex-induced vibration (VIV) of an inclined cylinder in steady flow is investigated by conducting numerical simulations. In order to create a perfect end-effect-free condition, periodic boundary condition is applied on the two end boundaries that are perpendicular to the cylinder. It is found that the response amplitude and frequency for an inclination angle of $\alpha = 40$ degrees agree well with their counterparts for $\alpha = 0$ degrees. The numerical results demonstrated the validity of the independence principle in the case of vortex-induced vibration, which has not been demonstrated by laboratory tests due to the difficulty in avoiding the end effects.

Cylindrical bodies
Navier Stokes equations
Numerical analysis
Vortex induced vibration

2016020444
Dynamic hydro-elastic response of a ship hull girder subjected to underwater explosion bubbles.
Journal of Ship Mechanics, n 5, 2015, pp 582-591
http://cblx.cssrc.com.cn/
Zhang, N., Zong, Z.

This paper based on the potential flow theory, studied the dynamic hydroelastic whipping response and the resonance effect of a ship hull girder subjected to underwater explosion bubbles. A theory of interaction between gas bubbles and a hull girder is presented. A bubble model with the bubble migration, free surface effect and drag force taken into consideration and an elastic hull girder model are established. Two different examples of real ships are given to demonstrate the effect of rigid-body motion on hull girder hydroelastic responses. Resonance mechanism in the hull girder’s elastic response to underwater bubbles is discussed.

Bubbles
Hull girders
Hydroelasticity
Resonance
Whipping

2016020444
Flow field around outer perforated circular cylinder under regular waves: numerical study.
Marine Systems & Ocean Technology, v 10 n 2, June 2015, pp 91-100
Chandrasekaran, S., Madhavi, N.

Offshore structures are often subjected to critical environmental loads that cause serious damage; MARS TLP in Gulf of Mexico damaged by hurricane Katrina in 2005 is an example. Existence of external perforated cover reduces hydrodynamic forces on the existing members caused by direct wave impact. The quantification of the force reduction in the offshore
structures is reported by many researchers by emphasizing the fact that there is reduction in force on the existing member due to the presence of outer perforated cover. From the existing literature, the annular spacing and the perforation ratio are taken as 0.5 and 11%. Velocity profile in the cylinder and around the perforation is investigated to give a better understanding of the physics for the considered case. Variation of velocity is also studied along the depth of cylinder and also in the perforation zone to get the clear understanding of the physics using the computational fluid dynamics tool STAR-CCM+ for various areas of perforation for different wave steepness (H/L).

2016020446

Experimental investigation on vortex-induced vibration of steel catenary riser.
China Ocean Engineering, v 29 n 5, October 2015, pp 691-704


English

The steel catenary riser (SCR) is the transmission device between the seabed and the floating production facilities. As developments move into deeper water, the fatigue life of the riser can become critical to the whole production system, especially due to the vortex-induced vibration (VIV), which is the key factor to operational longevity. As a result, experimental investigation about VIV of the riser was performed in a large plane pool which is 60 m long, 36 m wide and 6.5 m deep. Experiments were developed to study the influence of current speed and seabed on VIV of SCR. The results show that amplitudes of strain and response frequencies increase with the current speed both in cross-flow (CF) and in-line (IL). When the current speed is high, multi-mode response is observed in the VIV motion. The amplitudes of strain in IL direction are not much smaller than those in CF direction. The seabed has influence on the response frequencies of riser and the positions of damage for riser.

2016020445

Experimental study on response performance of VIV of a flexible riser with helical strakes.
China Ocean Engineering, v 29 n 5, October 2015, pp 673-690

Gao, Y., Fu, S-x., Et al

English

Laboratory tests were conducted on a flexible riser with and without helical strakes. The aim of the work is to further understand the response performance of the vortex induced vibration (VIV) for a riser with helical strakes. The experiment was accomplished in a towing tank and the relative current was simulated by towing a flexible riser in one direction. Based on the modal analysis method, the displacement responses can be obtained by the measured strain. The strakes with different heights are analysed here, and the response parameters like strain response and displacement response are studied. The experimental results show that the in-line (IL) response is as important as the cross-flow (CF) response, however, many industrial analysis methods usually ignore the IL response due to VIV. The results also indicate that the response characteristics of a bare riser can be quite distinct from that of a riser with helical strakes, and the response performance depends on the geometry on the helical strakes closely. The fatigue damage is further discussed and the results show that the fatigue damage in the CF direction is of the same order as that in the IL direction for the bare riser. However, for the riser with helical strakes, the fatigue damage in the CF direction is much smaller than that in the IL direction.

Responses
Risers
Vortex induced vibration
Study on the nonlinear characteristics of vortex induced motion and hydrodynamic performance of deepwater TLP.

Journal of Ship Mechanics, n 4, 2015, pp 369-380

http://cblx.cssrc.com.cn/

Gu, J-y., Tao, Y-w., Et al

Chinese

Vortex-induced motions of platforms are associated with rise and mooring system’s fatigue damage, which also endanger its security and stability. This paper studies the 3D vortex-induced motion and the flow field characteristics of deepwater TLP under different current velocities based on RANS (Reynolds-Averaged Navier-Stokes) solver for N-S equation combing with DES (Detached eddy simulation) turbulence model. Computational grid was set up by GAMBIT software and the code of solving dynamic control equations was embedded to UDF (User Defined Function). The instantaneous drag and lift forces of the columns and pontoons can be solved after the flow field renewal is achieved by dynamic mesh technology. The maximum stream-wise amplitude of TLP increase with the increase of reduced velocity, but it fluctuates on a small scale. The maximum transverse amplitude happen at the reduced velocity of 8.0 from 0 degree current, and the value is 0.38D. The stream-wise equilibrium position of three different flow approach angles increase with the increase of reduced velocity, but the growth rate is different. The growth rate of 22.5 degrees current and 45 degrees current cases is larger than the 0 degree current case. Spectrum energy of lift coefficient is relatively decentralized and the interference between column and pontoon has nonlinear effect. Finally, the pressure coefficient distribution and vorticity iso-surface characteristics of TLP surface are discussed.

Platform motions
Tension leg platforms
Vortices

Research on vibration and underwater radiated noise of ship by propeller excitations.

Journal of Ship Mechanics, n 4, 2015, pp 470-476

http://cblx.cssrc.com.cn/

Fu, J., Wang, Y-s., Et al

Chinese

The finite element method and boundary element method are used to calculate the structure vibration and underwater radiated noise of ship structures caused by propeller excitations. Analyses and comparisons showed that the influence of vibration and underwater radiated noise are caused by three direction forces (shaft, transverse and vertical). The study shows that the vibration response appears line spectrum at axial passing frequency (APF), blade passing frequency (BPF), 2BPF and ship nature frequencies. The underwater radiated noise is the biggest excited by the transverse force, then the vertical force, and lastly the shaft force. The biggest radiated noise power of a ship hull by three forces is mainly excited by transverse force at BPF, and then is excited by shaft force at APF. It is mainly because the BPF of transverse force is approach with ship nature frequency.

Noise
Numerical analysis
Propeller induced vibration
Ship structures

Validation of high fidelity CFD/FE FSI for full-scale high-speed planing hull with composite bottom panels slamming.


Volpi, S., Sadat-Hosseini, H., Et al

English

High fidelity CFD/FE FSI (Computational Fluid Dynamics/Finite Element Fluid-Structure Interaction) code development and validation by full-scale experiments is presented, for the analysis of hydrodynamic and structural slamming responses. A fully instrumented 9m high speed-planing hull with stern drive is used. Starboard and port bottom panels are constructed with different composite materials and fibre orientations, allowing for study of the relation between structural properties and slamming. The code CFDSHIP-Iowa is employed for CFD simulations and the commercial FE code ANSYS is used as structural solver. The hydrodynamic simulations include captive (2DOF without sterndrive) and 6DOF free running conditions for various Froude numbers in calm water and regular waves. Calm water simulations compares well with the experimental data and 1D empirical data provided
by the sterndrive manufacturer for resistance, heave, pitch and roll motions. Numerical one-way coupling FSI is performed in head and following regular waves representative of sea-trial conditions, using FE models for two bottom panels. The resulting strains are compared with experimental data showing a good qualitative and quantitative agreement.

Computational fluid dynamics
Finite element method
Fluid structure interaction
Planing hulls
Slamming

2016020450

Efficient FSI codes coupling with possible large added mass effects: applications to rigid and elongated flexible bodies in the maritime field.
book_COUPLED_15.pdf
Leroyer, A., Yvin, C., Et al

English

Co-simulation, which involves codes coupling, is the most popular technique in an industrial context to deal with multi-physics applications. This is mainly due to its modular nature and the use of specialized solvers which have the ability to integrate the most advanced numerical techniques and physical models in each scientific field. However, in many configurations, the development of coupling algorithms, easy to implement, leading to a stable, accurate and efficient tool is generally not straightforward. For Fluid-Structure Interaction (FSI) configuration involving hydrodynamics, it is well-known that added-mass effect tends to destabilize classical coupling algorithms, such as the Block-Gauss-Seidel algorithm (often denoted by Dirichlet-Neumann decomposition too). Here, some modifications of this algorithm are proposed to reach a weak-intrusive stable coupling method for rigid and elongated beam-like bodies. Efficiency is discussed and some applications are shown to demonstrate the capabilities of such a coupling.

Added mass
Computational fluid dynamics
Fluid structure interaction

2016020451

Higher-order FEM for nonlinear hydroelastic analysis of a floating elastic strip in shallow-water conditions.
book_COUPLED_15.pdf
Karperaki, A.E., Belibassakis, K.A., Et al

English

The hydroelastic response of a thin, nonlinear, elastic strip floating in shallow-water environment is studied by means of a special higher order finite element scheme. Considering non-negligible stress variation in lateral direction, the nonlinear beam model, developed by Gao, is used for the simulation of large flexural displacement. Full hydroelastic coupling between the floating strip and incident waves is assumed. The derived set of equations is intended to serve as a simplified model for tsunami impact on Very Large Floating Structures (VLFS) or ice floes. The proposed finite element method incorporates Hermite polynomials of fifth degree for the approximation of the beam deflection/upper surface elevation in the hydroelastic coupling region and 5-node Lagrange finite elements for the simulation of the velocity potential in the water region. The resulting second order ordinary differential equation system is converted into a first order one and integrated with respect to time with the Crank-Nicolson method. Two distinct cases of long wave forcing, namely an elevation pulse and an N-wave pulse, are considered. Comparisons against the respective results of the standard, linear Euler-Bernoulli floating beam model are performed and the effect of large displacement in the beam response is studied.

Finite element method
Hydroelasticity
Shallow water
Towards large-eddy simulation of complex flows in maritime applications.

**ECFD VI, 6th European Conference on Computational Fluid Dynamics; 20-25 July 2015; Barcelona, Spain. Proceedings. Published by CIMNE, Barcelona, Spain. P 4700 [12 p, 16 ref, 1 tab, 8 fig]**

Bandringa, H.J., Verstappen, R.W.C.P., Et al

Flows around bluff bodies, a circular cylinder for instance, are difficult to simulate accurately with a RANS method. To improve this type of simulation, LES models are considered in this paper. The idea behind these models is to minimize the subgrid dissipation. The models are based on the invariants of the rate of strain tensor. Also the governing equations are discretized such that less artificial dissipation is added. To proposed LES models are compared to an ILES model. The ILES model introduces artificial dissipation originating from the discretization of the governing equations. The comparison is performed using MARIN's in-house CFD solver ReFRESCO. A flow around a circular cylinder with Re = 3; 900 is considered here to evaluate the LES models. The (I)LES models clearly perform better than no model. The differences between the turbulence models, however, were small.

Computational fluid dynamics
Cylindrical bodies
Turbulent flow

Lift of a rotating circular cylinder in unsteady flows.

**Journal of Ocean and Wind Energy, v 1 n 1, February 2014, p 41 [9 p, 13 ref, 2 tab, 14 fig]**

Carstensen, S., Mandviwalla, X., Et al

A cylinder rotating in steady current experiences a lift known as the Magnus effect. In this study, the effect of waves on the Magnus effect has been investigated. This situation is experienced with the novel, floating offshore vertical axis wind turbine concept called the DEEPWIND concept, which incorporates a rotating spar buoy and thereby utilizes seawater as a roller bearing. The a priori assumption and the results suggest that the lift in waves, to a first approximation, may be represented by a formulation similar to the well-known Morison formulation. The force coefficients are experimentally found to depend primarily on the ratio between the surface speed of the cylinder and the outer flow velocity.

Cylindrical bodies
Lift
Magnus effect
Unsteady flow

Simulation of fluid-structure-interaction on tidal current turbines based on coupled multibody and CFD methods.

**Journal of Ocean and Wind Energy, v 1 n 2, May 2014, p 119 [8 p, 20 ref, 7 tab, 12 fig]**

Arnold, M., Cheng, P.W., Biskup, F.

In this paper, a method for simulation of fluid-structure-interaction on tidal current turbines is shown. This method is based on coupled multibody and CFD methods, leading to a code that will be able to simulate the FSI on a full tidal current turbine in an
adequate timescale. Besides the method and its implementation, a basic verification case is defined and compared to reference results.

Computational fluid dynamics
Fluid structure interaction
Tidal currents
Turbines

2016020456

Effect of sacrificial anodes and marine growths on hydrodynamic coefficients of rigid cylinders.
Kurian, V.J., Al-Yacouby, A.M., Et al
English

Estimation of accurate hydrodynamic coefficients for tubular cylinders fitted with anodes and wrapped with marine growth is a complex task. The interaction of fluid with sacrificial anodes and marine growth surface is not fully understood. The objective of this study is to determine the effect of sacrificial anodes and marine growth on hydrodynamic coefficients of rigid cylinders experimentally. In this study tubular cylinders with outer diameter Do = 42mm were tested in the wave tank. The total hydrodynamic forces and the corresponding drag and inertia coefficients were analysed at different Keulegan Carpenter (KC) numbers. In this experimental investigation, a scale factor λ of 1:55 was adopted and all the parameters are analysed and presented in terms of scaled up prototype values in accordance with Froude scaling law. The test results suggest that the cylinder fitted with sacrificial anodes and the one wrapped with rough surface have shown an overall increase in drag and inertia coefficients.

Cylindrical bodies
Drag coefficients
Fouling
Hydrodynamic coefficients
Sacrificial anodes

2016020457

Characteristics of bow-flare slamming loads on an ultra-large containership in irregular waves.
Hong, S.Y., Kim, K.-H., Et al
English

Bow-flare slamming has been attracting major ship classification societies because it causes local damage and severe whipping vibration that affect the ultimate strength and fatigue life of ships. In this study, a series of experimental investigations has been made on bow flare slamming loads under irregular wave conditions, which was a part of WILS JIP-III (Wave Induced Load on Ships Joint Industry Project-III). A 10,000 TEU containership model with six segments was used and a number of load cells were distributed on the bow-flare and deck areas in order to capture temporal and spatial distributions of slamming load. Based on the measured data, characteristics of the bow-flare slamming loads in irregular waves are presented and discussed.

Containerships
Impact loads
Irregular waves
Model tests
Slamming

3.5 AERODYNAMICS AND WIND ENGINEERING

2016020458

Numerical analysis of wind load on rectangular block cut into different shapes.
Yang, L., Zhang, D., Cui, J.
English

Wind flow around bluff body is very complicated. It is considered to be one of the world's most difficult fluid dynamic contents. In this paper a numerical simulation of wind flow around three different shapes of bluff body structures is presented. The famous
RNG k-ε turbulence model is employed in this simulation. By this simulation the authors obtained wind flow structure, drag coefficients and pressure distribution of the flow around these structures. This numerical simulation laid foundation for the research of wind flow around container ships.

2016020459

Experimental investigation of aerodynamic characteristics of the above-water parts of offshore platforms.
http://www.isope.org/publications/publications.htm
Solovyev, S.Y., Sokolov, V.V.
English

There is a wide variety of marine platforms intended to solve different problems and to operate in different areas. Wind tunnel studies at early stages of marine platform design allow significant reduction of adverse wind effects during installation and operation of the platform. This paper contains a brief description of the main types of experimental studies in the wind tunnel and some of the results of these studies.

2016020460

Experimental investigation of air flow over helicopter platform of a polar icebreaker.
OCEANS '15 MTS/IEEE Genova; 18-21 May 2015; Genova, Italy. Published by IEEE [8 p]
Rahimpour, M., Oshkai, P.
English

The air wake over the helicopter platform of a Canadian Coast Guard (CCG) polar icebreaker was studied experimentally. By application of high speed particle image velocimetry (PIV) on a 1:522 scaled model of the polar icebreaker, quantitative flow filed data were obtained in several vertical and horizontal planes. Present investigation was conducted with two types of the inflow conditions: (i) a uniform flow and (ii) a simulated atmospheric boundary layer (ABL). The incidence angle (α) varied between 0° to 330° with the increment of 30°. The unsteadiness of the flow was demonstrated by calculation of standard deviation of vertical airflow velocity (σ) over the helicopter platform, which directly influences the pilot workload. It was observed that, despite having relatively the same trend in different angels of incidence, the maximum value of σ is generally higher in the case of simulated ABL. It could be attributed to higher velocity gradients in oncoming flow associated with the simulated ABL inflow condition. Additionally this investigation showed that, in both inflow conditions, incidence angles of 0° and 300° were associated with the highest values for σ.

2016020461

Design and performance evaluation of superstructure modification for air drag reduction of a container ship.
http://www.isope.org/publications/publications.htm
Kim, Y., Kim, K-S., Et al
English

Reduction of the fuel oil consumption and corresponding greenhouse gas exhaust from ships is an important issue for today’s ship design and shipping. Several design concepts and devices on the superstructure of a container ship were suggested and tested in a wind tunnel to estimate the air drag reduction. As a preliminary performance evaluation, air drag contributions of each part of the superstructure and containers were estimated based on RANS simulations respectively. Air drag reduction efficiency of shape modification and add-on devices on the superstructure and containers was also estimated. Gap-protectors between container stacks and a visor in front of upper deck were found to be most effective for drag reduction. Wind tunnel tests had been carried out to confirm the drag
reduction performance between the base (without any modification) configuration and two modified superstructure configurations which were designed and chosen based on the computation results. The test results with the modified configurations show considerable aerodynamic drag reduction; especially the gap-protectors between containers show the largest reduction for the wide range of heading angles. RANS computations for three configurations were performed and compared with the wind tunnel tests. Computation results show the similar drag reduction trend with experiments for small heading angles.

3.6 FUNDAMENTAL FLUID MECHANICS

2016020462
Large-scale free surface measurement for the analysis of ship waves in a towing tank.
Experiments in Fluids, v 56 n 10, October 2015
Gomit, G., Chatellier, L., Et al
English
This paper presents an optical method for free surface measurement of a stationary flow suitable for large-scale experiments in a large towing tank. The new measurement device is based on the projection of laser beams on the surface of the fluid and on the use of a stereoscopic system. The principle of the method is to detect the impact of the laser beams on the air/water interface in order to determine the height of the surface by triangulation for a given number of positions. This method is applied to the measurement of the stationary wave field around a ship model at 1/10th scale. The paper also emphasizes that for low Froude numbers, \((F = U/\sqrt{gL})\), where \(U\) is the ship velocity and \(L\) the ship length, the effects of the scale on the flow characteristics are limited. These scale effects are studied by comparison with measurements taken in a smaller towing tank around the same ship model at scale 1/77.5. The free surface and the velocity field near the hull at the two scales are compared.

Free surfaces
Measurement
Ship waves
Towing tanks

4.1 STRUCTURAL RESPONSE

2016020463
A study on statistical analysis of local ice loads measured during the Arctic voyage of the IVRV ARAON.
Journal of Advanced Research in Ocean Engineering, v 1 n 3, p 186
http://www.jaroe.org/sub/issues/issues.html?icode=2
Kwon, Y.H., Lee, T-K., Choi, K.
English
In summer 2010, field measurements of local ice loads were carried out in the Arctic Ocean using the Korean first icebreaking research vessel, ARAON. In some previous studies by the authors, several investigations for the data measured at 2010 including the relationship between the measuring points and ice loads, the possibility for observation of higher ice load and the relationship between the ship speed and ice loads were reported. During 10 days in August 2013, new field measurements were performed in similar waters of the Arctic Ocean using the same vessel, ARAON. The aim of this study is to investigate the statistical properties of 2013 measurements and compare results by two periods.

Ice loads
Icebreakers
Measurement
Statistical analysis
Stresses
Spectral fatigue analysis for the topside structure of offshore floating vessel.
http://www.isope.org/publications/publications.htm
Kim, D.H., Ahn, J-W., Et al
English
In this study, spectral fatigue analysis was performed for the topside structure of an offshore floating vessel. The topside structure was idealized using beam elements in SACS program. The fatigue analysis was carried out considering wave and wind loads separately. For wave induced fatigue damage calculation, motion RAOS calculated from direct wave load analysis and regular waves with different period and unit wave height were utilized. And then the transfer functions of member end force were generated covering all loading conditions. Stress response transfer functions at each joint were produced using the specified SCFs and the transfer functions of member end force. Fatigue damages were calculated using the obtained stress ranges, S-N curve, wave spectrum, heading probability of each loading condition and their corresponding occurrences of the wave scatter diagrams. For wind induced fatigue damage calculation, the dynamic wind spectral fatigue analysis was performed. Firstly, dynamic natural frequency analysis was carried out to generate structural dynamic characteristics including eigenvalues (natural frequencies), eigenvectors (mode shapes) and mass matrix. To adequately represent the dynamic characteristic of the structure, the number of modes was determined appropriately in the lateral direction. Secondly, the wind spectral fatigue analysis was performed using the mode shapes and mass data obtained from the previous results. In this analysis, the Weibull distribution of wind speed occurrence, the probability of occurrence in each direction, damping coefficient, S-N curves and SCF of each joint are defined and used. Especially wind fatigue damages were calculated under the assumption that stress ranges follow Rayleigh distribution. Total fatigue damages considering wave and wind were calculated from the combination with both according to DNV rules.

Fatigue (materials)
FPSOs
Spectrum analysis

Security assessment of soft yoke moored FPSO for the hinge point problems.
http://www.isope.org/publications/publications.htm
Wang, Y., Fan, Z., Et al
English
Single point mooring systems are widely used. A soft yoke mooring system (SYM), one kind of the best single point mooring systems, is applied to moor FPSOs in shallow water in Bohai Bay, China. The SYM has 13 hinge points, which could be relieved by 3 freedoms in wave frequency motion (roll, pitch and heave), but only be restricted in low frequency motion (surge, sway and yaw) so that the tank could fix a position in a certain area. Due to the reasons of long-term use, improper maintenance and harsh ocean environmental conditions, the hinge points will have some problems, such as rust, which may cause damage of the yoke and other dangerous events even dragging down the tower platform. Thus the problems of the hinge points need to be addressed. In this paper, an integrity assessment method of SYM for hinge point problems is proposed based on field monitoring technology. The internal structure of the hinge point is analysed and the main failure modes of the hinge point are discussed. Based on the analyses, the field monitoring method for hinge point problems was given. Through the monitoring information, the integrity assessment of the SYM was given.

FPSOs
Hinges
Mooring systems
Structural monitoring

A new ice load-response model for structural design of ice classed ships.
http://www.isope.org/publications/publications.htm
Zhu, L., Shi, S., Xu, T.X.
English
Intensive research has been focused on the structural response under ice loads but repeated loads are not
included. The ice impact problem is a dynamic process under repeated loads in reality. In this paper, a new ice load-response model for repeated impacts of ice loads is presented to study the structural response of ice ship plates. The analytical solutions obtained are validated by comparing against the experimental data and numerical analysis. The approach demonstrates the capability of simplified analytical methods for the repeated impact problems and their potential use for ice Rules. An illustrative example is given to determine plate thickness using generated design curves. Simple formulae of design plate thickness under two different design requirements are proposed to provide useful information for structural design of ice-classed ships subjected to repeated impact from drifting ice.

Ice loads
Ice transiting vessels
Impact loads
Structural response

2016020467

A procedure to predict fatigue crack growth of ship structures under complex loading condition. Journal of Ship Mechanics, n 5, 2015, pp 541-552
http://cblx.cssrc.com.cn/
Zhang, D., Huang, X-p., Cui, W-c.
Chinese

Storm model proposed by Tomita et al is a simplified random loading model for fatigue strength assessment of ship structures. The time dependent random wave loading can be expressed by the storm model. The basic characteristics of storm model and short-term distribution situation of wave-induced stress are described. Storm model is combined with a unique crack growth rate curve and SIF calculation equations for surface crack in the weld toe, and the procedure to predict the fatigue crack growth behaviour of ship structures under complex loading conditions is discussed. Weight function is used to calculate SIF of surface crack under given residual stress distribution. Fatigue crack growth behaviour of surface crack at weld toe of butt welded joint in ship hull under storm wave loading condition is predicted. The results show that the size and order of storms, the initial size of crack and residual stress have significant effect on crack growth behaviour. Reasonable storm model parameters and initial crack size are very important for fatigue life prediction of ship structures.

Crack propagation
Fatigue cracks
Ship structures
Storm waves

2016020468

http://cblx.cssrc.com.cn/
Liu, K., Wang, Z-l., Et al
Chinese

Due to the complexity of ship collision, the analysis procedures are divided in to two parts: the external mechanics and internal mechanics. This paper successfully resolved the way of fluid-structure coupling and the ship-ship coupling based on the full-coupling technology. In collision simulation, ship structures around strike position were modelled as deformable using Lagrange finite element meshes. According to the FEM analysis, the movement of ships, damage behaviour and collision force as well as energy absorption were investigated. With many kinds of collision cases research, a curve of ultimate collision velocity was obtained. All of above can also provide technical supports for the future ship collision research.

Ship collisions
Structural analysis

2016020469

http://cblx.cssrc.com.cn/
Zhang, J-p., Geng, B-y., Et al
Chinese

This paper presents the study on the ultimate strength for river-to-sea ship. According to similarity principle, an experimental model was designed, the corresponding experiment was carried out and the load-deflection curve was obtained, the experimental results are of important reference value in the research of ultimate strength. Nonlinear FEM method (ABAQUS) and the collapse method (Mars2000) are adopted to Numerical Simulation analysis, compared with the trail results; the reasonability of the software
was proved. The software of ABAQUS was used to study the precision of the ultimate strength calculation and the general law of the ultimate strength, which will provide reference for structure’s optimal design of the ship.

Collapse
Finite element method
Oceangoing river vessels
Ultimate strength

2016020470
Residual hull girder ultimate strength of a double hull oil tanker.
Andrić, J., Kitarović, S., Pirić, K.
English

Within the scope of the presented work a hull girder ultimate strength analyses of the double hull oil tanker structures damaged by the collision or grounding is performed. An incremental-iterative progressive collapse analysis method prescribed by the forthcoming IACS Harmonized Common Structural Rules (H-CSR) is used for determination of the ultimate vertical bending moment and collapse sequence of the considered structures. Three characteristic variants of the oil tanker main frame cross sections of a different geometry and size (Aframax, Suezmax and VLCC) are considered. The position of a ship’s side and/or bottom damage is defined in accordance with the IACS H-CSR. Proposed analytical formulations of the relationship between reduction of the hull girder ultimate vertical bending moment (with respect to the undamaged state) and damage size are based on the results of a systematic variation of a ship’s side or bottom damage size. Finally, comparison of the collapse sequences determined for the undamaged and damaged state in upright position (defined by IACS H-CSR) of the considered structure of the Aframax ship example is performed.

Double hulls
Hull damage
Tankers
Ultimate strength

2016020471
Generation and application of a standardized load-time history to tubular T-joints in offshore platforms.
Li, S-s., Cui, W-c.
English

Marine structures are mostly made of metals and always experience complex random loading during their service periods. The fatigue crack growth behaviors of metal materials have been proved from laboratory tests to be sensitive to the loading sequence encountered. In order to take account of the loading sequence effect, fatigue life prediction should be based on fatigue crack propagation (FCP) theory rather than the currently used cumulative fatigue damage (CFD) theory. A unified fatigue life prediction (UFLP) method for marine structures has been proposed by the authors’ group. In order to apply the UFLP method for newly designed structures, authorities such as the classification societies should provide a standardized load-time history (SLH) such as the TWIST and FALSTAFF sequences for transport and fighter aircraft. This paper mainly aims at proposing a procedure to generate the SLHs for marine structures based on a short-term loading sample and to provide an illustration on how to use the presented SLH to a typical tubular T-joint in an offshore platform based on the UFLP method.

Crack propagation
Fatigue life
Loads (forces)
Offshore platforms
Tubular joints

2016020472
Fatigue strength evaluation taking the effect of the whipping stress into account.
Journal of the Japan Society of Naval Architects and Ocean Engineers, v 21, 2015, p 23 [8 p, 17 ref, 1 tab, 7 fig]
https://www.jstage.jst.go.jp/article/jiasnaoe/21/0/21_23/pdf
Oka, M., Niwa, T., Takagi, K.
Japanese

Hull girder stresses caused by whipping vibration increases as ship size becomes bigger, and it is therefore a concern that the design fatigue life of such
large ship might be conservative. In order to clarify the effects of superposed elastic vibrations on linear wave loads in the fatigue life estimation, using created time history of stress, numerical simulations for fatigue strength of a post-panamax container ship has been conducted. Random stress time history is created using a storm-model, and a high frequency stress model is proposed to estimate effects of the whipping vibration. Two kinds of evaluation methods are adopted. One is fatigue crack propagation analysis using fracture mechanics taking account of the nonlinear retardation phenomena. The other is fatigue damage factor based on Miner's Law. Results of the fatigue strength analysis in a period of the maximum storm condition for a ship's life in the North Atlantic show that the fatigue crack length obtained by the fatigue crack propagation analysis has a similar trend as the damage factor by Miner’s Law. With regard to the effect on the fatigue strength of the whipping, different treatments of high frequency stress to extract low frequency time history give different results. If the low frequency time-history (LF) is adopted, the difference is remarkable, the fatigue damage of RAW become approximately 50%-100% greater than LF. If the envelope time-history is adopted, the difference is relatively small, e.g. 0.1-2.0%.

Fatigue life
Fatigue strength
Hull stress
Whipping

2016020473

Service life assessment of fatigue crack growth for offshore jacket platform.
http://www.isope.org/publications/publications.htm
Zhao, S., Chen, C., Shen, Y.
English

A new approach is introduced in this paper for assessing fatigue crack growth. Critical crack size is calculated based on the stresses data extracted from SACS using Paris law under 8 types of random wave load. Failure Assessment Diagram is used to assess the acceptability of crack growth during each step. The complete process of calculation is compacted into software (JPEFA). A certain case has been performed to prove that the method is valid and effective. Finally a detailed analysis on the sensitivity of several important factors is performed.

Crack propagation
Fatigue cracks
Jacket structures
Life (durability)
Offshore platforms

2016020474

Natural vibration analysis of stiffened panels with arbitrary edge constraints using the assumed mode method.
http://pim.sagepub.com/content/229/4/340.abstract
Cho, D., Vladimir, N., Choi, T.
English

Natural vibration analysis of stiffened panels represents an important issue in different kinds of engineering applications. In this article, a procedure for the vibration analysis of stiffened panels with arbitrary edge constraints is presented. It is based on the assumed mode method, where natural frequencies and modes are determined by solving an eigenvalue problem of a multi-degree-of-freedom system matrix equation derived by using Lagrange’s equations of motion. The Mindlin thick plate theory is applied for a plate, while the effect of stiffeners having the properties of Timoshenko beams is accounted for by adding their strain and kinetic energies to the corresponding plate energies. The accuracy of the proposed procedure is justified by several numerical examples which include the natural vibration analysis of stiffened panels with different framing sizes, their lengths and orientations, plate thicknesses and different combinations of boundary conditions. A comparison of results with those obtained by the finite element method is provided, and good agreement is achieved.

Stiffened plates
Vibration analysis
Collision analysis of a cylindrical offshore structure with fluid region due to impact.


http://www.isope.org/publications/publications.htm

Lee, K., Hong, K.

English

The main object of this research is to establish the impact simulation techniques for offshore structures. The collision between ship and offshore structure is generally a complex problem and it is often impractical to perform rigorous finite element analyses to include all effects and sequences during the collision. This paper is focused on the structural behaviors of fixed cylindrical type offshore substructure with fluid part. A significant part of the collision energy is dissipated in terms of strain energy and the contribution from the elastic strain can normally be neglected. On applying the impact force of a service boat to the cylindrical structure, the maximum acceleration, internal energy, and plastic strain are calculated for each load cases using LS-Dyna finite element software. The fluid-structure interaction analysis was performed using ALE (Accidental Limit State) method which is possible to apply fluid region on the impact problem. A parametric study is carried out by changing design variables of the velocity of service boat and the thickness of the cylindrical structure considering fluid part. It is concluded that this paper provides designing process used for the rubber fender considering service boat impact.

Collision simulation
Impact loads
Offshore structures

An analytical method on the elastic-plastic response of clamped stiffened plates subjected to blast loads.


http://www.isope.org/publications/publications.htm

Zheng, C., Kong, X-s., Et al

English

The stiffened plate is the most fundamental structure which is widely used in the marine industry such as in ship hulls or offshore topside structures. It is of great importance to study the dynamic response of stiffened plates subjected to explosion loading. In this paper, theoretical analysis is conducted to investigate the dynamic response of fully clamped stiffened plates under blast loads. On the basis of the large deflection theory of plate and the energy conservation theory, the elastic-plastic analytical method for predicting the response of stiffened plates to explosion loading is developed, in which the effect of elastic deformation of plates is considered. In the paper, dynamic loads of the initial shock wave and quasi-static pressure generated by an inner explosion are substituted by three different kinds of equivalent load respectively. The elastic-plastic analytical method and nonlinear finite element method are used to analyse the dynamic response of six stiffened plates under explosion loading. Compared with the existing experimental data, the results of the elastic-plastic analytical approach proposed in this paper agree well with the experimental and the numerical results. It is concluded that the approach proposed in this paper can provide adequate predictions of the dynamic deformation behaviour of blast loaded stiffened plates.

Dynamic response
Elastoplasticity
Explosions
Stiffened plates
**2016020477**

**Ultimate shear strength of FPSO stiffened panels after supply vessel collision.**


[Santos Rizzo, N.A. dos, Caire, M., Bardanachvilli, C.A.](http://www.isope.org/publications/publications.htm)

**English**

The accidental frontal collision of a supply vessel with a FPSO can lead to significant plastic deformation. This damage may have an important influence on the ultimate shear strength of the platform stiffened side panels and should be carefully assessed. In order to investigate its effect, a nonlinear quasi-static finite element model is presented and implemented using ABAQUS. Geometric imperfections are introduced by considering the first buckling mode shape of the panel and a displacement loading control is then imposed to the bulb in order to evaluate the plastic deformation and springback effect. In the final analysis step the ultimate shear strength is assessed considering the geometric imperfection and the residual stresses from collision. For the case study, a parametric variation is carried out to investigate the influence of bulb displacement, initial imperfection amplitudes and plate thickness.

Collision resistance
Shear strength
Stiffened plates
Ultimate strength

**2016020478**

**Design and simulation of ship protection structure.**


[Zhao, X., Gan, L., Et al](http://www.isope.org/publications/publications.htm)

**English**

Ship collisions are catastrophic accidents, and may cause structural damage to the colliding ships. Vessels might be sunk and accidents may cause cargo leakage and generate pollution. A vertical collision from the rigid bulbous bow to the amidships is the worst situation in ship-ship collision. Thus it is necessary to improve the ship crashworthiness by improving the energy absorption capacity of the side structure, such as filling sandwiches (honeycomb sandwich plate, tube-style sandwich panels, folding sandwich plate etc.) in single-hull ships. The aim of this study is to investigate the crashworthiness of a ship with laminated honeycomb sandwich panels under lateral dynamic loads through a simulation with the finite element program MSC/Dytran. The damage deformation, the crushing load as well as the energy absorption of improved side laminated sandwich ships will be compared with the typical non-laminated sandwich ship through numerical simulations. These simulations verified that the side filling sandwich structure can effectively improve the ship crashworthiness performance while providing information to optimise the structure of the sandwich. Side filling interlayers increase the crashworthiness of a ship broadsides but also increase the mass of the ship. So it is necessary to design optimally the ship's side crashworthiness and ship’s mass. Calculation of an optimal model based on the three kinds of different structural designs for sandwich layers can ensure the effective crashworthiness of the ship side structure while not adding much weight to the ship.

Collision resistance
Sandwich panels
Ship collisions

**2016020479**

**Application of finite element simulation to damage on ship structures during ship collisions.**


[Li, H., Gan, L., Et al](http://www.isope.org/publications/publications.htm)

**English**

To reduce the structural damage from ship collisions and improve the energy absorption capacity of ships, a ship-ship collision model was established to simulate the process of collision. The initial kinetic energy of collision ship transforms into plastic deformation energy absorption, the remaining kinetic energy and the energy absorption of a fluid medium of a collided ship take up a negligible proportion so it can be disregarded. Based on the law of conservation of energy and using the collision of ship’s bow and another ship’s side as an example, the effects of collisions at different speeds including 10kts and 15kts at the same angles 45°, 60° and 90°, respectively and from different angles at the same speed on the
structural damage of ship collision areas are discussed. In addition, an appropriate collision state is defined so as to be beneficial for navigators who must reduce the losses from collision in cases of inevitable collision by steering based on simulations and display of the nonlinear dynamic responses using the finite element analysis program DYTRAN. When structural damage of the bow is small, the structural damage of the side is very big; the bow is regarded as a rigid body and the side is regarded as a deformation body. Simulation results indicate that the speed and angle have an effect on the energy absorption of a ship; different speeds and angles can lead to different degrees of structural damage. This research provides an empirical foundation for the control of speed and angle and also provides a reference for maritime collision investigations.

Damage
Energy absorption
Finite element method
Ship collisions

FE simulation of the resistance effect of ship side structures during collision collisions.
http://www.isope.org/publications/publications.htm
Deng, L., Gan, L., Et al
English

According to the European Maritime Safety Agency statistics, ship collision accounted for forty percent of total water accidents in the scope of their jurisdiction. However, human factors play a key role in the happening of about eighty percent accidents. Therefore we must strengthen safety consciousness and improve the mariner ability. It is also essential that we strengthen ship maintenance practices, and strictly follow a standard system for ship inspections. Some reasonable and effective measures must be taken when a potential danger is found. Reporting to the captain in time also is necessary. When a collision accident is inevitable, amidships is a dangerous place. Therefore ship's office as well as ship's engine room must be located as far as possible from amidships to avoid crashes. But due to lack of accurate analysis, the ship's office may lapse in judgment and cause a greater damage. Therefore, the paper departs from the perspective of the ship's structure and instead become vulnerable parts of the ship when adding a cross-shaped reinforcement according to a simulation study of inevitable ship collisions by applying the nonlinear finite element Program MSC.Patran/Dytran. The authors simulate the collision of two ships at different angles, velocities and collision points, and then study the damage of the ship's side during the collision and mechanical deformation of the structure of energy absorption mechanism via combining the basic principles of ship collision dynamics and plasticity kinetics. A comparative analysis of the hull's damage deformation in a variety of conditions, allows a relatively clear understanding of the ship's side energy absorption and the structural response under different collision factors.

Finite element method
Collision resistance
Ship sides

Numerical simulation and trail validation of the shock response of hull piping system under impact load.
http://www.isope.org/publications/publications.htm
Yu, F., Ding, J., Et al
English

In order to simulate the transient response of hull piping systems subjected to impact loads, a numerical model of ship diesel engine sea water cooling pipe system was established with the explicit finite element code ABAQUS. The reasonability of a finite element simulation method of pipes response under impact load was validated by pipe impact trials. Finally, the variation of pipes response induced by different support elasticity was investigated.

Finite element method
Impact tests
Piping systems
Shock
2016020482

The effect of symmetrical and asymmetrical shape in buckling strength on fixed offshore platform.


http://www.isope.org/publications/publications.htm

Alie, M.Z.M., Daud, S., Et al

English

This paper discusses the configuration effect of the symmetrical and asymmetrical shape tubular member in buckling strength on a fixed offshore platform. Two kinds of offshore structures are taken to be considered in the analysis. The axial and lateral loads are imposed to jacket legs and others structural components. The material and dimensions are assumed to be constant and homogenous. The boundary conditions are idealized to be fixed at bottom level. To assess buckling strength, the Finite Element Method (FEM) is used. As a fundamental case, buckling strength is performed by considering two dimensional planes into consideration (2D). In this case, the critical buckling load and stress-strain curve is achieved. The result obtained by FE Analysis is compared with the analytical solution.

Buckling
Finite element method
Jacket structures
Offshore platforms
Strength

2016020483

Structural damage alarming of offshore platform based on AR model and PCA in changing environment conditions.


http://www.isope.org/publications/publications.htm

Diao, Y., Cao, Y., Hua, P.

English

It is well known that the results of vibration based damage detection method do not depend only on damage but also on environmental conditions (temperature, humidity, mass loading, running speed). In this paper, a new damage alarming method in changing environmental conditions is proposed. Firstly, the autoregressive (AR) model is used to fit the structural acceleration response pre and post damage. Secondly, the principal component analysis (PCA) is employed to remove the influences of environmental conditions on the coefficients of AR model. Mahalanobis norm calculated from the AR coefficients is used as the damage-sensitive novelty index. Finally, the statistical control chart is used to alarm damage. A numerical model of a four floor steel offshore platform excited with white noise is used to test the method, the results show that the proposed method can accomplish the damage alarming in changing environmental conditions.

Damage
Detection
Environmental conditions
Offshore platforms
Structural response

4.2 PROPERTIES OF MATERIALS

2016020484

A data management system for material assessment at low temperature.


http://www.isope.org/publications/publications.htm

Kane, A., Osen, V., Et al

English

A data management system for material assessment at low temperature is developed in the context of large test programmes run in a current research project called Arctic Materials II. A generic database platform is proposed for efficient access to material data and to analyses of various materials such as steels/weldments, aluminium alloys, composites and polymers/coatings. Safe and flexible data processing accessible through a customized web interface is obtained by unifying test results, test methods, and procedures (e.g. tensile testing, fracture mechanics testing) and predictive models of fracture. The framework provides a solid support for the development of more robust solutions to account for the influence of, e.g., temperature, constraint effects, residual stresses, crack arrest, probabilistic scatter,
and scaling on the material response. Its aim is also to contribute to an improved design guideline for materials requirements in Arctic conditions (down to -60°C).

Arctic environment
Cryogenic materials
Data management

2016020485

The role of low temperature impact damage and freeze-thaw exposure on post impact compression strength of glass fibre reinforced polymer-matrix composite materials.
http://www.isope.org/publications/publications.htm
Gaarder, R.H., Grytten, F.
English

An experimental study of the role of sub-zero temperature impact damage and subsequent freeze-thaw exposure on post impact compression strength of quasi-isotropic glass fibre reinforced vinyl ester resin composite materials using non-crimp reinforcements typically applied in the marine industry is presented. Specimens cut from composite plates were impact loaded at two different temperatures according to ASTM D7136, then immersed in fresh water until saturation before being subjected to various number of ASTM C666 freeze-thaw cycles. After the freeze-thaw cycles, the specimens were compression tested using a Boeing anti-buckling device according to ASTM D7137.

Composite materials
Compression strength
Impact loads
Low temperature

2016020486

Estimating low temperature fracture properties for very high strength steels.
http://www.isope.org/publications/publications.htm
Wallin, K., Karjalainen-Roikonen, P., Pallaspuro, S.
English

The lack of design rules limits the application of VHSS. One critical point limiting their use lies in their poorly documented low temperature fracture properties in relation to more conventional steels. The two major concepts governing the assessment of steels construction codes are the Master Curve methodology and the T0-TCV28J transition temperature correlation. Focusing on novel directly quenched high performance steels, the applicability of the Master Curve methodology with special emphasis on the low temperature region is investigated and the validity of the standard T0-TCV28J transition temperature correlation is checked. Improvements to the criteria are proposed for further considerations.

Fracture strength
High strength steel
Low temperature

2016020487

Numerical simulation of fatigue crack propagation with crack opening and closing based on the strip yield model considering the strain hardening effect of materials.
Journal of the Japan Society of Naval Architects and Ocean Engineers, v 21, 2015, p 31 [12 p, 9 ref, 2 tab, 23 fig]
https://www.jstage.jst.go.jp/article/jjasnaoe/21/0/21_31/pdf
Yamashita, K., Gotoh, K.
Japanese

This paper presents a numerical simulation for fatigue crack propagation based on improved strip yield model, which enables the strain hardening effect of materials to consider. One-dimensional bar elements, which consist of the strain hardening materials, are plugged up the gap corresponding to the fictitious crack opening displacement in the plastic zone to describe the role of crack wake generated over fatigue crack surfaces. Validity of this numerical model under monotonic loading, unloading and reloading...
conditions was verified by comparison of the COD profile and plastic zones size with elastic-plastic FE analysis. Proposed model was implemented into the numerical simulation of fatigue crack propagation considering the crack opening / closing. Proposed simulation of fatigue crack propagation, which enables the strain hardening effect of materials, was validated by comparing fatigue crack propagation histories obtained by the numerical simulations with measured ones.

Crack propagation
Fatigue cracks
Numerical models
Strain hardening

2016020488

Influence of stress and plastic strain concentrations in front of notch tip on brittle fracture strength for strength mismatched welded joint.
Journal of the Japan Society of Naval Architects and Ocean Engineers, v 21, 2015, p 43 [11 p, 32 ref, 5 tab, 28 fig]
https://www.jstage.jst.go.jp/article/jjasnaoe/21/0/21_43/_pdf

Kiji, N., Fujikubo, M.
Japanese

In order to investigate the influence of strength mismatching on brittle fracture strength for large heat-input welded joints, a series of tension tests was conducted using surface notched specimens. Furthermore, notched round-bar tension tests were carried out for simulated bond material (homogeneous material) which was base metal heat-treated on the same condition as the weld bond. Thereby, cleavage fracture strength of the bond material without the influence of strength mismatching was obtained. The point of fracture initiation was identified by SEM observation and, the critical maximum principal stress at the point ($\sigma_{1c}$) was calculated by FE analysis for each specimen. $\sigma_{1c}$ values of surface notched specimens were found to be distributed in the range of 900-1,400N/mm2. This result indicates that the strength mismatching does not significantly affect $\sigma_{1c}$. In addition, distribution of $\sigma_{1c}$ for the notched round-bar specimens is in good agreement with that for surface notched specimens. This indicates that the cleavage fracture of the weld bond is a dominant fracture on the welded joints. Peak values of maximum principal stress $\sigma_{1p}$ and equivalent plastic strain $\varepsilon_{pp}$ increase with increase in the strength mismatching ratio defined as the ratio of yield strength of weld metal to that of HAZ ($\sigma_{YWM}/\sigma_{YHAZ}$). The increase in $\sigma_{1p}$ causes the decrease in fracture strength of the weld joints. $\varepsilon_{p}$ concentration at notch tip of HAZ side is due to the lower yield strength of HAZ. Except for small-scale and large-scale yielding conditions, the influence of $\varepsilon_{p}$ distribution caused by strength mismatching on fracture strength also needs to be considered.

Brittle fracture
Fatigue strength
Welded joints

2016020489

A study for shell buckling strength and ring frame tripping buckling strength of ring stiffened cylinders under external pressure.
Journal of the Japan Society of Naval Architects and Ocean Engineers, v 21, 2015, p 55 [8 p, 14 ref, 4 tab, 8 fig]
https://www.jstage.jst.go.jp/article/jjasnaoe/21/0/21_55/_pdf

Izumi, N., Sano, A., Eta
Japanese

Ring stiffened cylinders are generally used as main structural members of offshore and submersible structures. In designing of such structures, it is very important to estimate the buckling strength of ring stiffened cylinder under external pressure accurately. The buckling mode of ring stiffened cylinder under external pressure can be divided into the following four modes. The first is the general buckling mode which occurs over the entire length of the cylinder involving ring stiffeners. The second is the shell buckling mode which is the buckling of cylindrical shell between the ring stiffeners. The third is the frame tripping mode of ring stiffener. The fourth is the local buckling mode of ring stiffener’s web or face. The purpose of this research is to propose the simplified formula for predicting the elastic shell buckling strength included the influence of stress ratio of shell and ring stiffener, and to propose the simplified formula for predicting the elastic ring frame tripping strength combined the proposed formula of the elastic shell buckling strength. The
elastic shell buckling strength and the elastic ring frame tripping strength predicted by these simplified formulas are compared with the result of finite element analysis by changing various parameters, such as the scantling of ring stiffener and shell thickness. From the comparison of these results, accuracy of these simplified formulas is examined.

4.3 CORROSION AND FOULING

2016020491

Influence of pitting corrosion on fatigue and corrosion fatigue of ship and offshore structures, Part II – pit-crack interaction.
Polish Maritime Research, v 22 n 3, 2015, p 57 [10 p, 43 ref, 4 fig]
Jakubowski, M.

The paper discusses the influence of stresses on general corrosion rate and corrosion pitting nucleation rate and growth. The influence of roughness of pit walls on the fatigue life of a plate suffering pitting corrosion and the presence of the so called “non-damaging” pits which never lead to initiation of fatigue cracks, is presented. The possibility of prediction of pit-to-crack transition moment by two different methods, i.e. considering a pit a stress concentrator or an equivalent crack, has been analysed. Also, the influence of statistical distribution of depth of corrosion pits as well as anticorrosion protection on fatigue and corrosion fatigue is described.

Corrosion fatigue
Fatigue life
Offshore structures
Pitting corrosion
Ship structures

2016020492

Application of blue LED irradiation to antifouling of a ship's bottom.
OCEANS ’15 MTS/IEEE Genova; 18-21 May 2015; Genova, Italy. Published by IEEE [4 p]
Mimura, H., Hirono, K., Et al

The authors examined the effectiveness of LED irradiation on the inhibition of cypris larval settlement onto an adhesion plate, on which the certain area located just under the light source was continuously covered with the light. So far examined, the inhibition percentage of the population in the area varied from zero at 465.0 nm to 3.0±1.4% cm-2 at 600.0 nm in the laboratory experiment although the
maximum irradiance of LEDs differed from 170.7 W m\(^{-2}\) at 500.0 nm (blue-green) to 293.6 W m\(^{-2}\) at 465.0 nm. Similar results were obtained from the field experiment, indicating that blue LEDs with high irradiation have potential to inhibit the settlement of cypris larvae onto a ship's bottom.

**Fouling Hull bottoms Inhibitors**

**2016020493**

**The synergistic effects of cavitation erosion–corrosion in ship propeller materials.**

*Journal of Bio- and Tribo-Corrosion, v 1 n 2, June 2015*  

**Basumatary, J., Nie, M., Wood, R.J.K.**  
*English*

Synergy tests were performed for two most common propeller materials, duplex stainless steel (DSS) and nickel aluminium bronze (NAB), by means of an indirect ultrasonic vibratory system. Tests were conducted for pure cavitation erosion in distilled water, pure corrosion using in situ electrochemistry under 3.5 \% NaCl solution and a combination of cavitation erosion–corrosion to understand the overall synergism existing between the two. The results were analysed using gravimetric as well as volumetric analysis. Alicona and Talysurf were employed for the surface topography, and scanning electron microscope was used to see the microstructural morphologies of the samples under different conditions. As a result, the electrochemical tests held at open circuit potential showed that, although DSS exhibited higher resistance to corrosion under seawater alone, NAB exhibited much higher resistance to corrosion when subjected to cavitation. From the experiments conducted, it was concluded that synergy had measurable impact on the cavitation erosion–corrosion of both NAB and DSS. NAB was found to be more susceptable to erosion under both the conditions as compared to DSS with prominent selective cavitation erosion of alpha phase in the microstructure. The overall synergism of NAB was found to be higher than that of DSS.

Cavitation erosion  
Erosion corrosion  
Propellers  
Stainless steel

**2016020494**

**Microstructure and corrosion in simulated marine environment of CVD multilayer coatings.**  

**Zhang, J., Yang, C., Et al**  
*English*

The authors demonstrate the corrosion prevention application of multilayer chemical vapor deposition (CVD) TiC/Ti(CN)/Al2O3 on 2Cr13 steel in simulated marine environment. The immersion test in simulated solution with sea water contains 2\% sulfuric acid at 320-350\°C,52MPa for 2.5h and electrochemistry test in 12wt\% NaCl at room temperature were applied to investigate the corrosion behaviour of the coatings. XRD examination indicated that multilayer coatings consisted of TiC, Ti(C0.51N0.12), Al2O3 and the thickness was about 10μm. The adhesion of the coatings was found to be about 62N. The corrosion results revealed that the multilayer coatings can offer 2Cr13 steel higher corrosion resistance, especially the immersion corrosion test.

Coatings  
Corrosion prevention  
Corrosion resistance  
Marine environment  
Steel

**2016020495**

**Study on corrosion and wear resistance of titanizing coating on steel surface.**  

**Xue, Q., Li, J., Et al**  
*English*

Titanizing coating was prepared by infiltration of titanium compound particles on Cr12MoV (ASTM: D2) steel surface using thermal diffusion (TD) process in salt bath. Self-corrosion current of the coated specimen in 3.5\% NaCl solution was smaller by two orders of magnitude than that of uncoated specimen. The wear weight loss of the uncoated specimen was eleven times more than that of coated...
within the same testing period. The morphology, structure and mechanical properties of the titanizing coating were further investigated. The results indicate that the titanizing coating was composed of densified TiC crystals. The hardness reaches 3000HV0.1 when the thickness of coating is greater than 10μm.

Coatings
Corrosion resistance
Thermal diffusion
Titanium

5 NAVAL VESSELS AND DEFENCE TECHNOLOGY

2016020496
No author given
English
Trials on a Royal Netherlands Navy Holland-class patrol vessel suggest that a new Hull Vane has much to offer the naval market. The Hull Vane is an appendage that looks a little like an underwater spoiler. The patented fuel saving device consists of a submerged hydrofoil-type appendage, fixed at or below the stern of a ship. Unlike hydrofoils, the goal is not to lift the vessel out of the water but to generate forward-oriented lifting force and reduce a ship’s stern wave. It reduces the fuel consumption of ships through four different effects: it produces forward thrust out of the upward flow under the aft ship; reduces wave-making or pressure resistance; generates vertical lift to reduce the running trim of a ship; and reduces ship motions in waves such as pitching, heaving, rolling and yawing (and therefore the added resistance caused by these motions).

Fuel conservation
Hull appendages
Naval vessels
Vanes

2016020497
Xiong, Z., Hu, Y.
Chinese
The conceptual design of naval ships is of vital significance to the overall effectiveness, development risk, and cost of ships, since the main characteristics and functions of the ship are all determined during this phase. By analysing the conceptual design progress of US naval ships, three stages can be observed: the development of the ship synthesis model, the research on overall effectiveness, and the general optimisation of the conceptual plan. Firstly, the basic principles and drawbacks of the ship synthesis model are analysed. Secondly, the systematic framework and methods for evaluating the total effectiveness, which are represented by overall effectiveness, development risk, and cost, are presented. Lastly, the optimisation of the scheme and its applications are proposed.

Naval vessels
Ship design

2016020498
Kwatny, H., Bajpai, G., Et al
English
Fuel cost is a major concern for naval and commercial ship operations. One approach to fuel
efficiency improvement is to integrate propulsion and electric generating systems. This paper examines the use of hybrid electric drives as a means for reducing fuel costs in naval ship operations. Fuel efficiency can be improved by committing only the necessary power generating resources to supply the propulsion and electric power requirements for the mission. However, it is also necessary to insure a degree of reliability of power supply, which typically implies committing more resources than actually needed. This paper examines fuel optimisation in the presence of service reliability constraints. It considers optimal strategies for contingency response as a means of reducing the need to commit excess on-line power generating resources.

Control
Fuel conservation
Naval vessels
Optimisation
Ship electric power systems

2016020499
Overview of structural life assessment and reliability, Part IV: Corrosion and hydrogen embrittlement of naval ship structures.
http://www.ingentaconnect.com/content/sname/jspb/2015/00000031/00000004/art00004
Ibrahim, R.A.
English
Structural life assessment periodically evaluates the state and condition of a structural system and provides recommendations for possible maintenance actions or the end of structural service life. It is a diversified field and relies on the theories of fracture mechanics, fatigue damage process, probability of failure, and reliability. With reference to naval ship structures, their life assessment is not only governed by the theory of fracture mechanics and fatigue damage process, but by other factors such as corrosion, grounding, and sudden collision. The purpose of this series of review articles is to provide different issues pertaining to structural life assessment of ships and ocean structures. This article is devoted to a ship's life assessment resulting from corrosion and hydrogen embrittlement. Because structural components made from aluminum and its alloys are vital to the ship and aerospace industries, the influence of environment on aluminum structures and the means of corrosion control and monitoring in both aluminum and nonaluminum metals are presented. Hybrid ships consist of a stainless steel advanced double-hull centre section, to which a composite material bow and/or stern is attached. Such structures require strong joints between the composite and the steel parts. Some of the difficulties with joining composites and metal are related to the large difference in mechanical properties such as stiffness, coefficient of thermal expansion, etc., between the adherents and the large anisotropy of composites. Such differences generally lead to large stress concentrations and weak joints.

Corrosion
Fatigue life
Hydrogen embrittlement
Naval vessels
Structural reliability

6 MISCELLANEOUS

2016020500
Review of maritime transport 2015.

No author given
English
The year 2015 is a milestone for sustainable development. The international community has a unique opportunity to strengthen its commitment to sustainable development and consider how best to mainstream sustainability principles across all economic activities and sectors, including maritime transport. In this context, relevant chapters of the this edition of the Review of Maritime Transport highlight some issues that are at the interface of maritime transport and sustainability and underscore the role of maritime transport in helping implement a workable international sustainable development agenda.

Reviews
Marine transportation
Shipping
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