

Object Flow

Juan M.
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Outline

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Object Flow

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Technicolor

June 17, 2014

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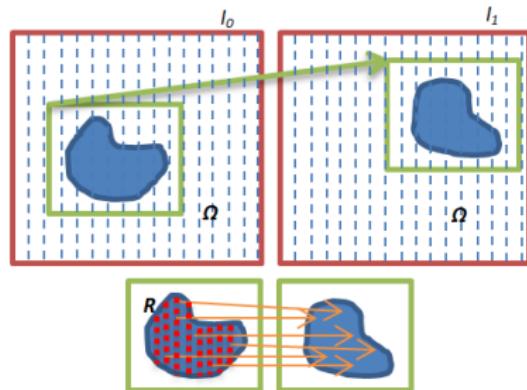
Problem definition

Given an image sequence, say $I_t, t : 0..N - 1$, and an initial position of the interest object in the first frame of this sequence.

Let $\mathcal{R} \in \Omega$ be the region corresponding to the support of the object in the bi-dimensional grid Ω . Then, the object flow,

$\mathcal{O}(x)$, is defined as

$$\mathcal{O}(x) = d_{0,t}(x), \forall x \in \mathcal{R}.$$



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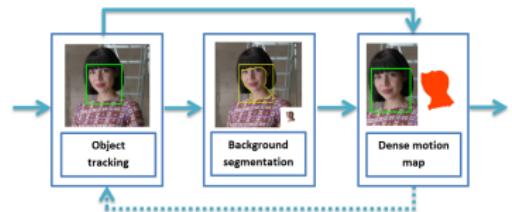
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Object flow pipeline

3 main steps: Tracking,
Segmentation and Flow
estimation. What information
to use to refine the object
motion?

Pipeline



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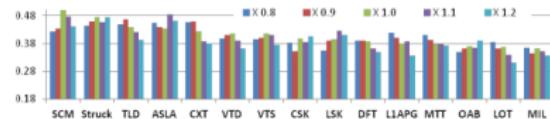
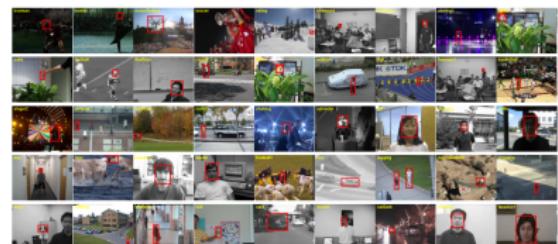
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Tracking

Tracking

Tracking has shown tremendous advances in the last years. Tracking by detection methods had shown very good performance in modern benchmarks.



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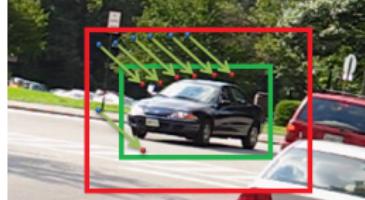
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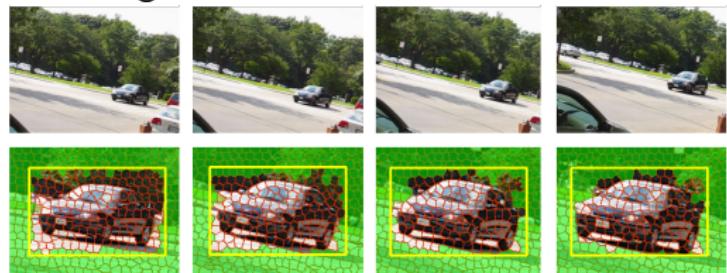
Tracker window offers valuable information for object segmentation. Can it be completed naturally by video dynamics?



Segmentation

Background tracking

Regions outside window can be labelled as background...



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Superpixel flow

A superpixel matching method is used to track background regions.

This matching can be modelled with a pairwise Markov Random Field.

$$E(I) = \sum_{p \in \Gamma} D_p(I_p; I_0, I_1) +$$

$$\sum_{(p,q):q \in \mathcal{N}_r} S_{p,q}(I_p, I_q)$$

With I the set of labels of the superpixels in I_0 , that match with those in I_1 . \mathcal{N}_r is a neighbourhood of radius r of the superpixel p . Γ is the set of superpixels in an image.

Segmentation

Data and Spatial terms

The correspondent superpixels are similar. $D_p(I_p; I_0, I_1) =$

$$\sqrt{1 - \frac{1}{\sqrt{\mathbf{h}(p)\mathbf{h}(p')N^2}} \sum_i \sqrt{\mathbf{h}_i(p)\mathbf{h}_i(p')}}.$$

Similar superpixels in one frame have similar motion vector. $S_{p,q}(I_p, I_q) =$

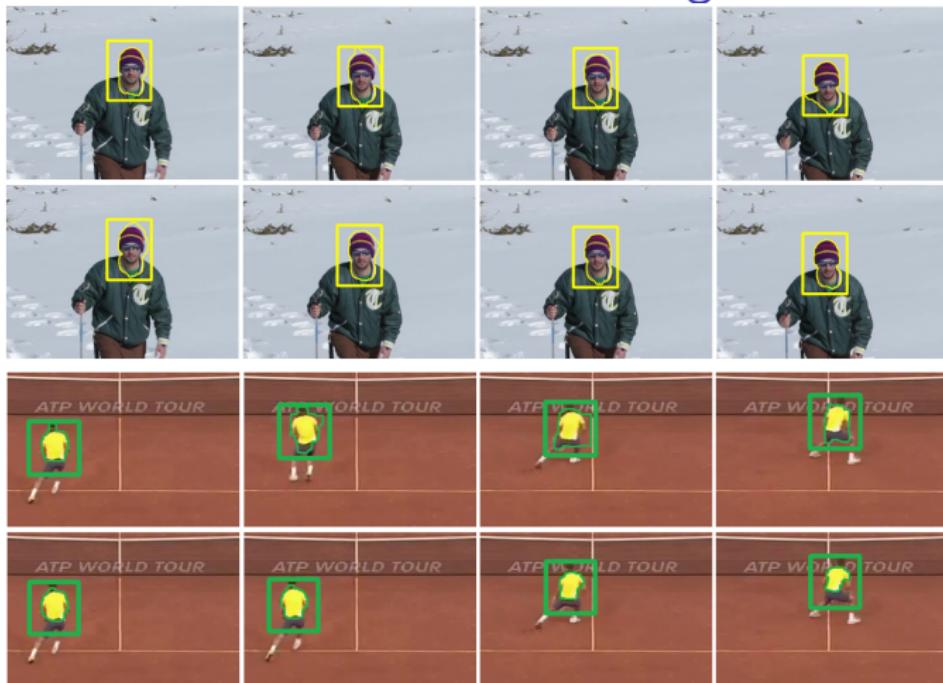
$$\lambda(p) \sqrt{\frac{|u_{pc} - u_{qc}|}{\|p_c - q_c\|} + \frac{|v_{pc} - v_{qc}|}{\|p_c - q_c\|}}$$

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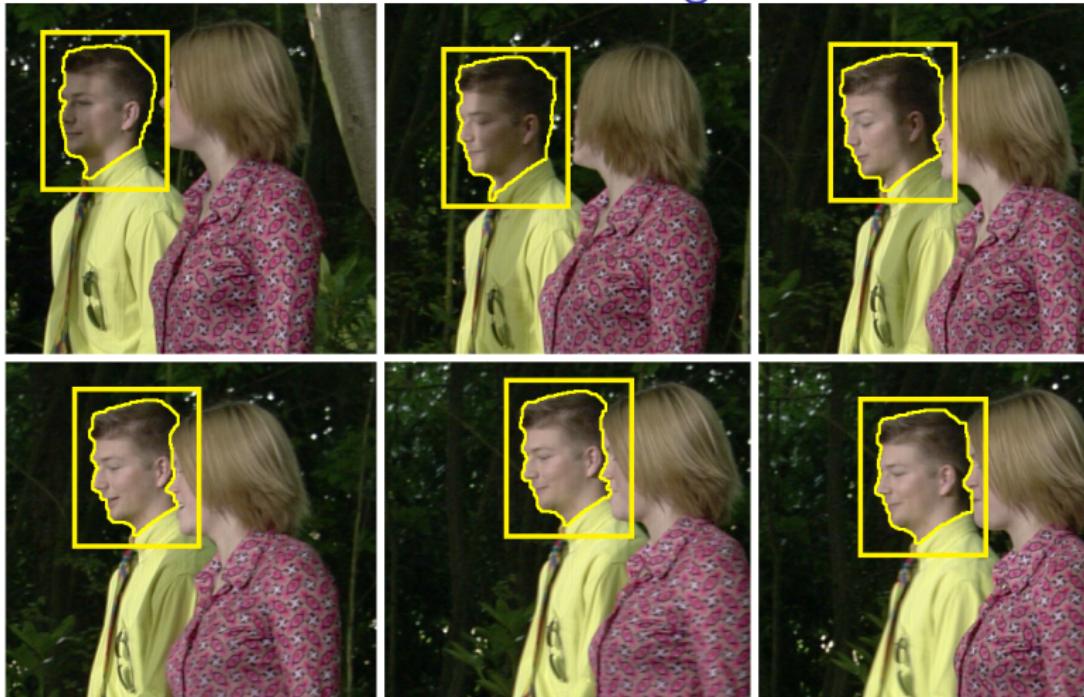
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Segmentation



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Flow estimation

In which parts of an image is valid the optical flow smoothness prior?



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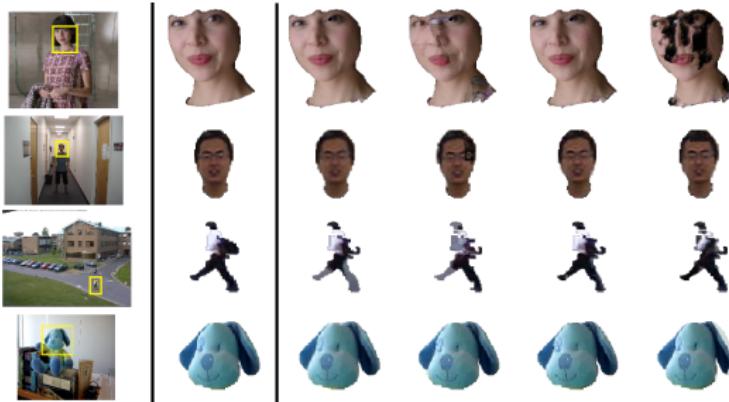
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Visual results

Extrapolation results between frame 2 distant frames by using integrated flow. GT Object. Object flow backward, Object flow forward, Optical flow backward, and forward. Simple Flow.



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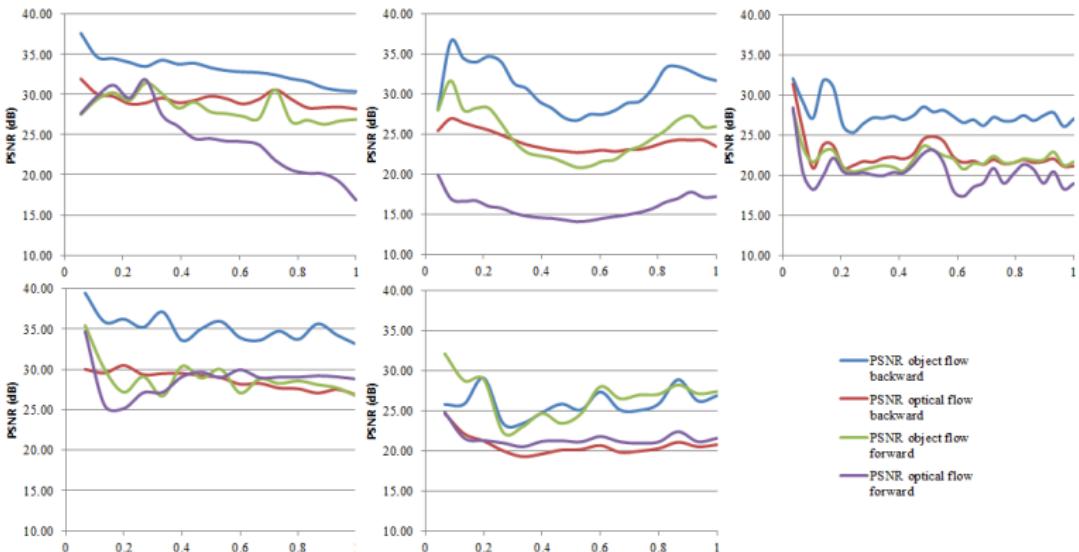
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PSNR for every extrapolated frame.



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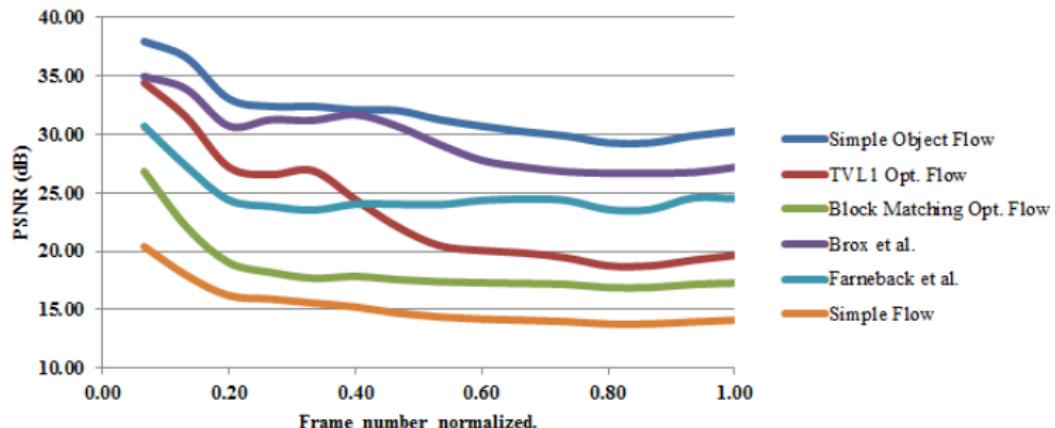
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Comparing several optical flow method with the object flow.



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SfM

