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BOOK REVIEW

Hydrodynamics of High-Speed Marine Vehicles. By ODD M. FALTINSEN. Cambridge University Press, 2006. 474 pp. ISBN 0-521-84568-8. £55.

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The hydrodynamics of high-speed marine vessels is a rapidly growing field. There is a large body of researchers working in the area. As a consequence, there is a rapidly increasing literature on the subject. The author, Professor Faltinsen, is therefore to be admired for the extensive and complete survey of the art as it exists at this time. The book strikes a good compromise in presentation between two possible extremes: a purely descriptive narrative on the one hand, and a highly mathematical treatment on the other hand. This reviewer believes that the book will soon become a standard reference on the subject.

The chapter headings are: *Introduction, Resistance and Propulsion, Waves, Wave Resistance and Wash, Surface-Effect Ships, Hydrofoil Vessels and Foil Theory, Semi-Displacement Vessels, Slamming Whipping and Springing, Planing Vessels, and Maneuvering*. This subdivision of the material is a practical compromise between categorizing according to vessel type (such as surface-effect ships, hydrofoil vessels, etc) and categorizing according to discipline (ship resistance, ship motion, etc). Perhaps the only suggestion offered here would be to divide the chapter on *Resistance and Propulsion* into its two obvious elements, since they can be treated relatively independently.

Each chapter is completed with an exhaustive set of exercises. These exercises represent a most useful addition to the book. They are on a very high level and so would require the assistance of a suitable academic guide for the student of the subject. A typical challenging example of these exercises is the first question in the chapter on *Surface-Effect Ships*, in which one is asked to analyse the static at-rest lateral stability of an SES, considering the influence of the depression of the water inside the air cushion and the influence of possibly-sloping surfaces on the insides of the sidehulls. Incidentally, this particular problem could also be solved by modelling the SES as a traditional displacement vessel with a large partly-filled internal tank, whose free surface reduces the lateral stability.

In this regard, the book would form the basis of a postgraduate course at a recognized university. Used in this manner, it would be necessary to select just some of the topics, because there is too much material for a single course – even one that ran for a full academic year (two semesters).

The general approach of the author is to develop the material in each section of the book with a very simple version of the problem at hand and then to add elements of sophistication, until the final complete problem has been presented. A typical example of this approach is the explanation of the theory of hydrofoil performance in the chapter *Hydrofoil Vessels and Foil Theory*. Circulation theory and potential-flow theory are first detailed. Then two-dimensional theory for a foil in an infinite domain (no effects from the sea surface) is presented. Next, the result for a lifting flat-plate foil is given. To this result are progressively added the effects of camber, a trailing-edge flap, three-dimensionality, drag effects, the free surface of the water,

interactions of neighbouring foils, and unsteady effects. Finally, the behaviour of the entire hydrofoil vessel in waves is explained. In this way, the reader is introduced to this very complicated problem one step at a time.

Linearized free-surface theory is used to good effect for the twin problems of wave resistance and 'wash' (the waves generated by a ship) in the chapter *Wave Resistance and Wash*. This is entirely appropriate because this theory provides excellent predictions for the slender hullforms of the vessels being considered here. This reviewer would have appreciated seeing some more comparisons of theoretical predictions of resistance with the corresponding experimental measurements, because such comparisons are known to be very favourable. Some comments on the influence of tank walls in towing-tank tests on ship models (particularly in water of finite depth) are also provided in this chapter, starting on p. 136. A graph or two of the results of some calculations, compared with experimental data for ship-model resistance, would show just how critical the relevant phenomena can be.

While the book is definitely mathematical, there are also many clear and straightforward explanations of the physics which should be acceptable to most engineering students. Thus, a fundamental limitation for hydrofoil vessels is the occurrence of cavitation. This constraint forces the designer of these craft to select disproportionately larger foils for larger vessels. This point is made on p. 168. In a somewhat more sophisticated manner, the author explains the relevance of beam-to-length ratio of a ship section when one is considering the response to waves, on p. 237. The wave interactions between the demihulls of a catamaran are clarified in a similar manner, as well as other aspects of the motions of semi-displacement vessels.

The book contains many useful and practical approximate formulae which will be of great value to the practical naval architect who requires a reliable 'rule of thumb', as well as the researcher concerned with making theoretical comparisons. One example of these is Hoerner's (1965) formula for the spray drag of a surface-piercing strut, on p. 176. Another example is Breslin's (1957) formula for the inviscid coefficient of drag of a hydrofoil of finite span in the presence of the free surface, on p. 204.

The reason that the book will made a deep impression on the naval architecture world is that Faltinsen has himself researched almost all of the topics that he presents. An epitome of my statement is his excellent discussion of the so-called 'cobblestone effect' in the chapter *Surface-Effect Ships*. This is a phenomenon experienced by an SES when it travels over waves possessing a short wavelength. This is caused by resonance effects within the air cushion; the result can be unpleasant for the passengers.

The typography of the book is of a high standard. Two minor shortcomings should be mentioned: firstly, the equations frequently employ the factor '0.5', where the pure fraction '1/2' would be much preferred. The reason is that the fraction is the result of a mathematical analysis, or the inherent physics, and one should not mask this fact (even if the decimal equivalent is exact). Secondly, the symbols in the *List of Symbols* at the beginning of the book should be set in italic font – but not the acronyms (such as CFD and RMS), of course.

In summary, the book can be viewed as an application of fluid mechanics to a practical engineering problem, that of the understanding of the behaviour of high-speed marine vessels. This problem is currently occupying the minds of many naval architects throughout the world, because of the surge of interest in this fascinating field with so many difficult challenges. Professor Faltinsen's book is enhanced even further by the fact that it contains a very generous list of references, amounting to approximately 400 in number. This will permit the reader to extend his or her study

of the subject in even greater depth. Recommended companion reference books in this subject area are Newman (1980) and Trillo (1971).

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