Synchronization of Rotations via Riemannian Trust-Regions

We estimate unknown rotation matrices $R_i \in \mathrm{SO}(n = 2, 3)$ from a set of measurements of relative rotations $R_i R_j^T$. Each measurement is either slightly noisy, or an outlier bearing no information. We study the case where most measurements are outliers. In (A. Singer, *Angular Synchronization by Eigenvectors and Semidefinite Programming*, ACHA 30(1), pp. 20–36, 2011), an estimator is computed from a dominant subspace of a matrix. We observe this essentially results in least-squares estimation, and propose instead a Maximum Likelihood Estimator, explicitly acknowledging outliers. We compute the MLE via trust-region optimization on a matrix manifold. Comparison of our estimator with Riemannian Cramér-Rao bounds suggests efficiency.

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