

Book Review

RADIONAVIGATION SYSTEMS

By Börje Forssell, Artech House,
685 Canton Street,
Norwood, MA 02062, U.S. 2008.
ISBN: 1-59693-354-2.
392 p.

“THE ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM (ECDIS) An Operational Handbook”

By Adam Weintrit,
CRC Press,
Taylor & Francis Group 2009,
ISBN 978-0-415-48246-2,
1101 pages.

RADIONAVIGATION SYSTEMS

Radionavigation Systems, by Börje Forssell, was originally published in 1991. This year, the original edition was reprinted as part of the Artech House GNSS Technology and Applications Series (a series edited by Elliott Kaplan and Chris Hegarty). Although the book is 17 years old, it contains a wealth of information that is still useful today, as well as details of older radio-navigation systems that are no longer found in more recent texts.

The book treats terrestrial and satellite navigation separately, and is divided accordingly into two parts. Part I begins with three concise introductory chapters describing the fundamentals of terrestrial navigation, error propagation and basic electromagnetic wave propagation. They are followed by three chapters describing the specifics of a long list of systems. Chapter 4 describes hyperbolic systems, including OMEGA, DECCA and LORAN-C. Chapter 5 discusses direction finding and Chapter 6 describes the aeronautical systems, including VOR, DME, ILS and MLS.

While the implementation details of OMEGA and DECCA may be of little use today, the rest of Part I is still current. Chapter 2, in particular, presents error calculations using an interesting combination of graphics and math that is not found in many other texts. The chapter also contains a very thorough discussion of error ellipses for each type of terrestrial system, although the relationship between error ellipse and the covariance matrix of the position solution is not emphasized. The chapter also contains a discussion of the relationship between the various accuracy measures, such as CEP and DRMS. The discussion of electromagnetic propagation in Chapter 3 is quite interesting, as it is more accessible than a typical physics text—but, unlike many satellite navigation books, it discusses tropospheric and ionospheric effects at a multitude of frequencies and not just in the L-band. Thirty-one pages are devoted to LORAN-C, including details not normally found in most textbooks, such as circuit diagrams for receiver components and descriptions of the transmitter stations and equipment. The chapter on direction finding is brief, but sufficient. Part I concludes with a comprehensive description of the major aeronautical radio-navigation systems. Again, there are other books about aeronautical radio-

navigation, but Forssell gives just enough information so that the reader understands the principles of operation and the major error sources of each system.

Part II on satellite systems begins with three chapters of fundamentals. This time, they are satellite orbits, navigation principles and a chapter on error calculations. TRANSIT, spread-spectrum signals, NAVSTAR/GPS, GLONASS and “Other satellite navigation systems” are then each treated in their own chapters. The discussion of satellite orbits is brief, as is the chapter on the principles of satellite navigation, where the concept of Doppler frequency and time transfer is discussed. Similar to Chapter 3, Chapter 9, where satellite navigation error calculations are discussed, is detailed. There is a good description of atmospheric errors and an interesting discussion of the relationship between satellite geometry and frequency error, which was an important consideration with TRANSIT and is not seen in more recent satellite navigation texts. Dilution of precision is also introduced in great detail, along with a derivation of the often quoted, though rarely explained, “volume approximation” of GDOP. Chapter 10 consists of a 24-page description of TRANSIT, which includes several historically interesting sections, amongst which are block diagrams of receivers and satellite data formats. Chapter 11 describes the spread spectrum codes used by GPS before Chapter 12 introduces GPS, and for this reason seems a little bit out of place. However, it contains details about the code generation and reception that are found in many electrical engineering references, but is written at a level that is easily accessible to non-specialists. The GPS chapter that follows is interesting in that it is very detailed in terms of describing the system, the control segment and the navigation message. However, the discussion of receivers is somewhat rudimentary. The treatment of differential GPS and carrier-phase techniques is valuable in that it pre-dates the widespread development of RTK techniques.

Part II concludes with a brief description of the then-Soviet Union GLONASS system in Chapter 13, as well as a short discussion of TSIKADA (the Soviet equivalent of TRANSIT) in Chapter 14. Also mentioned are several other satellite navigation systems, including STARFIX and GEOSTAR/LOCSTAR, as well as the NAVSAT proposal that preceded the European GALILEO program.

The book concludes with nine appendices covering topics from spherical trigonometry, to least squares and Kalman filtering, to a discussion of how satellites are launched into specific orbits.

Although many of the systems and specifications listed in the book are out of date, the fundamental principles are presented in a thorough, yet easy to understand, way that is not found in many more recent texts. Specifically, the two “error calculations” chapters should be required reading for any prospective surveyor or geomatics engineer. Overall, Radionavigation Systems is an excellent book, and one many younger navigation engineers will wish they had been able to obtain earlier in their careers.

Kyle o’Keefe

Note of the Editor: Reprinted by kind permission of the Canadian Institute of Geomatics.

**“THE ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM (ECDIS)
An Operational Handbook”**

One can find little fault about this book except its weight! Written by Adam Weintrit, who has a distinguished background as a mariner and academic, it provides a comprehensive view of ECDIS covering both governmental and commercial interests. It is lavishly illustrated and the written English is clear and readable. Its origin and no doubt its future use will be primarily in the school room and particularly in the hands of young navigators. The need for adequate training has been stressed repeatedly when new technology is being introduced and this volume will contribute substantially to that objective. The author, although working in the academic arena, clearly knows his way around the international institutions that have been so much involved in introducing this technology. He also seems most familiar with the numerous companies providing both systems and developing the chart data. He shows detailed knowledge of the development of the complex international legislation that has associated itself with the charts, the chart systems and the several other systems that today contribute to modern e-navigation. The illustrations are both colourful schematics describing processes and configurations and cartoon drawings, presumably used in the lecture hall. This is a good time to be

describing ECDIS as it is really coming of age. At long last Electronic Navigational Charts (ENCs) are available for most areas of interest and the long expected legal requirement for ECDIS to be carried is becoming a reality.

Before launching into a commentary of the strengths and few weaknesses of this book it may be useful to outline the contents:

1. Legal Aspects, Requirements and International Standards
2. Principal Types of ECS and Electronic Charts
3. ECDIS Data
4. Presentation of ECDIS Data
5. Main Functions of ECDIS
6. Special Functions for Route Planning
7. Route Monitoring and Special functions
8. Data Updating Systems
9. Additional Navigation- Related Information Sensors, Display and Function
10. Voyage Data Recording
11. Errors, Status Indications, Warnings and Alarms
12. Operational Requirements

In addition to discussing each of these subjects in great detail there are a number of appendices that cover such useful topics as the IMO ECDIS Model Course, a Glossary of ECDIS-Related Terms and a description of the Admiralty Vector Chart Service (AVCS).

Anyone who has spent time in the ECDIS arena of committees, working groups and assemblies since electronic charts first came on the scene in the early 1980s will know the extent of discussion that has gone on concerning every one of the titles above. The author has covered each in great detail objectively discussing the often opposing views of government and industry as the technology has developed. This has included the need to carefully distinguish between ECDIS and