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CONTENT

A Decision Support Model for Minimising Sloshing Risk in LNG Discharge Operations

By Egil Rokstad, Stein Ove Erikstad & Kjetil Fagerholt

Methods for the Aerodynamic Optimisation of Mega-yachts

By Stefan Harries & Florian Vesting

Two-stage Stochastic Programming Formulation for Ship Design Optimisation under Uncertainty

By Matteo Diez & Daniele Peri

A Multi-Objective Optimisation-Based Structural Design Procedure for the Concept Stage – A Chemical Product Tanker Case Study

By Sören Ehlers, Heikki Remes, Alan Klanac & Hendrik Naar

Effects of Uncertainty in Fuzzy Utility Values on General Arrangement Optimisation

By Anthony S. Daniels, Morgan C. Parker & David J. Singer

Multi-criteria Scantling Optimisation of Cruise Ships

By Jean-David Caprace, Frederic Bair & Philippe Rigo

CONTENT

VOL. 57 / NO. 3

154 A Decision Support Model for Minimising Sloshing Risk in LNG Discharge Operations

By Egil Rokstad, Stein Ove Erikstad & Kjetil Fagerholt

An optimisation model is proposed for the redistribution of cargo in LNG tanks during regasification from an offshore floating regasification unit in order to reduce sloshing-induced loads. The proposed model is a time discretised Integer Programming model, where a certain risk level is assigned to specific tank levels. The redistribution and discharge operation is modelled as a series of state transitions subject to a set of initialisation and continuity constraints. The resulting scheme reduces the time that each tank spends with filling levels within the 'barred zone', corresponding to filling levels from 15 to 45%, where high peak sloshing pressures are more likely to occur.

162 Methods for the Aerodynamic Optimisation of Mega-yachts

By Stefan Harries & Florian Vesting

Ships feature superstructures and components with steps, recesses and styling surfaces that lead to flow separation. A favourable air flow becomes a design criterion, particularly for mega-yachts and cruise ferries. For instance, exhaust gases should be kept from passengers and crew. This paper shows how Computer Aided Design (CAD) and Computational Fluid Dynamics (CFD) can be coupled for aerodynamic design. An example of a mega-yacht is studied. Systematic refinements were undertaken to clarify the levels of detail necessary for resolving geometry and fluid domain. Subsequently, the funnel was optimised in order to improve emissions.

172 Two-stage Stochastic Programming Formulation for Ship Design Optimisation under Uncertainty

By Matteo Diez & Daniele Peri

The paper presents a two-stage approach for ship design optimisation under uncertainties related to stochastic parameters that cannot be controlled by the designer. The designer decision is partitioned into two sets: the first contains variables that have to be decided before the onset of any uncertain condition, while the second involves variables that may be decided once the random events have occurred. The first-stage variables are selected so that the sum of the first-stage cost and the expectation of the second-stage cost is minimised. The problem is solved as a two-nested-loop minimisation problem, which combines robustness of the first-stage decision with flexibility of the second-stage decision. The approach is applied to the conceptual optimisation of a bulk carrier.

182 A Multi-Objective Optimisation-Based Structural Design Procedure for the Concept Stage – A Chemical Product Tanker Case Study

By Sören Ehlers, Heikki Remes, Alan Klanac & Hendrik Naar

The paper presents a structural design procedure based on multi-objective optimisation and using a decision-support algorithm to identify the competitive optimum. The procedure is applied to a chemical product tanker. In addition to the rule compliance under service loading, optimisation is performed with respect to the ship weight, production cost or service life. Appropriate assumptions and simplifications are proposed for not yet known structural solutions or loading conditions. Objectives of the stakeholders are identified in interviews. The paper studies the influence of various objectives on the resulting structural alternatives.

198 Effects of Uncertainty in Fuzzy Utility Values on General Arrangement Optimisation

By Anthony S. Daniels, Morgan C. Parker & David J. Singer

The Intelligent Ship Arrangements (ISA) software system assists designers in developing rationally-based arrangements, which should satisfy design specific needs, general Navy requirements and standard practices. The system is intended to be used following Advanced Ship and Submarine Evaluation Tool (ASSET). The optimisation core uses fuzzy programming to provide the framework upon which the objective function and constraints are based. This methodology relies on fuzzy utility functions that quantify the satisfaction of design goals and constraints, which allows for a very powerful and generic foundation for problem description. The uncertainty of the fuzzy utility preference values and the corresponding impacts on design optimisation are studied. The uncertainty is introduced by inserting a normal distributed stochastic perturbation into the fuzzy utility values.

210 Multi-criteria Scantling Optimisation of Cruise Ships

By Jean-David Caprace, Frederic Bair & Philippe Rigo

A numerical tool for the optimisation of the scantlings of a ship is extended by considering production cost, weight and moment of inertia in the objective function. A multi-criteria optimisation of a passenger ship is conducted to illustrate the analysis process. Pareto frontiers are obtained and results are verified with Bureau Veritas rules.

222 Imprint

AUTHORS

2010

issue, page

- 1, 8 **El Moctar, O., Rathje, H. & Shigunov, V.:** *Operational Guidance for Prevention of Cargo Loss and Damage on Container Ships*
- 1, 26 **Boulougouris, E., Papanikolaou, A., Zaraphonitis, G. & Sotiris, S.:** *An Integrated Methodology for the Design of Ro-Ro Passenger Ships*
- 1, 40 **El Moctar, O., Povel, D. Vladimir, S. & Tide, A.:** *Fire Investigation in a Container*
- 1, 56 **Chen, Y.-J., Kouh, J.-S. & Chien, H.-P.:** *Numerical Simulation of Motions of a Floating Body by a Pressure-Convection Particle Method*
- 1, 64 **Cha, J.-H., Park, K.-P. & Lee, K.-Y.:** *Dynamic Response of a Floating Crane in Waves by Considering the Nonlinear Effect of Hydrostatic Force*
- 1, 74 **Volker Bertram:** *Flow Simulations for Offshore Structures*
- 2, 84 **Adnan, F. A., Nishi, K. & Yasukawa, H.:** *Wave-Induced Motions on a Laterally Drifting Ship*
- 2, 100 **Liefvendahl, M.:** *Investigation of Propeller Wake Instability using LES*
- 2, 108 **Ehlers, S. & Körgesaar, M.:** *An Assessment Procedure of the Crashworthiness of an LNG Tanker Side Structure*
- 2, 120 **Kraskowski, M.:** *Simulating Hull Dynamics in Waves using a RANSE Code*
- 2, 128 **Furlong, M., Phillips, A. B. & Turnock, S. R.:** *Accurate Capture of Propeller-Rudder Interaction using a Coupled Blade Element Momentum-RANS Approach*
- 2, 140 **Ivanov, L. D. & Kokarakis, J. E.:** *On the Ship's Trimming using Moments of Weight and Buoyancy Forces of High Order*
- 3, 154 **Erikstad, S. O., Fagerholt, K. & Rokstad, E.:** *A Decision Support Model for Minimising Sloshing Risk in LNG Discharge Operations*
- 3, 162 **Harries, S. & Vesting, F.:** *Methods for the Aerodynamic Optimisation of Mega-yachts*
- 3, 172 **Diez, M. & Peri, D.:** *Two-stage Stochastic Programming Formulation for Ship Design Optimisation under Uncertainty*
- 3, 182 **Bair, F., Rigo, R. & Caprace, J.-D.:** *Multi-criteria Scantling Optimisation of Cruise Ships*
- 3, 198 **Ehlers, S., Remes, H., Klanac, A. & Naar, H.:** *A Multi-Objective Optimisation-Based Structural Design Procedure for the Concept Stage - A Chemical Product Tanker Case Study*
- 3, 210 **Daniels, A. S., Parker, M. C. & Singer, D. J.:** *Effects of Uncertainty in Fuzzy Utility Values on General Arrangement Optimisation*

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