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LMI-based 2D-3D Registration: from Uncalibrated Images to Euclidean Scene

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Abstract

This paper investigates the problem of registering a scanned scene, represented by 3D Euclidean point coordinates, and two or more uncalibrated cameras. An unknown subset of the scanned points have their image projections detected and matched across images. The proposed approach assumes the cameras only known in some arbitrary projective frame and no calibration or autocalibration is required. The devised solution is based on a Linear Matrix Inequality (LMI) framework that allows simultaneously estimating the projective transformation relating the cameras to the scene and establishing 2D-3D correspondences without triangulating image points. The proposed LMI framework allows both deriving triangulation-free LMI cheirality conditions and establishing putative correspondences between 3D volumes (boxes) and 2D pixel coordinates. Two registration algorithms, one exploiting the scene's structure and the other concerned with robustness, are presented. Both algorithms employ the Branch-and-Prune paradigm and guarantee convergence to a global solution under mild initial bound conditions. The results of our experiments are presented and compared against other approaches.

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