Rotation Averaging and Strong Duality

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Abstract

The authors explore the role of duality principles within the problem of rotation averaging, a fundamental task in a wide range of computer vision applications. In its conventional form, rotation averaging is stated as a minimization over multiple rotation constraints. As these constraints are non-convex, this problem is generally considered challenging to solve globally.

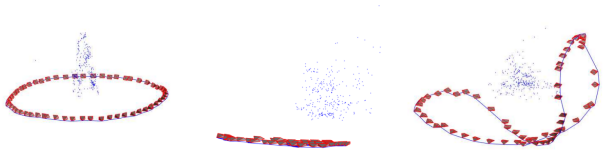

Figure 1. In many structure from motion pipelines, camera orientations are estimated with rotation averaging followed by recovery of camera centres (red) and 3D structure (blue). Here are three solutions corresponding to different local minima of the same rotation averaging problem.[2]

1. Introduction

Rotation averaging appears as a subproblem in many important applications in computer vision, robotics, sensor networks and related areas. Given a number of relative rotation estimates between pairs of poses, the goal is to compute absolute camera orientations with respect to some common coordinate system. In computer vision, for instance, non-sequential structure from motion systems such as [3],[1] rely on rotation averaging to initialize bundle adjustment. The overall idea is to consider as much data as possible in each step to avoid suboptimal reconstructions. In the context of rotation averaging this amounts to using as many camera pairs as possible.

Indeed, both L_1 and L_2 formulations of rotation averaging can have local minima, see Fig. 1. Wilson *et al.* [4] studied local convexity of the problem and showed that instances with large loosely connected graphs are hard to solve with local, iterative optimization methods.

References

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