Image-Based 3D Reconstruction Using Constrained Optimization

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In 3d structure recovery from multiple images applications, 3d structure parameters and camera parameters are usually posed as the minimization of the geometric error in the image measurements, and solved by a suitable non-linear optimization algorithm. Optimization algorithms play an important role in recovering 3d structure from multiple images. There are mainly two kinds of optimization algorithms: unconstrained optimization and constrained optimization. If the estimated parameters are all uncorrelated, unconstrained optimization is used to optimize the objective function. In practical applications, there are often known constraints in the scene. The scene constraints can be enforced on the estimated parameters. Under these circumstances, constrained optimization is more suitable to be used to optimize the cost function while keeping the constraints satisfied. Point, line and surface primitives are often used in vision applications to represent 3d structures. There are many kinds of constrains associated with these primitives. The following constraints are often used in practical applications: distance between points, point on line and point on surface, line on surface.

SQP is a powerful constrained minimization algorithm and has been successfully applied in a wide variety of industrial fields. It has a concise mathematical formulation and can incorporate a wide variety of constraints. In this paper we have successfully applied SQP in single view 3D recovery applications and multiple view 3D recovery applications.