Foreword

No other technology has had a more profound influence on surveying and mapping during the past ten years than the global positioning system. GPS changed the way in which surveyors establish triangulation networks, photogrammetrists control aerial photographs, geodesists measure the dimensions of the Earth, and cartographers collect spatial topographic information for digital maps. But GPS is not limited to mapping applications; it will have an even more profound impact on aerial and marine navigation, and be a major component of intelligent vehicle highway systems. GPS even has the potential of unifying the large number of individual local coordinate systems that exist in every country and continent. It is the first time that the world community has accepted and can practically utilize a common global coordinate system.

Photogrammetrists have been major users of the global positioning system from the beginning. Recognizing its enormous potential for improving the data collection process and therefore making photogrammetric mapping more efficient and more competitive, GPS was first used to establish ground control, and later to eliminate ground control by directly observing the orientation parameters of photographs.

About eight years ago the first simulation studies were published; practical tests followed soon thereafter. The early reports indicated the tremendous potential of this revolutionary technology. Although skeptics questioned the feasibility of relying exclusively on GPS for aircraft navigation and control of photogrammetric blocks, research and practical experimentation continued at institutions all over the world. Now that the full constellation of GPS satellites is in place, and we have continuous coverage all over the globe, the years of research and investigation are bearing fruit. GPS photogrammetry has become an operational technique of aerotriangulation which is used by mapping agencies and companies all over the world. By simultaneously collecting aerial photographs and the precise locations of the aircraft, they are able to reduce the amount of ground control considerably.

In this special issue we try to show that GPS photogrammetry has become the technique of choice for aerotriangulation. The large number of articles submitted from photogrammetrists of many different countries is proof of the feasibility and the advantages of this method. The majority of articles included in this issue are about practical experiences with GPS photogrammetry, i.e., its application for aerial triangulation and photogrammetric mapping. The articles by Merchant, Gruen *et al.*, and Jakobsen represent different approaches for utilizing GPS during the photoflight; all are based on practical tests and show the high accuracy this method yields. The article by Becker and Barriere demonstrates the additional benefit of using GPS in the aircraft for flight navigation. This allows the pilot to take photographs precisely at the planned location; additionally, he may check the proper coverage by means of a moving map display directly in the airplane. In addition to the elimination of ground control, GPS-assisted photo collection can significantly accelerate the photogrammetric triangulation process.

This issue should be both informative and instructive. Some of the articles address the problems of practically using GPS in an aircraft. They should be of interest to readers who intend to take advantage of GPS photogrammetry, but did not want to take this step yet because of an uneasiness with the new technology. We hope that these readers are encouraged by the good results obtained by our authors, and that the published operational guidelines (see the articles by Curry and Schuckman and by Tudhope) are helpful. More theoretical papers by Ackermann and Schade, and Colomina introduce the reader to the analytics of GPS-controlled aerotriangulation. They are of value for the reader who wants to understand the mathematical background of GPS aerotriangulation and the modifications required to conventional aerial triangulation software.

Finally, we address new topics and applications of GPS in photogrammetry. As scientists strive for perfecting photogrammetric data capture, the field of sensor integration becomes more important. There are exciting new developments under way, such as the ones described by Schwarz, Chapman, Cannon, and Gong, that integrate GPS in the aircraft with a multitude of sensors, such as digital cameras, laser scanners, inertial systems, and radar. The objectives of these developments are the full automation of the photogrammetric mapping process. GPS holds a tremendous potential for allowing the automation of aerial triangulation simply by eliminating the need for ground control. The utilization of digital imaging sensors in the aircraft will make GPS aerotriangulation an integral part of digital photogrammetry.

Research in the advancement of GPS techniques and their application to photogrammetry is ongoing all over the world. For the interested reader we included announcements of working groups and committees specializing in this topic. The American Society for Photogrammetry and Remote Sensing (ASPRS) established a working group on "GPS Applications to Photogrammetry" and a special working group on "GPS Photogrammetry Standards." The International Society for Photogrammetry and Remote Sensing (ISPRS) focuses on GPS-related topics in WG II/1, "Real Time Mapping," and WG III/1, "Integrated Sensor Orientation." The interested reader is invited to contact the respective chairpersons and actively participate in these committees.

We hope that the collection of papers published in this Special Issue of *PE&RS* gives the reader a good overview of the state-of-the-art in GPS Photogrammetry. The articles demonstrate that GPS Photogrammetry is operational today. The positive experiences shared by the authors will be very valuable for the reader, and will convince new users of the potential savings that can be realized by applying GPS for photogrammetric mapping. The future will bring exciting new developments in sensor integration and mobile mapping — technologies that strongly rely on the global positioning system for the precise orientation of imaging sensors mounted on moving platforms.

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