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TOWARDS AN EASIER ORIENTATION FOR SPHERICAL PHOTOGRAMMETRY

G. Fangi
Università Politecnica delle Marche, Italy

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Abstract. For architectural metric documentation, Spherical Photogrammetry (SP) has demonstrated its validity and efficiency in many projects already. The speed of surveying is high, the accuracy and completeness of the plotting are satisfactory. However, there are still many problems to be solved. The weakest point is the orientation procedure, which is rather difficult to perform, in the sense that only very experienced people can run it, and few people only make use of it. The old orientation steps are 1) model formation (limited to binocular panoramas couples); 2) link of all the models in a block adjustment with independent model triangulation; 3) block bundle adjustment with 4 parameters/pano (3 coord.+1 orientation bearing); 4) block bundle adjustment with 6 parameters/pano, say the previous 4 + 2 correction angles around the horizontal axes. The panoramas must be spherical and quasi-horizontal. In order to make easier the orientation, enabling more people to use SP, an improved approach has been set up. It consists in the combination of any possible model formed either by three and two panoramas. The trinocular vision, say the combination of three different panoramas to form a unique model, has the advantage to be much more robust in comparison to binocular vision in the sense that the trinocular model is likely to be more error-free than any of the three composing binocular models. It contains less model deformation, the model coordinates are validated by the mutual comparison of the three intersecting binocular models. In addition, the number of possible trinocular models is normally much larger than the one of binocular models. The steps for a semi-automatic orientation of a block of panoramas proceed as follows:

- Form any possible trinocular models by combination of the panoramas;

- in case that no trinocular model has been formed, form any possible binocular model;

- run a block adjustment with the algorithm of independent model, to link together the models in a unique reference system;

- run a block bundle adjustment with collinearity equations with 4 unknown parameters per panorama;

- run a block bundle adjustment with collinearity equations with 6 unknown parameters per panorama.

The control requirements are limited to one fixed control point and two perpendicular constraints.

Given a project with n panoramas, the trinocular possible models are the combination of n, 3 by 3, say (n*(n-1)*(n-2))/3!. As an example, in a project with 10 panoramas the trinocular possible models are 120, while the possible binocular models are (n*(n-1))/2= 45. Obviously not all the panoramas will be formed, because a minimum of four common tie points is required.

It is possible to select and filter out the best models by fixing a critical value on sigma naught for testing. The advantages are as follows:

- no need of approximate value for the unknown coordinates and parameters;

- easiness to find gross errors in the gradual block formation.

The epipolar geometry has been investigated, the expression of the curve described and assessed: it can be useful in the trinocular model formation. For any try of the model the operator, thus causing troubles to him, must approximately choose formation, up to now the starting value of the orientation bearing for any panorama. However, a new procedure, not requiring any approximate value of the orientation bearing, has been set-up and tested: the orientation bearing can vary stepwise by a given selected interval, until the model is successfully formed. The computation time increases significantly, but it is still negligible.

Up to now the control and tie points selection and observation is manual, making the orientation and the plotting to be slow and time consuming. Nevertheless, on the other end, the procedure is fully controlled and supervised by the operator, enabling the observation of the residuals and allowing the improvement of the orientation, and to perform some statistical quality analysis on the adjustment, which are not possible with automatic procedures based on Structure from Motion (SfM).

Another weak point of the SP is the speed of plotting. Commercial programs are now available, based on SFM algorithm, producing point clouds of good quality in an unknown scale and orientation. The correct scale and orientation can be therefore supplied by SP orientation with high accuracy. Examples are shown taken from two real projects.

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