ABSTRACT

MULTIVIEW CONSTRAINT THEORY FOR POINTS WITH APPLICATION TO BUNDLE ADJUSTMENT AND CAMERA CALIBRATION

The current industry gold standard for multi-image measurements (colinearity based bundle adjustment) is generally improved when multiview constraints are included in the math model. For completeness, the multiview constraint derivations given in Faugeras (1996), Hartley and Zisserman (2000), Heyden (2000), Ma et al. (2004), and Mugnier et al. (2004) are repeated here. Further, it is herein shown that they all enforce the same geometry, and that Faugeras (1996), Hartley and Zisserman (2000), Heyden (2000), and Ma et al. (2004) formulations are special cases of the general form presented in part by Mugnier et al. (2004). A new general form 2x2 determinant trilinear constraint is given. Multiple degenerative cases are discovered that show it is necessary but insufficient that the determinant of multiview constraints equal zero. Minimal sets of sufficient bilinears, trilinears, and quadrilinears are revealed for arbitrary numbers of conjugate image points.

Three methods for implementing the multiview constraints as part of a bundle adjustment are disclosed, including novel computational methods of optimization. In numerous test cases the enhanced bundle adjustment demonstrated improved reliability and accuracy with reduced total processor time. This constitutes an improvement to the fundamental math model for multi-image measurement.

Orrin Howard Thomas
December 2009