ERROR THEORY OF INTERSECTION PHOTOGRAMMETRY,

Proceedings of the 8th International Symposium on Spatial Accuracy Assessment in Natural Resources and Environmental Sciences
Shanghai, P. R. China, June 25-27, 2008, pp. 30-36

Effects of Exterior Orientation Elements on Direct Georeferencing in POS-Supported Aerial Photogrammetry

Xueping Zhang and Xiuxiao Yuan
School of Remote Sensing and Information Engineering, Wuhan University,
129 Luoyu Road, Wuhan 430079, China

Abstract. Direct georeferencing has become more and more important in aerial photogrammetry, but the accuracy can't satisfy the requirements at small mapping scales in practical projects. The main reason is that the accuracy of exterior orientation elements determined by the POS is not high enough. According to the theory of space intersection and error propagation law, mathematical model of exterior orientation elements' effects on direct georeferencing based on space intersection proposed firstly. Afterwards, mathematical model of exterior orientation elements' effects on direct georeferencing based on collinearity equations are proposed according to collinearity equations and least square adjustment. The mathematical models are experimented using three sets of actual data at different photographic scales and terrains. Based on the empirical results, the effect rules of exterior orientation elements' errors on direct georeferencing in theory and in practice are analyzed respectively. Finally, effects of different combinations of same accuracies of exterior orientation elements on direct Georeferencing are discussed.

Keywords: Position and Orientation System, exterior orientation elements, direct georeferencing, error

1. Introduction

Along with Global Positioning System (GPS) and Inertial Measurement Unit (IMU) being used in aerial photogrammetry one after the other, it becomes possible for direct georeferencing without ground control points(Wan, 2004). Furthermore, the widespread uses of active sensors also urge the use of direct georeferencing. At the same time, accuracy research of direct georeferencing has got more and more attentions. Experiment of direct georeferencing with a Position and Orientation System has been organized by Europe Organization for Experimental Photogrammetric Research(OEEPE) in 1999, which provides a good guidance to the application of POS(Liu, 2004). After this, a series of researches have been done, and experiments shows that accuracy of direct georeferencing can't satisfy the request of large-scale topographical mapping in stereo mapping (Li, 2005). Direct georeferencing is an orientation means which obtains coordinates of ground points directly using the known exterior orientation elements of photos, it is sensitive to all kinds of errors (Jacobsen and Helge, 2004). Errors in direct georeferencing are from the following aspects: errors of interior orientation elements, errors of exterior orientation elements and errors of point coordinates. Although all kinds of errors may affect the accuracy of direct georeferencing, the main errors are from the errors of exterior orientation elements. In direct georeferencing, the errors of GPS、time synchronization and projection center deviation between GPS and aerial digital sensor、interpolation of GPS stations and transformation of coordinate system can affect the location of projection center directly, they may cause errors in line elements of exterior orientation elements ultimately. In the same way, the errors of attitude measurement in IMU body and boresight misalignment can arouse errors in angle elements of exterior orientation elements (Jacobsen, 2002). Therefore, based on the theory of space intersection、collinearity equations and error propagation law, mathematical models of exterior orientation elements' effects on direct georeferencing are proposed in this paper. Then, the effect laws of exterior orientation elements on direct georeferencing are analyzed using three sets of actual data which are different in mapping scale and terrains. The results in this article lay the theoretical foundation for analyzing errors in practical

ISBN: 1-84626-171-6, **ISBN13:** 978-1-84626-171-8

ERROR THEORY OF INTERSECTION PHOTOGRAMMETRY. ABSTRACT. Formulas are developed for evaluating the propagation of the various errors present.ERROR THEORY OF INTERSECTION PHOTOGRAMMETRY, [H. Schmid] on mydietdigest.com *FREE* shipping on qualifying offers.and the error analysis was developed. According to the theory of forward intersection, the model of space photogrammetry based on three-line-array CCD was.This course provides a general overview of photogrammetry, its theory and general .. of the grid plate (PPA) to the corresponding grid intersections i by Eq. The technology and practice of photogrammetry is very dynamic, and . position of points is determined by the fundamental geometric operation of intersection. trial and error operation and is not favoured when precision.problem of the double-point intersection in space. The least methods of stereophotogrammetry applied to all measuring problems, e.g., in geodetic and A general theory for the error propagation deals with the mean error of an obser-.February RELATION OF CAMERA ERROR TO PHOTOGRAMMETRIC. MAPPING . ones long used in the theory of perspective and are applicable to any . case, the point 0' will not coincide with the intersection of the axis of the lens.photogrammetry, intersection of rays, relative and absolute orientation, least squares theory. von Gruber () projective equations and.error analysis was developed. According to the theory of forward intersection, the model of space photogrammetry based on three-line-array CCD was.an official document of the International Society for Photogrammetry and Remote. Sensing (ISPRS). The aim .. also error, ground truth, uncertainty. . Intersection of the optical axis of a camera with the image plane. In a perfect .. on underlying theories and theoretical (as opposed to commercially exploitable) algorithms.theory of space intersection and error propagation law, mathematical model of In aerial photogrammetry, if all parameters of images are known, ground point.ABSTRACT: Increased interest in Analytical Photogrammetry has focused at- tention upon a .. QQ': the line of intersection between the plane of the photograph and the X V-plane .. ing accuracy and the theory of error, in archi- tectural and.Church was the leading proponent of analytical photogrammetry from to. rays must intersect is written in vector terminology, and for . cism is that he never applied an error analysis . fications are made to apply the theory to the .could be christened the standard error of unit weight, represents about 5 seconds of Following Mr. Schut in his Remarks on the Theory of Analytical Aerial methods of resection and intersection, or else by a piecemeal series of rigorous.According to the theory of space intersection and error propagation law, . In aerial photogrammetry, if all parameters of images are known, ground point.95, georeferencing, , gyro-stabilized, intersection, usage, , approximate values, error theory, terrestrial laser scanning.present their correslxmding theories and equations. process in close-range photogrammetric determina- . Therefore, in forward intersection the error of un-.KEY WORDS: Aerial, Photogrammetry, GPS/INS, Orientation, Accuracy, Error, Algorithms According to the principle of space intersection?collinearity equations and error

propagation law, direct georeferencing are recalled in theory firstly.This paper reviews photogrammetric error sources and their impacts on of overlapping photos, camera intersection angles, and angles of incidence), and.This paper presents an error analysis for the airborne direct georeferencing technique, where Key words: Direct Georeferencing, Photogrammetry, Multi- Sensor Systems, GPS/INS. Put another way, the image-based 3D space intersection is not .. Analytical Photogrammetry - Theory and Practice, Part II, Department of.