

BOOK REVIEWS

tant idea found a place in the main text, and not in a footnote. A short paragraph would certainly not have been too much out of place, specially as the section is aimed at explaining what is an ensemble.

I was not too happy with the quality of production. In a book, I like to have a new chapter start on a new page. With heavy technical subjects, one looks forward to these end-of-chapter markers as psychological boosters. They are like a pat on the back for having persisted so far, or as inducement to continue just a bit longer. I think the benefits are well worth the added cost of extra paper. Unfortunately, in this book, a new chapter starts just where the last one is finished. The number of misprints is not large, but a more watchful copy editor would have spotted errors like the title of the book mentioned incorrectly in the Foreword. There are other goofs, e.g. the book informs that the Monte Carlo method is 'named after a city, in the province of Monaco, south of France', an irrelevant bit of geographical information, but forgets to mention the casinos that give the method the name. Some pictures of percolation clusters, or of the Marsaglia lattice structure would have helped the reader better than words.

On the whole, I think the book is likely to be useful to practitioners of the Monte Carlo technique, and to students wanting to learn about the technique. It would be a good addition to libraries of universities and research institutes.

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Essentials of GPS. N. K. Agrawal. Geodesy and GPS, 202, KNR Apartments, Street No. 8, Habsiguda, Hyderabad 500 007. 2006. 145 pp. Price: Rs 260.

In the 1970s, the US Department of Defense developed a super-precise form of worldwide positioning for military applications at a huge cost of about 12 billion

US dollars. This has resulted in a good Global Positioning System (GPS) and has changed navigation forever.

GPS is a worldwide radio navigation system formed from a constellation of 24 satellites and their ground stations. Satellites transmit information towards the earth and the GPS receivers take the transmitted information and use a form of triangulation to calculate the user's exact location, accurate to a few metres. Advanced form of GPS can make measurements better than a centimetre. Soon, GPS will become an indispensable tool of utility like the telephone.

The World Geodetic System (WGS-84) utilizes detailed gravitational irregularities of the earth, and is used as a standard earth model for GPS applications.

Maps and coordinates in India are in a local geodetic reference system based on Everest Spheroid – Indian geodetic system. The coordinates in this system may differ even by a few hundreds of metres compared to WGS-84 coordinates. Both the systems are related by a transformation.

GPS measures distance (range) using travel time of radio signals. This in turn needs accurate timing, position of the satellite in space and to correct for any delays the signal experiences as it travels through the atmosphere. By accurately measuring the distance from three satellites, one can triangulate the position from anywhere on the earth. Satellites use atomic clocks.

Differential GPS (DGPS) is a system in which differences between observed and computed coordinates or ranges, known as differential corrections, at a particular known point called reference station, are transmitted to the user (Rover GPS receiver) in real-time to improve the accuracy of the user receiving position. Positional accuracies are less than 10 m. DGPS services currently available in India provide accuracies up to 10 cm.

GPS including DGPS is an all-weather, real-time, continuously available, economic, precise positioning and time-determination technique. Applications include military and police, navigation, aviation, surveys, geophysics, geology, mining, engineering, etc. Cost of a GPS receiver varies from a few hundred US dollars to US \$30,000 (Rs 10,000 to 15 lakhs).

Different countries have employed different satellite navigational systems. GAGAN is the proposed Indian space-based augmentation system, jointly between ISRO and Airports Authority of

India, to provide seamless navigation service for all the phases of flight over the Indian airspace.

Today, GPS is revolutionizing many fields, including surveying, automated vehicle tracking, municipal planning, etc. GPS provides accurate positional information to individuals and organizations around the world. This improves the quality of everything, from asset management to field workforce operations. Also, the US is proposing anti-jam capabilities. Recent development such as removal of selective availability has not merely made this technology more accurate, but has also opened up a new segment of applications, particularly in location-based services. In future, every one of our houses will be GPS-indexed, rather than have a house number.

The book under review by N. K. Agrawal is a short one of 145 pages, consisting of 97 pages of text and about 50 pages of articles/columns on GPS with references. It is a straightforward introductory text and can be used by any enthusiast of GPS who wants to know how the system works and what it can be used for. In each chapter, only essentials are given. Mathematically non-rigorous, starting with geodesy fundamentals in chapter 1, the book deals with the reference coordinate system, GPS, signal processing and GPS observables, error budget and corrections, differential GPS and GPS applications.

To my knowledge, there are no Indian books on GPS and Agrawal's book is the first. His knowledge and experience, both as a practitioner and as a teacher of GPS, is reflected in each of the topics. The narration is concise and straight to the point, rather than dealing with lots of theory and details. A list of questions at the end of each chapter is given for reviewing. For the first time we see in this book the transformation of coordinates from WGS-84 to Everest ellipsoid.

The articles and columns in this book provide interesting reading and give insight into various aspects of GPS besides revealing highly useful information, national and international.

Some interesting points are mentioned below:

The author has given details and inferences drawn from an experimental study with a hand-held GPS receiver called Garmin GPS Navigator. According to him, it can be used only for planimetry and not for height determination. Also,

accuracies of a hand-held receiver are discussed in detail (pp. 139–141).

GPS is the single biggest contributor to the US war against Afghanistan and is described as the poor man's cruise missile (p. 103).

Monitoring underwater environment (coral reefs and vegetation) is possible with GPS.

Experiences of GPS in Antarctica is also mentioned on p. 105.

President Clinton of USA announced his decision to stop degrading GPS accuracy on 1 May 2000. As a result, the accuracy has increased from 100 to 15 m. Agrawal points out the urgent need to

have an Indian policy on GPS, keeping in mind the threat perceptions to national security. The present policy of obtaining a license to procure a GPS in India is also to be discussed.

The author brings out the capabilities and limitations of a GPS in use in India as well as different types of receivers manufactured all over the world.

Receiver-Independent exchange format enables combining outputs from two different GPS receivers.

GPS training and graduate programmes are in their infancy in India.

On the whole, the book will be a useful addition to libraries and is recommended

to all those who want to have a look at the basics of GPS in a compressed form. The author should include in his next edition subject index, a brief history of each topic, GPS modernization, and further reading in each chapter in order to provide a good understanding of all aspects to the readers.

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