

Marine Hydrodynamics

Handbook of MARINE CRAFT HYDRODYNAMICS AND MOTION CONTROL The latest tools for analysis and design of advanced GNC systems Handbook of Marine Craft Hydrodynamics and Motion Control is an extensive study of the latest research in hydrodynamics, guidance, navigation, and control systems for marine craft. The text establishes how the implementation of mathematical models and modern control theory can be used for simulation and verification of control systems, decision-support systems, and situational awareness systems. Coverage includes hydrodynamic models for marine craft, models for wind, waves and ocean currents, dynamics and stability of marine craft, advanced guidance principles, sensor fusion, and inertial navigation. This important book includes the latest tools for analysis and design of advanced GNC systems and presents new material on unmanned underwater vehicles, surface craft, and autonomous vehicles. References and examples are included to enable engineers to analyze existing projects before making their own designs, as well as MATLAB scripts for hands-on software development and testing. Highlights of this Second Edition include: Topical case studies and worked examples demonstrating how you can apply modeling and control design techniques to your own designs A Github repository with MATLAB scripts (MSS toolbox) compatible with the latest software releases from Mathworks New content on mathematical modeling, including models for ships and underwater vehicles,

hydrostatics, and control forces and moments New methods for guidance and navigation, including line-of-sight (LOS) guidance laws for path following, sensory systems, model-based navigation systems, and inertial navigation systems This fully revised Second Edition includes innovative research in hydrodynamics and GNC systems for marine craft, from ships to autonomous vehicles operating on the surface and under water. Handbook of Marine Craft Hydrodynamics and Motion Control is a must-have for students and engineers working with unmanned systems, field robots, autonomous vehicles, and ships. MSS toolbox: <https://github.com/cybergalactic/mss> Lecture notes: <https://www.fossen.biz/wiley> Author's home page: <https://www.fossen.biz>

This book unifies the most important geometries used to develop analytical solutions for hydrodynamic boundary value problems.

These proceedings represent the most recent and complete state of the art review of three-dimensional models of the modern generation for the study of marine hydrodynamics and management of the marine system. The book is well illustrated by application to well-documented case studies.

This book details the efforts to build a large naval vessel capable of traveling at one hundred knots. It is the first book to summarize this extensive work from historical and technical perspectives. It explores the unique principles and challenges in the design of high-speed marine craft. This volume explores different hull form concepts, requiring an understanding of the four forces

affecting the lift and the drag of the craft. The four forces covered are hydrostatic (buoyancy), hydro-dynamic, aerostatic, and aerodynamic. This text will appeal to naval researchers, architects, graduate students and historians, as well as others generally interested in naval architecture and propulsion.

Hydrodynamics of High-Speed Marine Vehicles, first published in 2006, discusses the three main categories of high-speed marine vehicles - vessels supported by submerged hulls, air cushions or foils. The wave environment, resistance, propulsion, seakeeping, sea loads and manoeuvring are extensively covered based on rational and simplified methods. Links to automatic control and structural mechanics are emphasized. A detailed description of waterjet propulsion is given and the effect of water depth on wash, resistance, sinkage and trim is discussed. Chapter topics include resistance and wash; slamming; air cushion-supported vessels, including a detailed discussion of wave-excited resonant oscillations in air cushion; and hydrofoil vessels. The book contains numerous illustrations, examples and exercises.

This is a comprehensive two-volume set of books devoted to the hydrodynamics of high-performance marine vessels. These vessels may also be generally referred to as high-speed or advanced marine craft. Types of craft addressed include monohulls, catamarans, trimarans and other multihull vessels, air-cushion vehicles, surface-effect ships and planing craft. The hydrodynamic aspects dealt with are the steady-state resistance, wave generation, sinkage and trim,

unsteady effects and motions in waves. Separate chapters are devoted to viscous resistance, transom sterns and the behavior of skirts for air-cushion vehicles and seals for surface-effect ships. Effects of the finite depth of the water and the possible lateral restriction on the width of the waterway feature prominently in the books. In each case, the presentation includes a full analytical development of the theory accompanied by a comparison of the theoretical predictions with extensive experimental data. In the two volumes there is a total of 939 full-color Letter-size pages. The text is accompanied by 473 photographs of ships and ship models, 1202 graphs, 1294 equations and 1435 references. The work represents the author's research, consulting and professional experience in both universities and research centers spanning a period of over fifty years. The books are targeted at university-level students and specialized industry engineers in the field of naval architecture and associated areas.

This book is intended as an introduction to classical water wave theory for the college senior or first year graduate student. The material is self-contained; almost all mathematical and engineering concepts are presented or derived in the text, thus making the book accessible to practicing engineers as well. The book commences with a review of fluid mechanics and basic vector concepts. The formulation and solution of the governing boundary value problem for small amplitude waves are developed and the kinematic and pressure fields for short and long waves are explored. The transformation of waves due to variations in depth and

their interactions with structures are derived. Wavemaker theories and the statistics of ocean waves are reviewed. The application of the water particle motions and pressure fields are applied to the calculation of wave forces on small and large objects. Extension of the linear theory results to several nonlinear wave properties is presented. Each chapter concludes with a set of homework problems exercising and sometimes extending the material presented in the chapter. An appendix provides a description of nine experiments which can be performed, with little additional equipment, in most wave tank facilities.

"Vive la Revolution!" was the theme of the Twenty-Third Symposium on Naval Hydrodynamics held in Val de Reuil, France, from September 17-22, 2000 as more than 140 experts in ship design, construction, and operation came together to exchange naval research developments. The forum encouraged both formal and informal discussion of presented papers, and the occasion provides an opportunity for direct communication between international peers. This book includes sixty-three papers presented at the symposium which was organized jointly by the Office of Naval Research, the National Research Council (Naval Studies Board), and the Bassin d'Essais des Carènes. This book includes the ten topical areas discussed at the symposium: wave-induced motions and loads, hydrodynamics in ship design, propulsor hydrodynamics and hydroacoustics, CFD validation, viscous ship hydrodynamics, cavitation and bubbly flow, wave hydrodynamics, wake dynamics, shallow water hydrodynamics, and fluid dynamics in the naval context.

Numerical Modelling of Marine Hydrodynamics

This report is part of a series of reports that summarize this regular event. The report discusses research developments in

ship design, construction, and operation in a forum that encouraged both formal and informal discussion of presented papers.

The early development of the screw propeller. Propeller geometry. The propeller environment. The ship wake field, propeller performance characteristics.

Hydrodynamics of Semi-Enclosed Seas

This book describes the latest developments in the hydrodynamics and morphodynamics of tidal inlets, with an emphasis on natural inlets. A review of morphological features and sand transport pathways is presented, followed by an overview of empirical relationships between inlet cross-sectional area, ebb delta volume, flood delta volume and tidal prism. Results of field observations and laboratory experiments are discussed and simple mathematical models are presented that calculate the inlet current and basin tide. The method to evaluate the cross-sectional stability of inlets, proposed by Escoffier, is reviewed, and is expanded, for the first time, to include double inlet systems. This volume is an ideal reference for coastal scientists, engineers and researchers, in the fields of coastal engineering, geomorphology, marine geology and oceanography.

The Twenty-Second Symposium on Naval Hydrodynamics was held in Washington, D.C., from August 9-14, 1998. It coincided with the 100th anniversary of the David Taylor Model Basin. This international symposium was organized jointly by the Office of Naval Research (Mechanics and Energy Conversion S&T Division), the National Research Council (Naval Studies Board), and the Naval Surface Warfare Center, Carderock Division (David Taylor Model Basin). This biennial symposium promotes the technical exchange of naval research developments of common interest to all the countries of the world. The forum encourages both formal and informal discussion of the

presented papers, and the occasion provides an opportunity for direct communication between international peers.

The International Conference on Hydrodynamics is an increasingly important event at which academics, researchers and practitioners can exchange new ideas and their research findings. This volume contains papers from the 2004 conference covering a wide range of subjects within hydrodynamics, including traditional engineering, architectural and mechanical issues as well as significant new technologies and methodologies such as bio-fluid mechanics and computational fluid mechanics.

A textbook that offers a unified treatment of the applications of hydrodynamics to marine problems. The applications of hydrodynamics to naval architecture and marine engineering expanded dramatically in the 1960s and 1970s. This classic textbook, originally published in 1977, filled the need for a single volume on the applications of hydrodynamics to marine problems. The book is solidly based on fundamentals, but it also guides the student to an understanding of engineering applications through its consideration of realistic configurations. The book takes a balanced approach between theory and empirics, providing the necessary theoretical background for an intelligent evaluation and application of empirical procedures. It also serves as an introduction to more specialized research methods. It unifies the seemingly diverse problems of marine hydrodynamics by examining them not as separate problems but as related applications of the general field of hydrodynamics. The book evolved from a first-year

graduate course in MIT's Department of Ocean Engineering. A knowledge of advanced calculus is assumed. Students will find a previous introductory course in fluid dynamics helpful, but the book presents the necessary fundamentals in a self-contained manner. The 40th anniversary of this pioneering book offers a foreword by John Grue. Contents Model Testing " The Motion of a Viscous Fluid " The Motion of an Ideal Fluid " Lifting Surfaces " Waves and Wave Effects " Hydrodynamics of Slender Bodies.

Remote Sensing of Shelf Sea Hydrodynamics

We have identified a need to draw together knowledge of physiochemical and biological aspects of pollution in tropical aquatic systems. This book results from this and we hope will assist in providing management strategies to protect these systems from pollution effects. In organising the book we have, as far as possible, attempted to cover the range of topics important in understanding pollution in tropical areas. Authors who are expert in their particular fields have been invited to contribute. We recognise that many topics remain uncovered but we hope will serve to assist in identifying these and stimulate interest in this area.

Practical Ship Hydrodynamics provides a comprehensive overview of hydrodynamic experimental and numerical methods for ship resistance and propulsion, maneuvering, seakeeping and vibration. Beginning with an overview of problems and approaches, including the basics of modeling and full scale testing, expert author Volker Bertram introduces the marine applications of computational fluid dynamics and boundary element

methods. Expanded and updated, this new edition includes: Otherwise disparate information on the factors affecting ship hydrodynamics, combined to provide one practical, go-to resource. Full coverage of new developments in computational methods and model testing techniques relating to marine design and development. New chapters on hydrodynamic aspects of ship vibrations and hydrodynamic options for fuel efficiency, and increased coverage of simple design estimates of hydrodynamic quantities such as resistance and wake fraction. With a strong focus on essential background for real-life modeling, this book is an ideal reference for practicing naval architects and graduate students.

This is a textbook aimed at graduate students and offshore engineering practitioners that covers basic fluid mechanics and the deterministic and statistical descriptions of infinitesimal and finite amplitude water waves. It reviews the theory of wave loading on structures and closes with a chapter on the potential of ocean wave energy and devices for extracting it. Since the 1980s there has been tremendous progress in numerical and physical modelling of coastal and offshore structures in waves. This calls for a clear understanding of the phenomena of wave generation, propagation, deformation and its effects on marine structures. This book will help the reader to understand the many results and descriptions found in journals, reports and research papers. It is self-contained, and encompasses the fundamentals of the subject with sufficient description and illustrations.

This book discusses the subject of wave/current flow around a cylinder, the forces induced on the cylinder by the flow, and the vibration pattern of slender structures in a marine environment. The primary aim of the book is to describe the flow pattern and the resulting load which develops when waves or current meet a cylinder.

Attention is paid to the special case of a circular cylinder. The development in the forces is related to the various flow patterns and is discussed in detail. Regular as well as irregular waves are considered, and special cases like wall proximities (pipelines) are also investigated. The book is intended for MSc students with some experience in basic fluid mechanics and for PhD students.

Contents: Flow Around a Cylinder in Steady Current Forces on a Cylinder in Steady Current Flow Around a Cylinder in Oscillatory Flows Forces on a Cylinder in Regular Waves Mathematical and Numerical Treatment of Flow Around a Cylinder Diffraction Effect. Forces on Large Bodies Forces on a Cylinder in Irregular Waves Flow-Induced Vibrations of a Free Cylinder in Steady Currents Flow-Induced Vibrations of a Free Cylinder in Waves Vibrations of Marine Pipelines Mathematical Modelling of Flow-Induced Vibrations. Readership: Civil and ocean engineers.

keywords: Pipelines; Offshore Structures; Hydroelastic Vibrations; Flow-induced Vibrations; Forces on Offshore Structures; Flow Around Offshore Structures; Wave Loading; Vibrations; Waves; Steady Currents; Pipeline Stability; Diffraction; Irregular Waves; Oscillatory Flow; Mathematical Modelling; Coastal Structures; Marine Structure; Flow Loading; Vibration of Marine Pipelines

“The figures are very good. Many of them are photographs and sketches of aspects of flow that are sometimes difficult to explain in words. The references are extensive, quoting many recent papers. The treatment of the subjects is up-to-date and particularly the chapters on numerical simulation and vibrations contain excellent synopses of new research, much of it by the authors themselves. The style is lucid and the text is well-organized. This book can be highly recommended to anyone who deals with cylindrical structures.”

Professor J W Kamphuis Coastal Engineering

The value of analytical solutions relies on the rigorous formulation, and a strong mathematical background. This comprehensive volume unifies the most important geometries, which allow for the development of analytical solutions for hydrodynamic boundary value problems. It offers detailed explanations of the Laplace domain and numerical results associated with such problems, providing deep insight into the theory of hydrodynamics. Extended numerical calculations are provided and discussed, allowing the reader to use them as benchmarks for their own computations and making this an invaluable resource for specialists in various disciplines, including hydrodynamics, acoustics, optics, electrostatics, and brain imaging. A textbook that offers a unified treatment of the applications of hydrodynamics to marine problems. The applications of hydrodynamics to naval

architecture and marine engineering expanded dramatically in the 1960s and 1970s. This classic textbook, originally published in 1977, filled the need for a single volume on the applications of hydrodynamics to marine problems. The book is solidly based on fundamentals, but it also guides the student to an understanding of engineering applications through its consideration of realistic configurations. The book takes a balanced approach between theory and empirics, providing the necessary theoretical background for an intelligent evaluation and application of empirical procedures. It also serves as an introduction to more specialized research methods. It unifies the seemingly diverse problems of marine hydrodynamics by examining them not as separate problems but as related applications of the general field of hydrodynamics. The book evolved from a first-year graduate course in MIT's Department of Ocean Engineering. A knowledge of advanced calculus is assumed. Students will find a previous introductory course in fluid dynamics helpful, but the book presents the necessary fundamentals in a self-contained manner. The 40th anniversary of this pioneering book offers a foreword by John Grue. Contents Model Testing • The Motion of a Viscous Fluid • The Motion of an Ideal Fluid • Lifting Surfaces • Waves and Wave Effects • Hydrodynamics of Slender Bodies Fundamentals of Ship Hydrodynamics: Fluid

Mechanics, Ship Resistance and Propulsion Lothar Birk, University of New Orleans, USA Bridging the information gap between fluid mechanics and ship hydrodynamics Fundamentals of Ship Hydrodynamics is designed as a textbook for undergraduate education in ship resistance and propulsion. The book provides connections between basic training in calculus and fluid mechanics and the application of hydrodynamics in daily ship design practice. Based on a foundation in fluid mechanics, the origin, use, and limitations of experimental and computational procedures for resistance and propulsion estimates are explained. The book is subdivided into sixty chapters, providing background material for individual lectures. The unabridged treatment of equations and the extensive use of figures and examples enable students to study details at their own pace. Key features:

- Covers the range from basic fluid mechanics to applied ship hydrodynamics.
- Subdivided into 60 succinct chapters.
- In-depth coverage of material enables self-study.
- Around 250 figures and tables.

Fundamentals of Ship Hydrodynamics is essential reading for students and staff of naval architecture, ocean engineering, and applied physics. The book is also useful for practicing naval architects and engineers who wish to brush up on the basics, prepare for a licensing exam, or expand their knowledge.

Optical Remote Sensing is one of the main technologies used in sea surface monitoring. Optical Remote Sensing of Ocean Hydrodynamics investigates and demonstrates capabilities of optical remote sensing technology for enhanced observations and detection of ocean environments. It provides extensive knowledge of physical principles and capabilities of optical observations of the oceans at high spatial resolution, 1-4m, and on the observations of surface wave hydrodynamic processes. It also describes the implementation of spectral-statistical and fusion algorithms for analyses of multispectral optical databases and establishes physics-based criteria for detection of complex wave phenomena and hydrodynamic disturbances including assessment and management of optical databases. This book explains the physical principles of high-resolution optical imagery of the ocean surface, discusses for the first time the capabilities of observing hydrodynamic processes and events, and emphasizes the integration of optical measurements and enhanced data analysis. It also covers both the assessment and the interpretation of dynamic multispectral optical databases and includes applications for advanced studies and nonacoustic detection. This book is an invaluable resource for researches, industry professionals, engineers, and students working on cross-disciplinary problems in ocean hydrodynamics,

optical remote sensing of the ocean and sea surface remote sensing. Readers in the fields of geosciences and remote sensing, applied physics, oceanography, satellite observation technology, and optical engineering will learn the theory and practice of optical interactions with the ocean.

Technical introduction to ship propeller hydrodynamics, for researchers in ocean technology, naval architecture, mechanical engineering.

This book offers a timely review of wave energy and its conversion mechanisms. Written having in mind current needs of advanced undergraduates engineering students, it covers the whole process of energy generation, from waves to electricity, in a systematic and comprehensive manner. Upon a general introduction to the field of wave energy, it presents analytical calculation methods for estimating wave energy potential in any given location. Further, it covers power-take off (PTOs), describing their mechanical and electrical aspects in detail, and control systems and algorithms. The book includes chapters written by active researchers with vast experience in their respective field of specialization. It combines basic aspects with cutting-edge research and methods, and selected case studies. The book offers systematic and practice-oriented knowledge to students, researchers, and professionals in the wave energy sector. Chapters 17 of this book is available open access under a CC

BY 4.0 license at link.springer.com.

The primary reference for the modeling of hydrodynamics and water quality in rivers, lake, estuaries, coastal waters, and wetlands This comprehensive text perfectly illustrates the principles, basic processes, mathematical descriptions, case studies, and practical applications associated with surface waters. It focuses on solving practical problems in rivers, lakes, estuaries, coastal waters, and wetlands. Most of the theories and technical approaches presented within have been implemented in mathematical models and applied to solve practical problems. Throughout the book, case studies are presented to demonstrate how the basic theories and technical approaches are implemented into models, and how these models are applied to solve practical environmental/water resources problems. This new edition of Hydrodynamics and Water Quality: Modeling Rivers, Lakes, and Estuaries has been updated with more than 40% new information. It features several new chapters, including one devoted to shallow water processes in wetlands as well as another focused on extreme value theory and environmental risk analysis. It is also supplemented with a new website that provides files needed for sample applications, such as source codes, executable codes, input files, output files, model manuals, reports, technical notes, and utility programs. This new edition of the book: Includes

more than 120 new/updated figures and 450 references Covers state-of-the-art hydrodynamics, sediment transport, toxics fate and transport, and water quality in surface waters Provides essential and updated information on mathematical models Focuses on how to solve practical problems in surface waters—presenting basic theories and technical approaches so that mathematical models can be understood and applied to simulate processes in surface waters Hailed as “a great addition to any university library” by the Journal of the American Water Resources Association (July 2009), *Hydrodynamics and Water Quality, Second Edition* is an essential reference for practicing engineers, scientists, and water resource managers worldwide.

Introduction to Fluid Mechanics is a mathematically efficient introductory text for a basal course in mechanical engineering. More rigorous than existing texts in the field, it is also distinguished by the choice and order of subject matter, its careful derivation and explanation of the laws of fluid mechanics, and its attention to everyday examples of fluid flow and common engineering applications. Beginning with the simple and proceeding to the complex, the text introduces the principles of fluid mechanics in orderly steps. At each stage practical engineering problems are solved, principally in engineering systems such as dams, pumps, turbines, pipe flows, propellers,

and jets, but with occasional illustrations from physiological and meteorological flows. The approach builds on the student's experience with everyday fluid mechanics, showing how the scientific principles permit a quantitative understanding of what is happening and provide a basis for designing engineering systems that achieve the desired objectives. Introduction to Fluid Mechanics differs from most engineering texts in several respects: The derivations of the fluid principles (especially the conservation of energy) are complete and correct, but concisely given through use of the theorems of vector calculus. This saves considerable time and enables the student to visualize the significance of these principles. More attention than usual is given to unsteady flows and their importance in pipe flow and external flows. Finally, the examples and exercises illustrate real engineering situations, including physically realistic values of the problem variables. Many of these problems require calculation of numerical values, giving the student experience in judging the correctness of his or her numerical skills.

This book covers the basics of the hydrodynamics and vibration of structures subjected to environmental loads. It describes the interaction of hydrodynamics with the associated vibration of structures, giving simple explanations. Emphasis is placed on the applications of the theory to practical

problems. Several case studies are provided to show how the theory outlined in the book is applied in the design of structures. Background material needed for understanding fluid-induced vibrations of structures is given to make the book reasonably self-sufficient. Examples are taken mainly from the novel structures that are of interest today, including ocean and offshore structures and components. Besides being a text for undergraduates, this book can serve as a handy reference for design engineers and consultants involved in the design of structures subjected to dynamics and vibration.

This book demonstrates that different rudder configurations have different hydrodynamic characteristics, which are influenced by the profile, the parameters, and the specific configuration. The author proposes new regression formulas to help naval architects quickly estimate the rudder-induced forces and moments in maneuvering. Furthermore, the author proposes and validates an integrated maneuvering model for both seagoing ships and inland vessels. Using the proposed regression formulas and maneuvering model, the specific impacts of rudder configurations on inland vessel maneuverability are studied. In turn, the book demonstrates the application of Reynolds-Averaged Navier–Stokes (RANS) simulations to obtain rudder hydrodynamic characteristics, and the integration of the RANS results into maneuvering models as an

accurate estimation of rudder forces and moments needed to quantify the impacts of rudder configurations on ships' maneuvering performance. In addition, the author proposes new criteria for the prediction and evaluation of inland vessel maneuverability. Simulations of ships with various rudder configurations are presented, in order to analyze the impacts of rudder configurations on ship maneuverability in different classic and proposed test maneuvers. Offering essential guidance on the effects of rudders for inland vessel maneuverability, and helping practical engineers make informed design choices, the book is of interest to researchers and academics in the field of naval engineering, as well as students of naval architecture. Industrial practitioners working on ship design may also find it beneficial.

The papers which follow were presented at an International Symposium held in Lisbon from 8-11 July 1985 on the Hydrodynamics of Ocean Wave-Energy Utilization and sponsored by the International Union of Theoretical and Applied Mechanics. The subject of the Symposium embraced wave statistics, numerical methods, theoretical, experimental and field studies of wave energy devices. The idea of extracting useful energy from ocean waves continues to attract the curiosity of scientists and engineers in many parts of the world as the following papers indicate. Increasingly the

trend is towards smaller devices suitable for use near remote island communities where wave power, as an alternative to costly diesel fuel for electric generators, is already very competitive in economic terms. The decision to build two different prototype wave-power devices into the cliffs off Bergen in Norway has provided a welcome impetus to the field, stimulating a large amount of theoretical work on oscillating water column-type devices. In particular phase control methods - in which force and velocity of a rigid body, or pressure and volume flux across a turbine are matched in phase to achieve maximum power output - rightfully occupy a central place in the papers that follow. In addition to the established workers in the field, a new generation of wave-energy enthusiasts is emerging, learning from the mistakes of others and contributing exciting ideas of both a conceptual and practical nature.

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