Tensor Voting: Fundamentals and Recent Progress

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Abstract

We start with an overview of the Tensor Voting Framework, which embodies perceptual grouping principles. It is is a local, non parametric method that provides an efficient way to learn the local complex geometric structure, even under significant amount of noise.
We illustrate the method in 2-D and 3-D, and show how it applies to Computer Vision problems such as stereo matching and motion segmentation.
We then present its generalization to N-D, with a recently derived closed form formulation.
Next, we present an extension of Tensor Voting to deal with uncertainty in the position of the input data, using a probabilistic framework.
Finally, we address the main limitation of the Tensor Voting framework: it is strictly a local method, thus not efficient to infer the global properties of complex manifolds. We therefore suggest constructing a unique graph which we call the Tensor Voting Graph, in which the affinity is based on the contribution of neighboring points to a point's local tangent space estimated by Tensor Voting.
We experimentally demonstrate that we can accurately estimate the geodesic distance on complex manifolds, and substantially outperform all state of the art competing approaches, especially when outliers are present.

Keywords

Perceptual Organization, Manifold Learning, Unsupervised Learning, Non-parametric robust estimation, Subgraph Clustering