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Book Review

Publishers are invited to send two copies of new books for review to Dr. I. Michael Ross, Code: AA/Ro, Department of Aeronautics and Astronautics, U.S. Naval Postgraduate School, 699 Dyer Road, Monterey, CA 93943.

Aerospace Sensor Systems and Applications

Shmuel Merhav, Springer–Verlag, New York, 1996, 454 pp., $79.95, ISBN 0-387946055

Merhav states in the Introduction:

> This book is about aerospace sensors, their principles of operation, and their typical advantages, shortcomings, and vulnerabilities. They are described in the framework of the subsystems where they function and in accordance with the flight mission they are designed to serve. The book is intended for students at the advanced undergraduate or graduate level and for engineers who need to acquire this kind of knowledge. An effort has been made to explain, within a uniform framework of mathematical modeling, the physics upon which a certain sensor is based, its construction, its dynamics, and its error sources, and their corresponding mathematical models.

This is a good summary of the book and, if the statements are viewed as objectives, the author has achieved his objectives with one minor exception. Some engineers interpret the word *aerospace* to include aircraft and spacecraft. The sensors discussed in this book are those for aircraft and missiles, i.e., accelerometers and gyros. These sensors are also used sometimes on spacecraft, but those sensors that are unique for spacecraft, such as horizon sensors, sun sensors, and star sensors, are not discussed. The mathematical level of the book is that of any graduate engineer having completed a course in linear system theory. For each of the sensors discussed, mathematical models are presented along with sufficient figures and physical insight to make the subject easily understood.

Chapter 1 introduces the principal types of aerospace sensors in generic form, and Chapter 2 is an introduction to random processes. In Chapter 1, the author establishes the framework from which he discusses the sensors and their characteristics. The reviewer liked this approach. Chapter 2 provides a good discussion of random processes and is recommended for anyone wanting a quick review of this subject.

The remainder of the book, with the exception of Chapter 9, is dedicated to specific sensors. Both the traditional sensors, analog accelerometers and electromechanical gyros, and the newer high-technology sensors, Coriolis angular rate sensors, interferometric fiber optic gyros (IFOG), and the ring laser gyros (RLG), are treated. Chapters 3 and 4 cover the traditional analog accelerometers and electromechanical gyros. Obviously, all of the types of force and rotation sensors cannot be discussed. These chapters, however, include the ones most frequently used: the vertical gyro, the directional and rate gyros, the floated rate-integrating gyro, and the dry-tuned-rotor gyro. Chapter 5 presents some applications of gyroscopic technology. The reader will appreciate the inclusion of the analysis of the effects of imperfections, such as dynamical errors, noise, offsets, and resolution, on system performance.

Chapter 6 is devoted to the principles of operation of Coriolis rate sensors, sensors that use rotating or vibrating accelerometers to obtain measurements of inertial angular rate. Because the need for smaller, rugged sensors for applications such as unmanned air vehicles is increasing, the inclusion of this subject is timely and will be appreciated by many engineers. The IFOG and the RLG, gyros whose principles of operation are based on the universal constancy of light in a vacuum, are presented in Chapters 7 and 8. In addition to the principles of operation, the limitations and imperfections are discussed. The final chapter provides an introduction to filtering, estimation, and aiding and their application to these sensors.

In summary, this book is an excellent choice for a course on aerospace sensors, and it provides an excellent introduction to the subject for engineers who want to learn about these sensors. As with most books, the topics discussed can be found in other sources. This book, however, discusses all of these sensors with a uniform framework of mathematical modeling and an emphasis on physical insight. There are numerous examples and figures to aid understanding. The book is useful for engineers moving into research and development in this area, as well as for system engineers trying to understand the critical issues so that they can interface with vendors and other engineers.

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