ISPRS Technical Commission I Symposium, Sustaining Land Imaging: UAVs to Satellites
17 – 20 November 2014, Denver, Colorado, USA, MTSTC1-229

AUTOMATING THE PHOTOGRAMMETRIC BRIDGING BASED ON MMS IMAGE SEQUENCE PROCESSING

J. F. C. Silva [a, *], M. C. Lemes Neto [b], V. Blasechi [c],

[a] Unesp, Faculdade de Ciências e Tecnologia, Dept Cartography, 19060-900 Presidente Prudente, SP, Brazil – jfcsilva@fct.unesp.br
[b] UFTPR, Londrina, PR, Brazil – mauricioneto@utfpr.edu.br
[c] Unesp, Faculdade de Ciências e Tecnologia, PPGCC, 19060-900 Presidente Prudente, SP, Brazil – v.blasechi@gmail.br

Commission I, ISPRS/IAG7 – Design, construction, characterization, and installation…

KEY WORDS: Photogrammetric Bridging, Bundle Block Adjustment, Mobile Mapping, Automation, Image Sequence, SIFT.

ABSTRACT

A sequence of terrestrial images is a special sequence of consecutive frontal images taken from bases that are moved forward along the main axis of the site to be mapped such as the cameras optical axes align approximate parallel to the surveying axis. Typically this situation arises when a pair of cameras is mounted on a vehicle of a mobile mapping system (MMS) to acquire images of a street or road to be surveyed and mapped. In general, MMS sensor orientation is provided directly by means of integration of GNSS (GPS) and INS (IMU) data. Particularly, in an urban environment, the reception of GNSS signals may be blocked or disturbed mainly by buildings and other structures like tall trees and overpasses. Although INS data can provide MMS sensor orientation for a not long time interval, photo-triangulation may also be used as a method of orienting (both sensors of) the stereo-camera. In cases where navigational data and real time data are not intended, bundle triangulation may be a reasonable method of connecting a sequence of stereo-pairs. This is what we call photogrammetric bridging, also referred as photogrammetric traverse. Let us suppose that an object point or detail on the street, for example, may be clearly seen in one, two or three stereo-bases and then in two, four or six images. Simple, double or triple photogrammetric intersections can compute the spatial object point coordinates. Theoretically, considering that object point, the closest stereo-base delivers the highest accuracy and the farthest base the lowest accuracy when the photogrammetric intersection is separately computed. In each stereo-pair the object to image point distance relationship – the scale ratio – varies significantly so SIFT algorithm seems to be suitable for finding corresponding points because it is a technique developed to extract features that are invariant from rotation and scale in digital images. We propose to automate the photogrammetric bridging based on a fully automatic extraction of homologous points in stereo image pairs. The technique uses SIFT algorithm and the point correspondence is given by the search for similarity descriptors of each key point whose metric analyzed is the smallest Euclidean distance. Taking a sequence of nine pairs of images, the technique is applied sequentially to two pairs (pair 1, images L and R; pair 2, images L and R): firstly to both stereoscopic pairs (1 and 2), then to the "pairs" L1-L2 and R1-R2. These four images form a small block that is treated by the bundle block adjustment (BBA) method after initial arbitrary orientation values are set to the first pair of images. This process that follows up to the end of the sequence is actually semi-automatic because each block is processed independently and the transition from one block to the next one depends on the intervention of an operator. This paper will discuss new results obtained from the fully automated process as an advance compared to the semi-automatic one either for classical stereo pairs or new arrangement of three cameras (collinear and coplanar sets). Standard statistics regularly applied to BBA will be used to analyze both processes. We hope that in a short future this photogrammetric method combined with IMU/MEMS technology may contribute to the image orientation and navigation in the realm of MMS.

* Corresponding author. This is useful to know for communication with the appropriate person in cases with more than one author.