Robust and Scalable 3D Reconstruction

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Obtaining a digital model of a real-world 3D scene is a challenging task pursued by computer vision and computer graphics. Given an initial 3D model, popular processes always perform the reconstruction of all camera position, camera orientation, and scene points.

Unfortunately, simultaneously solving for both camera position and camera orientation is an ill-conditioned problem. To ameliorate this, we propose a novel formulation obtained via a computational technique based on invariant theory, which eliminates the camera orientation variables from the reconstruction equations. This new formulation exhibits noticeably better numerical properties at the expense of an additional computational cost. We alleviate the additional cost by linearization or by automatically partitioning the dataset while still achieving significant error reduction over standard bundle adjustment. We empirically demonstrate our formulation using several different size models and image sequences.