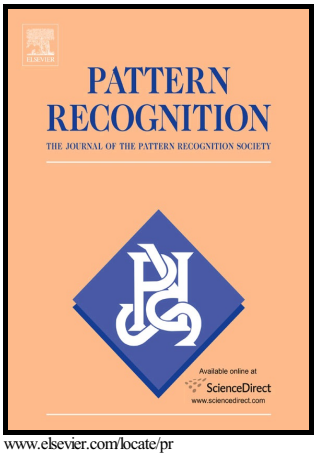
Variational Method for Joint Optical Flow Estimation and Edge-aware Image Restoration

Zhigang Tu, Wei Xie, Jun Cao, Coert van Gemeren, Ronald Poppe, Remco C. Veltkamp



www.elsevier.com/locate/pr

PII: S0031-3203(16)30343-0
DOI: http://dx.doi.org/10.1016/j.patcog.2016.10.027
Reference: PR5935

To appear in: *Pattern Recognition*

Received date: 15 April 2016
Revised date: 20 October 2016
Accepted date: 22 October 2016

Cite this article as: Zhigang Tu, Wei Xie, Jun Cao, Coert van Gemeren, Ronald Poppe and Remco C. Veltkamp, Variational Method for Joint Optical Flow Estimation and Edge-aware Image Restoration, *Pattern Recognition*, http://dx.doi.org/10.1016/j.patcog.2016.10.027

Variational Method for Joint Optical Flow Estimation and Edge-aware Image Restoration

Zhigang Tu[1,*], Wei Xie[2*], Jun Cao[3*], Coert van Gemeren[1*], Ronald Poppe[1*], Remco C. Veltkamp[1*]

[1] *Department of Information and Computing Sciences, Utrecht University Princetonplein 5, Utrecht, The Netherlands*

[2] *School of Computer, Central China Normal University LuoyuRoad 152, Wuhan, China*

[3] *Intel Corp., 4500 S. Dobson Road, Chandler, AZ 85224, USA*

Abstract

The most popular optical flow algorithms rely on optimizing the energy function that integrates a data term and a smoothness term. In contrast to this traditional framework, we derive a new objective function that couples optical flow estimation and image restoration. Our method is inspired by the recent successes of edge-aware constraints (EAC) in preserving edges in general gradient domain image filtering. By incorporating an EAC image fidelity term (IFT) in the conventional variational model, the new energy function can simultaneously estimate optical flow and restore images with preserved edges, in a bidirectional manner. For the energy minimization, we rewrite the EAC into gradient form and optimize the IFT with Euler-Lagrange Equations. We can thus apply the image restoration by analytically solving a system of linear equations. Our EAC-combined IFT is easy to implement and can be seamlessly integrated into various optical flow functions suggested in literature. Extensive experiments on public optical flow benchmarks demonstrate that our method outperforms the current state-of-the-art in optical flow estimation and image restoration.

*Corresponding author

Email addresses: Zhigang.Tu@asu.edu (Zhigang Tu), XW@mail.ccnu.edu.cn (Wei Xie[2]), Jun.Cao@intel.com (Jun Cao[3]), C.J.Vangemeren@uu.nl (Coert van Gemeren[1]), R.W.Poppe@uu.nl (Ronald Poppe[1]), R.C.Veltkamp@uu.nl (Remco C. Veltkamp[1])