[A]Preface

Photogrammetry developed slowly during the first 70 years of the twentieth century, but since 1972, when ERTS – later to become Landsat – was launched, the changes have become rapid. Landsat introduced digital images to a wide audience, and when SPOT-1 – an Earth observation satellite able to collect stereoscopic images – was launched in 1986, photogrammetry using images from space became a major interest of mapmakers and scientists. With Landsat, remote sensing became a recognised subject, initially concerned with the interpretation and classification of images, but then converging with photogrammetry, so that today the two subjects are fully complementary. This is particularly so with high resolution optical images, which compete with aerial imagery for smaller-scale mapping; high resolution data is also used for interpretation, studying the environment and intelligence gathering. This book is concerned with the photogrammetric use of high resolution images, although aspects of image processing are also discussed. The book aims to bring together information on a range of sensors, including their characteristics and the applications to which they are put.

The definition of "high resolution" is not universally agreed upon and for this reason we start with Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data, with 15 m ground sample distance (GSD). Stereoscopic images are acquired and the data is used photogrammetrically, particularly for digital elevation model (DEM) generation. SPOT-1 images with 10 m GSD are among the most widely used, and established the interest in the use of stereoscopic images from space. The current commercial sensors with GSD of less than 1 m are dealt with in the most detail because of their current importance. Photographic images are not forgotten, however, although their use today is minimal, and is mainly for monitoring purposes. We aim to present comprehensive information on all of these sensors and put them into context in the current world of geospatial information.

The second edition is fully revised to include sensors launched since the first edition and a new chapter on applications has been added. The data used in examples in the first edition have been retained as these demonstrate principles relating to the type of sensors rather than specific sensors. Updated results are however included.

The objective of the book is to explain the way in which high resolution imagery is obtained – along with the issues which surround its collection and use – to students, people working in map production and scientists working in fields other than mapping. In 2012 the book was awarded the Karl Kraus Medal by ISPRS as the best textbook in photogrammetry and remote sensing in the 2008-2012 period.

A step-by-step approach is employed, beginning with a discussion of the fundamentals of mapping from imagery in Chapter 1. Chapter 2 presents a historical overview of the development of optical sensors in space and covers CORONA and other film cameras. These played an important role in the establishment of the use of image data from space, but the problems of film recovery and the limitations of film in processing images led to their demise once SPOT demonstrated what could be done with push-broom stereo imagery.

Chapter 3 deals with the generic aspects of sensor hardware and the systems needed to record and transmit data from space, with an introduction to instrumentation to provide data for direct georeferencing of images from space.

Chapters 4 and 5 give details of specific sensors, particularly those in widespread use. Chapter 4 covers sensors with a GSD of greater than 2 m and includes SPOT 1–5 and ASTER; these sensors are mostly designed to collect stereoscopic data using two or more telescopes, pointing at fixed or variable angles. On the other hand, the sensors with a GSD of less than 2 m, discussed in Chapter 5, are mainly agile sensors which can be pointed in any direction, up to given limits. These two chapters discuss the technical specifications and

performance of the sensors, based on published studies.

Chapter 6 is devoted to with calibration, sensor models and orientation. This is a key chapter for users of the data and covers both rigorous models and rational polynomial coefficients, as well as variations of these methods. This chapter ends with a comparison of orientation methods.

Chapter 7 deals with product generation; the discussion is fairly generic and includes the principles of image matching and the particular problems of DEM generation from satellite-borne sensors. Issues of resolution and interpretation are discussed, again in the context of satellite data.

Chapter 8 covers some applications other than mapping, which is dealt with in chapter 7, and shows how high resolution Earth observation data collected from satellites can be used for many applications which benefit society through the provision of information for such diverse topics as health, disaster management, agriculture and location based services.

A final chapter summarises the current status of high resolution optical satellite imagery and reviews future developments.

The authors gratefully acknowledge support from organisations that have provided information and material used in preparing this book, in particular SSTL of Guildford (UK), GeoEye and DigitalGlobe. We also thank Keith Whittles for his encouragement to start and finish the book.

We hope that this book will help to expand the use of high resolution satellite data by enabling students and professionals to understand the technology involved and to appreciate and wonder at the magnificent images and detailed information which can be obtained from hundreds of kilometres above the surface of the Earth.