

# Abstract

This research has been oriented towards the design of a new technique for fast and reliable dense motion estimation. We used variational models of optical flow computation to estimate the dense motion in a sequence of images. We have been interested in developing a multilevel optimization solver to produce accurate optical flow estimation for real-time applications. To the best of our knowledge, two-ways multilevel optimization techniques are used for the first time in the context of a computer vision problem. We evaluated the performance of different optimization techniques developed in the context of optical flow computation with different variational models. In particular, based on truncated Newton methods (TN) that have been an effective approach for large-scale unconstrained optimization, we developed the use of efficient multilevel schemes for computing the optical flow. More precisely, we evaluated the performance of a standard unidirectional multilevel algorithm - called multiresolution optimization (MR/Opt), to a bidirectional multilevel algorithm - called full multigrid optimization (FMG/Opt). The FMG/Opt algorithm treats the coarse grid correction as an optimization search direction and eventually scales it using a line search. Experimental results on three image sequences using four models of optical flow with different computational efforts show that the FMG/Opt algorithm outperforms significantly both the TN and MR/Opt algorithms in terms of the computational work and the quality of the optical flow estimation.