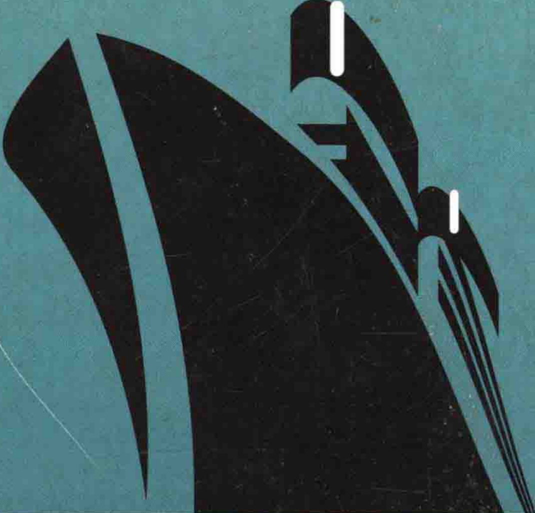
Marine Control Systems

Guidance, Navigation, and Control of Ships, Rigs and Underwater Vehicles



Thor I. Fossen

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This book is dedicated

to

Professor Jens G. Balchen

who introduced me to the fantastic
world of feedback control.

Preface

The main motivation for writing this book was to collect new results on nonlinear control of marine craft that have appeared since I published my first book: "*Guidance and Control of Ocean Vehicles*" (John Wiley & Sons Ltd. 1994). Most of these results have been developed in the Department of Engineering Cybernetics at Norwegian University of Science and Technology (NTNU) in close cooperation with my doctoral students; *Ola-Erik Fjellstad, Trygve Lauvdal, Jann Peter Strand, Jan Fredrik Hansen, Bjørnar Vik, Svein Peder Berge, Mehrdad P. Fard, Karl-Petter Lindegaard, Ole Morten Aamo,* and *Roger Skjetne* in the period 1991–2002. We have all been a great team, producing more than one hundred international publications in this period. These have resulted in several patents and industrial implementations.

In particular, I want to express my gratitude to *Dr. Roger Skjetne* and *Dr. Jann Peter Strand* for suggestions, case studies and comments to the manuscript. They have been instrumental in most of the work presented in the book. United European Car Carriers (UECC) and SeaLaunch LLC should also be thanked for contributing with full scale experimental results and case studies to the book. *Dr. Svein Peder Berge* and *Lars Ove Sæther* at Marintek AS have contributed with experimental results from the Ocean Basin in which model ships have been tested. *Adjunct Professor Svein I. Sagatun* and Norsk Hydro should be thanked for supporting our research projects on inertial navigation systems and marine operations.

Dr. Bjørnar Vik has been invaluable as a research fellow and colleague in the period 1998–2002. His expertise in the rapid prototyping of ship control systems, control theory and navigation systems has been most valuable. This expertise has been one of the keystones in the development of the GNC Lab (Guidance, Navigation and Control Laboratory), MCLAB (Marine Cybernetics Laboratory), and GPS/INS Laboratory at NTNU.

I would like to thank my family, *Heidi, Sindre,* and *Lone* for supporting this book project. Without their support it would have been impossible to accomplish the task of writing 586 pages with equations in less than two years.

Professor Asgeir J. Sørensen and *Professor Tor Arne Johansen* should be thanked for their careful proofreading and comments on the final manuscript. *Professor Olav Egeland* should be thanked for our mutual discussions on modeling and control. I am also grateful to *Andrew Ross* at the University of Glasgow for his assistance with the English language. The book also greatly benefits from students who took the course in Guidance, Navigation and Control at NTNU in 2002. They have all helped me to keep the number of typographical errors to an acceptable level.

Finally, I would like to thank *Professor Miroslav Krstic* for inviting me on a sabbatical at the University of California, San Diego (UCSD) in 2001, so that I could escape the office in Norway and finish the book in a reasonable time.

Thor I. Fossen
November 2002

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