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OBTAINING APPROXIMATE VALUES OF EXTERIOR ORIENTATION ELEMENTS OF MULTI-INTERSECTION IMAGES USING PARTICLE SWARM OPTIMIZATION

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Abstract. In this paper, an efficient global optimization algorithm in the field of artificial intelligence, named Particle Swarm Optimization (PSO), is introduced into close range photogrammetric data processing. PSO can be applied to obtain the approximate values of exterior orientation elements under the condition that multi-intersection photography and a small portable plane control frame are used.

PSO, put forward by an American social psychologist J. Kennedy and an electrical engineer R.C. Eberhart, is a stochastic global optimization method based on swarm intelligence, which was inspired by social behavior of bird flocking or fish schooling.

The strategy of obtaining the approximate values of exterior orientation elements using PSO is as follows: in terms of image coordinate observed values and space coordinates of few control points, the equations of calculating the image coordinate residual errors can be given. The sum of absolute value of each image coordinate is minimized to be the objective function. The difference between image coordinate observed value and the image coordinate computed through collinear condition equation is defined as the image coordinate residual error. Firstly a gross area of exterior orientation elements is given, and then the adjustment of other parameters is made to get the particles fly in the gross area. After iterative computation for certain times, the satisfied approximate values of exterior orientation elements are obtained. By doing so, the procedures like positioning and measuring space control points in close range photogrammetry can be avoided. Obviously, this method can improve the surveying efficiency greatly and at the same time can decrease the surveying cost. And during such a process, only one small portable control frame with a couple of control points is employed, and there are no strict requirements for the space distribution of control points.

In order to verify the effectiveness of this algorithm, two experiments are carried out. In the first experiment, images of

a standard grid board are taken according to multi-intersection photography using digital camera. Three points or six points which are located on the left-down corner of the standard grid are regarded as control points respectively, and the exterior orientation elements of each image are computed through PSO, and compared with these elements computed through bundle adjustment. In the second experiment, the exterior orientation elements obtained from the first experiment are used as approximate values in bundle adjustment and then the space coordinates of other grid points on the board can be computed. The coordinate difference of grid points between these computed space coordinates and their known coordinates can be used to compute the accuracy. The point accuracy computed in above experiments are ±0.76mm and ±0.43mm respectively. The above experiments prove the effectiveness of PSO used in close range photogrammetry to compute approximate values of exterior orientation elements, and the algorithm can meet the requirement of higher accuracy.

In short, PSO can get better results in a faster, cheaper way compared with other surveying methods in close range photogrammetry.

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