

Modeling Alternatives for Implementing the Point-based Bundle Block Adjustment

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Abstract

This thesis examines the multilinear equations of the calibrated pinhole camera. The multilinear equations describe the linear relations between camera parameters and image observations in the same tensor formats. This thesis includes derivations and analysis of the trilinear equations through the point feature relation. For the four-frame and more than four frame cases, this paper gives derivations and analysis using a combination of the bilinear and trilinear equations to represent general multi-frame point geometry. As a result, a three-frame model (TFM) for general multi-frame point geometry is given. This model provides a concise set of minimal and sufficient equations and minimal unknowns.

Based on the TFM, there are two bundle adjustment (BA) approaches developed. The TFM does not involve the object parameters/coordinates necessary and indispensable for the collinearity equation employed by BA. The two methods use TFM as the condition equation fully and partially, replacing the collinearity equation. One operation using both TFM and the collinearity equation is designed to engage the object structures' prior knowledge. The synthetical and real data experiments demonstrate the rationality and validity of the TFM and the two TFM based methods. When the unstable estimate of the object structures appears, the TFM used BA methods have a higher accept ratio of the adjustment convergence.