Robust Motion Estimation and Analysis based on Statistical Information

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Abstract:

Accurate and Robust estimation of optical flow continues to be of interest due to the deep penetration of digital cameras into many areas including robot navigation and video surveillance applications. The canonical approach to the flow estimation relies on local brightness constancy which has limitations. In this thesis, we re-examine the optic flow problem and formulate an alternate hypothesis that optical flow is an apparent motion of local information across frames and propose a novel framework to robustly estimate flow parameters. Pixel-level matching approach has been implemented according to the proposed formulation in which optical flow is estimated based on local information associated with each pixel. Self information and a variety of divergence measures have been investigated for capturing the local information. Results of benchmarking with the Middlebury dataset show that the proposed formulation is comparable to the top performing methods in accurate flow computation. The distinguishing aspects however are that these results hold for small as well as large displacements and the flow estimation is robust to distortions such as noise, illumination changes, non-uniform blur etc. Thus, the local information based approach offers a promising alternative to computing optical flow. We also developed a method to remove motion blur from frames by using the information measures. The effectiveness of the proposed motion estimation approach is also demonstrated on extraction of structure from motion of synthetic micro-texture patterns, cardiac ultrasound sequences and colorization of black and white videos.