Enhancement of Trajectory Estimation for a Multi-Camera Indoor Mapping System Using Constrained System Motion

Ronald R Benziger¹, Ayman Habib¹
¹School of Civil Engineering, Purdue University

Commercial indoor mapping systems are expensive to purchase and are primarily utilized when GPS or other accurate spatial positioning is unavailable. In order to accurately model the trajectory of indoor mapping systems, off-the-shelf multi-camera systems provide a cheaper alternative to the commercial systems by enforcing constraints on the mounting parameters. The trajectory estimation for these systems can be further enhanced by placing constraints on the system motion and enabling redundancy for outlier detection. In our proposed approach, the mounting parameters are estimated by performing a system calibration procedure, and using data acquired at successive epochs, the system trajectory is estimated. To implement the procedure, the relative orientation parameters among temporal stereo-pairs are derived while considering assumed prior information regarding the nature of the indoor mapping system. Then, the accuracy of the trajectory estimation is improved by computing multiple estimates of the rotation matrix between successive epochs that are obtained from the relative orientation results while enforcing the rigid relationship among the constituents of the multi-camera system. Subsequently, the potential outliers are filtered out and the rotation parameters are computed by averaging the inlier data. The system translation is solved at the final step using a system of linear equations. Using this proposed methodology, we have been successful in extracting the Exterior Orientation Parameters (EOP) of the system at different epochs and determine the trajectory of the indoor mapping system.