Springer Handbook of

Geographic Information

Kresse
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Editors

2nd Edition

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Editors

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2nd Edition

With 620 Figures and 98 Tables

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Preface

> "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me".
> (Isaac Newton)

In this sense, the book may help us to discover a small bay in the ocean of truth and may slightly improve our insight into geographic information.

It has been almost 60 years since the phrase "geographic information system" was coined in the early 1960s. Geographers recognized the need for automation of detail-oriented processing, and computers had matured enough to handle rudimentary models of the geographic phenomenon. In the early days, geographic information systems were operated mostly in the purview of national governments and universities. As processing power and model complexity grew, and the cost of memory storage dropped, GIS slowly spread beyond governments into many disciplines and the private sector. Since the turn of the century, GIS has continued to grow rapidly, and with the advent of the Internet is now used every day even by nongeographic literate people in all walks of life.

As a typical cross-sectional science, geographic information supports many other subject areas with respect to their spatial components. The diversity of geographic information is often overlooked; one of the goals of this handbook to demonstrate this variety of applications. They range from classical subjects, such as cartography and photogrammetry, through modern fields, like Internet-based Earth browsers, to specialized systems for agriculture or health services, just to mention two of them.

Often, the term "geoinformatics" is used in place of geographic information science. This is deliberately done because the International Standardization Committee considers geographic information a specialization of information technology. Consequently, formerly prevailing paradigms have been pushed back. Cartography is no longer primarily an "engineering art". Data capture from aerial and satellite imagery is not above all precision engineering, optics, and applied mathematics. Property cadastre is not exclusively measuring art and legislation. The new philosophy is applied information technology, in particular the Internet – static and mobile, data bases, and a braiding of components from computer science. The handbook is concerned with explaining this common ground. ISO and OGC standards are referenced in many chapters as an important foundation for geographic information applications.

This second edition of the handbook follows the format of the successful first edition. Because of the rapid advancement of geographic information technology every chapter has been revised. The authors, experts in their fields, were keen to provide the latest development in the technology of their field. Several new chapters have been added: Big Data Analytics, Surveying, Building Information Modeling, Open Source GIS, and Smart Cities.

The handbook is subdivided into three parts, Basics and Computer Science, Geographic Information, and Applications. Although the structure may be quite clear, not every topic can be absolutely allocated to one of the three parts.

The first part of the book begins with a chapter about modeling; the basic concepts for abstracting real-world geographic phenomena into data for use in an information system. Other chapters in this part are linked to the basics of information technology and mathematics. The

chapters about big data and the geospatial semantic web (Part 2) illuminate developments of information technology that are essential for spatial data that are often characterized by huge volumes of data, as well as multicultural and multilinguistic environments, but are still developing rapidly.

The second part addresses the specific foundations of geographic information. Chap. 6 starts with a little textbook about geographic information. Other chapters present geodesy and coordinate reference systems, data acquisition, remote sensing, metadata, geometry, and cartography, among others.

Out of the multiplicity of applications only a limited number of typical cases can be presented in the third part of the book. However, the selection focuses on the broad range of the field and stimulates the reader to gain a better understanding and, perhaps, some new ideas.

The authors, from all parts of the world, convey their distinctive perspectives of the same large field of geographic information. While in Europe geographic information is driven by legislative and organizational framework, with respect to property cadaster and planning in particular, in other parts of the world it is more technology driven.

The development of applications reaches from proprietary systems to the open-source community. The handbook allows for both. Large software vendors keep playing a predominant role in governmental systems and/or demanding developments. This is illustrated in the chapters about marine GIS and hydrography, energy suppliers, and defense. The open-source concept is addressed in the chapter of the same name. Geology, which has always been a driving force for development in cartography and geographic information, may today count for both sides, administrative systems and the open-source world.

Access to the Internet via cell-phone networks has widely abolished the distinction between static and mobile applications. Mobile applications mainly differ from static ones in their specific tasks. This topic is addressed in the chapters Geospatial Web Services, Location-Based Services, and GIS in Transportation.

Economically relevant applications are fully developed and in daily operation but only because they were preceded by research activities like those covered in several of the handbook chapters, such as in Change Detection and Marine GIS with a focus on marine ecology.

What is the distinction between a textbook and a handbook? A handbook is like a collection of many small textbooks. Every chapter conveys a good and complete summary of a subject area with references for further study. The authors have solved their tasks in different ways. Some of them have prepared the subject like a tutorial to help understand a lecture. An example is the chapter about positional accuracy improvement, including an introduction to adjustment theory in Chap. 2. Other authors explain the basics and complement these with elaborated examples, as is, e.g., done in the section about spatial databases in Chap. 3. Further on, the handbook promotes the harmonization of content and terminology, primarily in Chap. 12 about standards.

As described above, geographic information is a diversified subject that resists full documentation in one single book. We hope that our selection of topics reflects all important and many typical perspectives, and that the numerous references to other sources may help the reader to proceed where coverage by the handbook ends.

Neubrandenburg and Vienna, VA — Wolfgang Kresse
May 2022 — David M. Danko

Abbreviations

AIP	Archival Information Package
API	Application Programming Interface
ARP	aperture reference point
ASCII	American Standard Code for Information Interchange
ATS	abstract test suite
dBsm	decibels referenced to a square meter
CORBA	Common Object Request Broker Architecture
DCOM	Distributed Component Object Model
DEM	Digital Elevation Model
DIP	dissemination information package
DOP	Digital Orthophoto
DSM	Digital Surface Model
DSNU	dark signal non uniformity
DTM	Digital Terrain Model
ECEF	Earth Centered Earth Fixed
ETS	executable test suite
FITS	Flexible Image Transport System
FOM	figure of merit
FOV	Field of View
GML	Geography Markup Language
GNSS	Global Navigation Satellite System
GRP	ground reference point
HARLIE	Holographic Airborne Rotating Lidar Instrument
ICS	Implementation Conformance Statement
IERS	International Earth Rotation Service
IFOV	Instantaneous Field of View
IRI	Internationalized Resource Identifier
ISBN	International Standard Book Number
IUT	Implementation Under Test
IXIT	Implementation extra Information for Testing
JPEG	Joint Photographic Expert Group
LIDAR	Light Detection and Ranging
MCES	multichannel echo sounding
MIME	Multipurpose Internet Mail Extensions
OAIS	Open Archival Information System
OASIS	Organization for the Advancement of Structured Information
ODP	Open Distributed Processing
OGC	Open Geospatial Consortium
OSE	open systems environment
OWL	Web Ontology Language
PDI	preservation description information
PHD	phase history data

PRNU	pixel response non-uniformity
PSLR	peak side lobe ratio
RAF	Reference Architecture Foundation
RDF	Resource Description Framework
RFID	Radio Frequency Identification
SAR	Synthetic Aperture Radar
SBES	single beam echosounder
SIP	Submission Information Package
SNR	signal-to-noise ratio
SOAP	Simple Object Access Protocol
SONAR	Sound Navigation and Ranging
SUT	System Under Test
TIFF	Tagged Image File Format
TOF	time of flight
TRF	terrestrial reference frame
TRS	terrestrial reference system
UDDI	Universal Description, Discovery and Integration
UPA	ubiquitous public access
URI	Uniform Resource Identifier
VRS	Vertical Reference System
WSDL	Web Services Description Language
XML	Extensible Markup Language
XSLT	Extensible Stylesheet Language Transformations

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