Variational Methods and Geometric Optimization for Computer Vision

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Abstract

Variational methods are among the most classical and established methods to solve a multitude of problems arising in computer vision and image processing. Over the last years, they have evolved substantially, giving rise to some of the most powerful methods for optic flow estimation, image segmentation and 3D reconstruction, both in terms of accuracy and in terms of computational speed. In this tutorial, I will introduce the basic concepts of variational methods.

I will then focus on problems of geometric optimization including image segmentation and 3d reconstruction. I will show how the regularization terms can be adapted to incorporate statistically learned knowledge about our world. Subsequently, I will discuss techniques of convex relaxation and functional lifting which allow to computing globally optimal or near-optimal solutions to respective energy minimization problems. Experimental results demonstrate that these spatially continuous approaches provide numerous advantages over spatially discrete (graph cut) formulations, in particular they are easily parallelized (lower runtime) and they do not suffer from metrication errors (better accuracy).

Keywords

Statistical shape learning, geometric reconstruction and visual SLAM.