Digital Photogrammetry

Wilfried Linder

Digital Photogrammetry

A Practical Course

Fourth Edition

Springer

Wilfried Linder
Geographisches Institut
Universität Düsseldorf
Düsseldorf
Germany

Additional material to this book can be downloaded from http://extras.springer.com.

ISBN 978-3-662-50462-8 ISBN 978-3-662-50463-5 (eBook)
DOI 10.1007/978-3-662-50463-5

Library of Congress Control Number: 2016942003

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer-Verlag GmbH Berlin Heidelberg

Preface to the Fourth Edition

During the time since the last edition, the software development went on, and therefore it was necessary to adapt the text according to the actual program versions which were also tested to work properly under MS Windows 10. A few options which are obsolete nowadays were removed, some new options were added, handling of the software was simplified in several places, and so on. For the use of own images taken with a custom digital camera, a new chapter offers an easy way of lens calibration and explains how to get good results with a minimal work. Nevertheless, the general structure and the aims of this book remain unchanged: Step by step the reader is led through several tutorials to see and learn the basics of photogrammetric processing.

Like in the previous editions, not only the input data but also the intermediate and final results are presented, so that it is possible to skip parts of a tutorial and go on with a later state. The software and the data are no more delivered on CD-ROM but are available in a server: Just go to extras.springer.com and key in the ISBN number of this book.

Many thanks to Mrs. Angela Rennwanz (University of Düsseldorf) for her help with the layout of this book!

Düsseldorf
March 2016

Wilfried Linder

Preface to the Third Edition

Also the second edition was sold successful. It seems that the hope I wrote about in chapter 6.8 ("A view into the future: Photogrammetry in 2020") will be fulfilled—photogrammetric techniques are not only in use until today but even new fields of applications came up. One of them is stereo photogrammetry with high resolution satellite images about which we will talk and learn in a new tutorial, see chapter 6.6. Another interesting new chapter (6.7) deals with simple flatbed scanners which you can use to create anaglyph images from small objects.

Again the software (included on the CD-ROM) was improved, a new programme (LISA FFSAT) was added, and the text in this book was actualised to the new possibilities of the software.

This is the place to thank the publisher and in particular Dr. Christian Witschel for the pleasant and straightforward collaboration since nearly 10 years!

January 2009 Wilfried Linder
Düsseldorf

Preface to the Second Edition

During the short time between the first edition and now many things happen giving the editors and me the idea not only to actualise this book but also to include further chapters. The changes are (among others):

The subtitle. It was the goal to give readers a compact and practical course with theoretical background only as far as necessary. Therefore we changed the subtitle from "Theory and Applications" to "A practical course". Nevertheless, and this was a remark of several reviewers, some more theory than before is included.

More about close-range photogrammetry. The first edition dealt mainly with aerial photogrammetry, now the field of terrestrial or close-range applications is expanded. For instance, an automatic handling of image sequences (time series) was developed and will be presented.

In this context we also take a special look to digital consumer cameras which now are available for low prices and which the reader may use for own projects in close-range applications. Regarding the lens distortion of such cameras, a chapter dealing with lens calibration was added.

A glossary now gives the reader a quick reference to the most important terms of photogrammetry. All words or technical terms included there are written in *italics* in this book.

Last but not least: The software which you find on the CD-ROM was improved and expanded, and the installation of software and data is now easier than before.

July 2005 Wilfried Linder
Bad Pyrmont

Preface to the First Edition

Photogrammetry is a science based technology with more than a century of history and development. During this time, the techniques used to get information about objects represented in photos have changed dramatically from pure optic-mechanical equipment to a fully digital workflow in our days. Parallel to this, the handling became easier, and so it's possible also for non-photogrammetrists to use these methods today.

This book is especially written for potential users which have no photogrammetric education but would like to use the powerful capabilities from time to time or in smaller projects: Geographers, Geologists, Cartographers, Forest Engineers who would like to come into the fascinating field of photogrammetry via "learning by doing". For this reason, this book is not a textbook—for more and deeper theory, there exists a lot of literature, and it is suggested to use some of this. A special recommendation should be given to the newest book from KONECNY (2002) for basic theory and the mathematical backgrounds or to the book from SCHENK (1999) for the particular situation in digital photogrammetry. For a quick reference especially to algorithms and technical terms see also the Photogrammetric Guide from ALBERTZ & WIGGENHAGEN (2005).

This book includes a CD-ROM which contains all you need from software and data to learn about the various methods from the beginning (scanning of the photos) to final products like ortho images or mosaics. Starting with some introductory chapters and a little bit of theory, you can go on step by step in several tutorials to get an idea how photogrammetry works. The software is not limited to the example data which we will use here—it offers you a small but powerful Digital Photogrammetric Workstation (DPW), and of course you may use it for your own projects.

Some words about the didactic principle used in this book. In Germany, we have an old and very famous movie, "Die Feuerzangenbowle" with Heinz Rühmann. This actor goes to school, and the teacher of physics explains a steam engine:

"Wat is en Dampfmaschin? Da stelle mer us janz dumm, un dann sage mer so: En Dampfmaschin, dat is ene jroße, schwachze Raum…" (SPOERL, 1933.

A language similar to German, spoken in the area of Cologne; in English: What is a steam engine? Suppose we have really no idea, and then let's say: A steam engine, that is a big black hole…). This "suppose we have no idea" will lead us through the book—therefore let's enter the big black hole called photogrammetry, let's look around and see what happens, just learning by doing. Theoretical background will only be given if it is indispensable for the understanding, but don't worry, it will be more than enough of theory for the beginning!

Concerning the object(s) of interest and the camera position(s), we distinguish between terrestrial (close-range) and aerial photogrammetry. This book mostly deals with the aerial case. Nevertheless, the mathematical and technical principles are similar in both cases, and we will see an example of close-range photogrammetry in the last tutorial.

A briefly description of the software is included in the last part of this book (chapter 10).

This is the right place to give thanks to all people who helped me:

To my chief, Prof. Dr. Ekkehard Jordan, for all the time he gave me to write this book, and for his interest in this science—he was one of the first Geographers using analytical photogrammetric methods in glacier investigation—and to all my friends and colleagues from the Geographic Institute, University of Düsseldorf, for many discussions and tests. To Mrs. Angela Rennwanz from the same institute—she made the final layout, therefore my special thanks to her!

To Prof. Dr. mult. Gottfried Konecny, who encouraged, helped and forced me many times and gave me a lot of ideas, and to all my friends and colleagues from the Institute of Photogrammetry and GeoInformation (IPI), University of Hannover, for their scientific help and patience—especially to my friend Dr.-Ing. Karsten Jacobsen. To Prof. Dr.-Ing. Christian Heipke, now chief of the IPI, who agreed that I could use all of the infrastructure in this institute, and for several very interesting discussions especially concerning image matching techniques.

For proof-reading of this book thanks (in alphabetical order) to Dr. Jörg Elbers, Glenn West and Prof. Dr. mult. Gottfried Konecny.

Un agradecimiento de corazón a mis amigos del America del Sur, especialmente en Bolivia y Colombia!

It may be of interest for you: All figures in this book are also stored on the CD-ROM (directory …\figures) as MS PowerPoint™ files. Whenever you would like to use some of them, may be for education or scientific texts, please refer to this book! Thanks to the publishers for this agreement.

March 2003 Wilfried Linder
Bad Pyrmont

Contents

List of Figures

Formulas