Guidance and Control Problems of Marine Vehicle Track-Keeping

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The book deals with the problem of optimal ship stabilization on a trajectory under the effect of stochastic disturbances with the state vector measured either not fully or in error. Particular attention has been given to:
- substantiation of the possibility to use a suboptimal law in controlling a nonlinear object;
- allowance made for uncertainty of ship model parameters and disturbances using the control law, identification and state vector estimation;
- study of optimal methods for processing navigation information with consideration for dynamic features of the control object;
- definition of the requirements to the accuracy of navigation data sensors based on the analysis of ship motion control efficiency.
The book is intended for scientists, engineers and technicians engaged in navigation and motion control, as well as for teachers training postgraduates and high-school students in these subjects.

Bibliography: 175 references. 8 illustrations.

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The book considers metrology both as a pure and application-oriented science basing on a system approach. The discussion is prefaced with the basics of the general theory of systems. Metrological problems of systems modeling are considered on the basis of the analysis of the conception of a system. It is shown that in the system information plays a role of an integral factor and control - an integral function. The essence of the system study is shown by the example of metrology.

The measurement traceability system (MTS) is dealt with as the basic metrological system. Its place in the measurement control system and national measurement system, the metasystems that rank next in the level, is shown. The structures of

purposes, functions and subjects of the MTS are revealed, with emphasis on spacial(territorial) aspect or the level of localization.

The problem of centralization and decentralization are analyzed in the context of control in the MTS.

The structure and the scope of the problems of the main MTS subsystems: scientific, technical, organizational and legal are considered. Metrology of measuring systems, measuring information systems and measuring control systems were subjected to the methodological analysis. The advisability of applying the principles of metrological control to measuring information and control systems is justified. Measuring systems and measuring information systems are classified. A generalized structure of measuring control system including a measuring and information subsystems is presented. The role of classification as a general system function has been revealed. The necessity of estimating semantic information is shown, the requirements to estimates have been formulated, the relations used for estimation, as applied to the procedure of alternative and two-alternative check-in procedure, have been proposed.

The system outlook for the development of metrology is justified as a consequence of the present-day tendencies.

The discussion is illustrated with examples from measurements in navigation. A number of metrological problems are presented as a generalization of peculiarities of navigational measurements.

The book is intended for specialists of different branches of industry or science that make use of sophisticated measuring systems and complexes, as well as for designers of this kind of instrumentation. The book can be used by students and postgraduates who study the present-day metrology.

References: 166. Illustrations: 35.

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The book deals with integrated orientation and navigation systems (IONS) which are the main source of information of automatic motion control systems of marine vehicles.

The purpose and the basic design of IONS are considered, the algorithms for the operation of strapdown inertial measurement units (SIMU) and receivers of spacecraft navigation systems (SNS) are given**.** The purpose and the problems solved by electronic chart display information systems (ECDIS) are described. The SIMU mathematical error models based on different types of gyroscopes and gyroless SIMU are presented, as well as IONS error models for alignment and calibration modes, autonomous and observation operational modes.

The state of the art in the development of the main modules of IONS, in particular, SIMU sensitive elements, receivers of SNS and ECDIS is reviewed. The present-day requirements are formulated and structure of IONS for ships and vessels of various classes is described.

The accuracy in generation of navigational and dynamic motion parameters of marine vehicles provided by IONS based on SIMU with electrostatic, laser and fiber-optic gyros, as well as gyroless SIMU with angular accelerometers is analysed. A mathematical model, analytical expressions for errors and the results of computational error modeling are given for each of IONS considered in the book.

The book is intended for engineers, technicians and researchers engaged in marine engineering, navigation and marine motion control problems. The book can be used by teachers, postgraduates and senior students of naval schools.

References: 79. Illustrations: 71.

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