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Study of an adjustment method in the pose relay videometric using camera network

CHAO Zhi-chao 1,3 YU Qi-feng2,3 JIANG Guang-wen1,3 FU Si-hua1,3

Summary

Thanks to its high precision, non-contact feature and low cost, videometrics has found wide application in recent years. However, it is generally suited only for the pose (i.e., position and attitude) measurement of intervisible objects or objects in the same viewing field. The traditional videometric approach cannot be used to measure the pose deformation of objects in a large viewing field or of non-intervisible objects in the large structures commonly used in technological and engineering construction today. To overcome the difficulties encountered in applying traditional videometrics to deformation measurement between non-intervisible objects, Yu et al. have proposed and developed a pose-relay videometric method using camera series. A large number of experiments conducted both outdoors and indoors and real ship measurements have shown that this method is an effective solution to the problem of measuring between two non-intervisible objects in a large structure or between objects in a large viewing field. Pose-relay videometric method using camera network, which is developed from the camera series, can be used to measure multiple non-intervisible targets in large structures. In order to improve the measurement system's precision and robustness, in this paper we developed an adjustment method to take full advantage of the data redundancy among different pose-relay cameras. Firstly, it is need to find all of the pose parameters to be optimized and the corresponding constraints according to the special structure of the camera network. Secondly, the survey adjustment model will be built to solve the corrections. Finally, the corrected values measured by cameras in the network can be obtained with the corrections solved. If the corrected measured value still fails to satisfy the constraints, iterative adjustment will be carried out until it meets certain conditions and achieves the required precision. Simulated results show that one to three iterations are adequate to reduce the absolute value of the correction of every Euler angle to less than 1 arc second. Compared with the measurements without optimizations, the method present here can improve the precision of the videometric using camera network obviously, especially when the structure of the camera network is complex enough and more constraints and be used. The results of simulation experiments and theory analyzing demonstrate that the proposed method could suppress noise effectively, enhances the measuring precision as well as robustly owing to its use of the restraint conditions inherent in the system.