Global Positioning System: Theory and Applications

Volume II

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Preface

Overview and Purpose of These Volumes

Of all the *military* developments fostered by the recent cold war, the Global Positioning System (GPS) may prove to have the greatest positive impact on everyday life. One can imagine a 21st century world covered by an augmented GPS and laced with mobile digital communications in which aircraft and other vehicles travel through "virtual tunnels," imaginary tracks through space which are continuously optimized for weather, traffic, and other conditions. Robotic vehicles perform all sorts of construction, transportation, mining, and earth moving functions working day and night with no need for rest. Low-cost personal navigators are as commonplace as hand calculators, and every cellular telephone and personnel communicator includes a GPS navigator. These are some of the potential positive impacts of GPS for the future. Our purpose in creating this book is to increase that positive impact. That is, *to accelerate the understanding of the GPS system and encourage new and innovative applications.*

The intended readers and users of the volumes include all those who seek knowledge of GPS techniques, capabilities, and limitations:

• Students attending formal or informal courses
• Practicing GPS engineers
• Applications engineers
• Managers who wish to improve their understanding of the system

Our somewhat immodest hope is that this book will become a standard reference for the understanding of the GPS system.

Each chapter is authored by an individual or group of individuals who are recognized as world-class authorities in their area of GPS. Use of many authors has led to some overlap in the subject matter which we believe is positive. This variety of viewpoints can promote understanding and contributes to our overall purpose. Books written by several authors also must contend with variations in notation. The editors of the volume have developed common notations for the important subjects of GPS theory and analysis, and attempted to extend this, where possible, to other chapters. Where there are minor inconsistencies we ask for your understanding.

Organization of the Volumes

The two volumes are intended to be complementary. Volume I concentrates on fundamentals and Volume II on applications. Volume I is divided into two parts: the first deals with the operation and theory of basic GPS, the second section with GPS performance and errors. In Part I (GPS Fundamentals), a

standing of the three GPS segments: User, Satellite, and Control. Even the best of systems has its limitations, and GPS is no exception. Part II, GPS Performance and Error Effects, is introduced with an overview of the errors, followed by chapters devoted to each of the individual error sources.

Volume II concentrates on two aspects: augmentations to GPS and detailed descriptions of applications. It consists of Parts III to VI:

- III. Differential GPS and Integrity Monitoring
- IV. Integrated Navigation Systems
- V. GPS Navigation Applications
- VI. Special Applications

Parts III and IV expand on GPS with explanations of supplements and augmentations to the system. The supplements enhance accuracy, availability, or integrity. Of special interest is differential GPS which has proven it can provide sub-meter (even centimeter) level accuracies in a dynamic environment. The last two sections (V and VI) are detailed descriptions of the major applications in current use. In the rapidly expanding world of GPS, new uses are being found all of the time. We sincerely hope that these volumes will accelerate such new discoveries.

Acknowledgments

Obviously this book is a group undertaking with many, many individuals deserving of our sincere thanks. In addition to the individual authors, we would especially like to thank Ms. Lee Gamma, Mr. Sam Pullen, and Ms. Denise Nunes. In addition, we would like to thank Mr. Gaylord Green, Dr. Nick Talbot, Dr. Gary Lennon, Ms. Penny Sorensen, Mr. Konstantin Gromov, Dr. Todd Walter, and Mr. Y. C. Chao.

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