Stixels Motion Estimation without Optical Flow Computation

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KU LEUVEN

Motivation

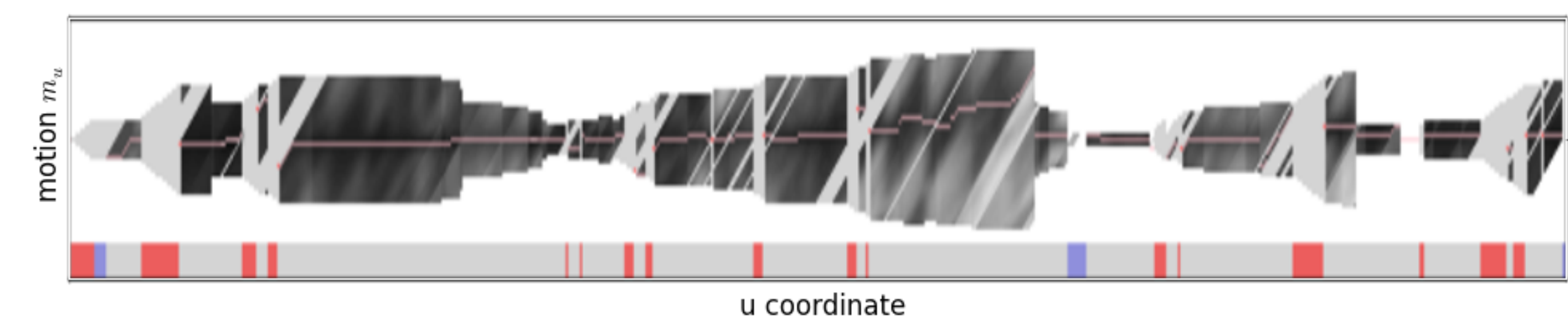How to detect objects above the ground, without class specific knowledge?

How to estimate their velocities?
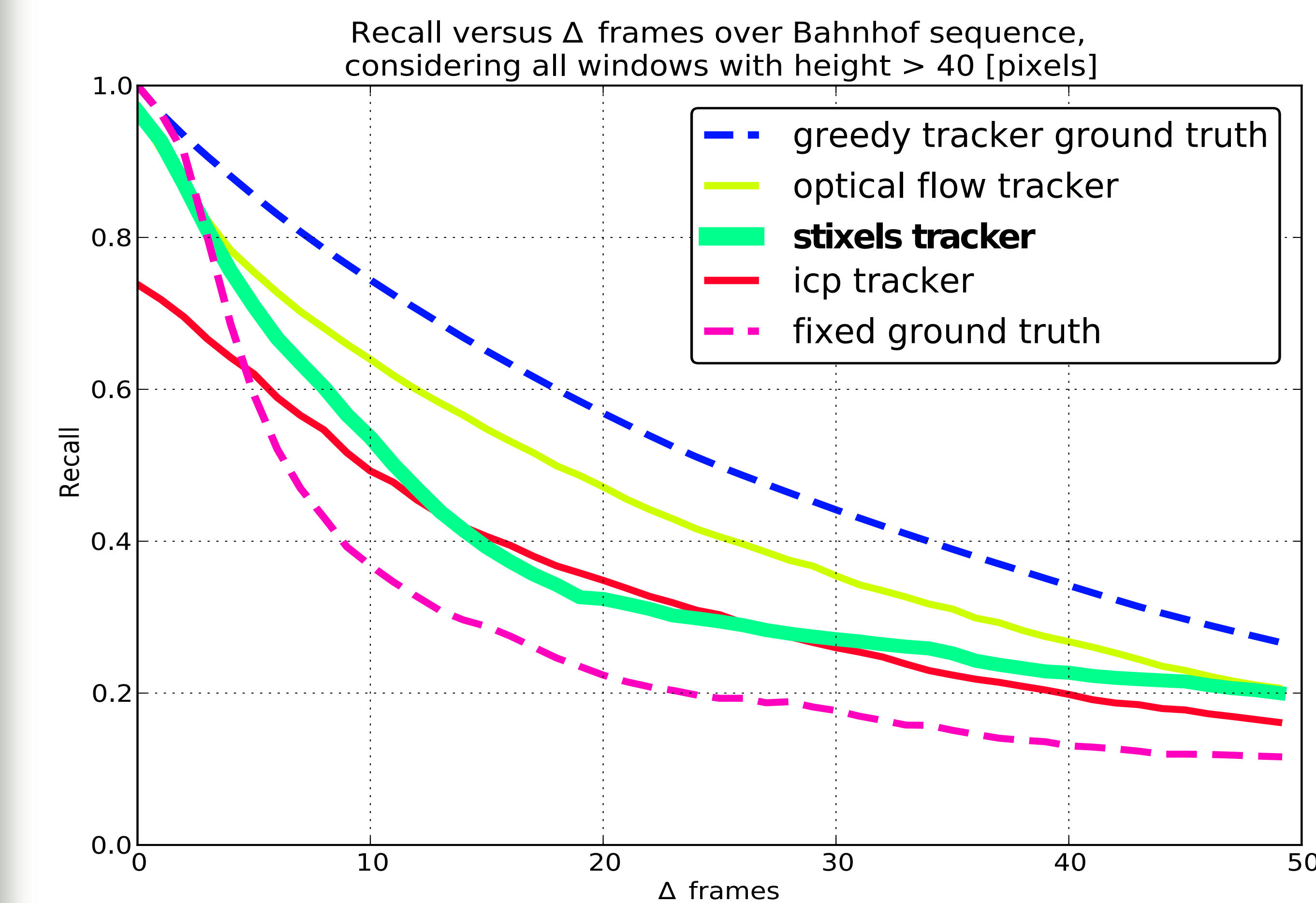
How to keep a low computational cost?

System Overview

Input Stereo Images   Stixel World Estimation   Stixel Motion Estimation   Stixel Motion Estimates

We use the *stixel world model*; the dominant objects in the scene are represented as vertical sticks. (Badino et al. 2009)

Obstacles

Ground plane

The ground plane and stixel distances are estimated *without* a depth map, at 100 fps (Benenson et al. 2011 & 2012).

Motion of stixels is estimated *without* computing the pixelwise optical flow.

Key Idea

In the stixel world, motion estation becomes a simple 2D dynamic programming problem.

Simpler problem ⇒ faster solution

motion m_u
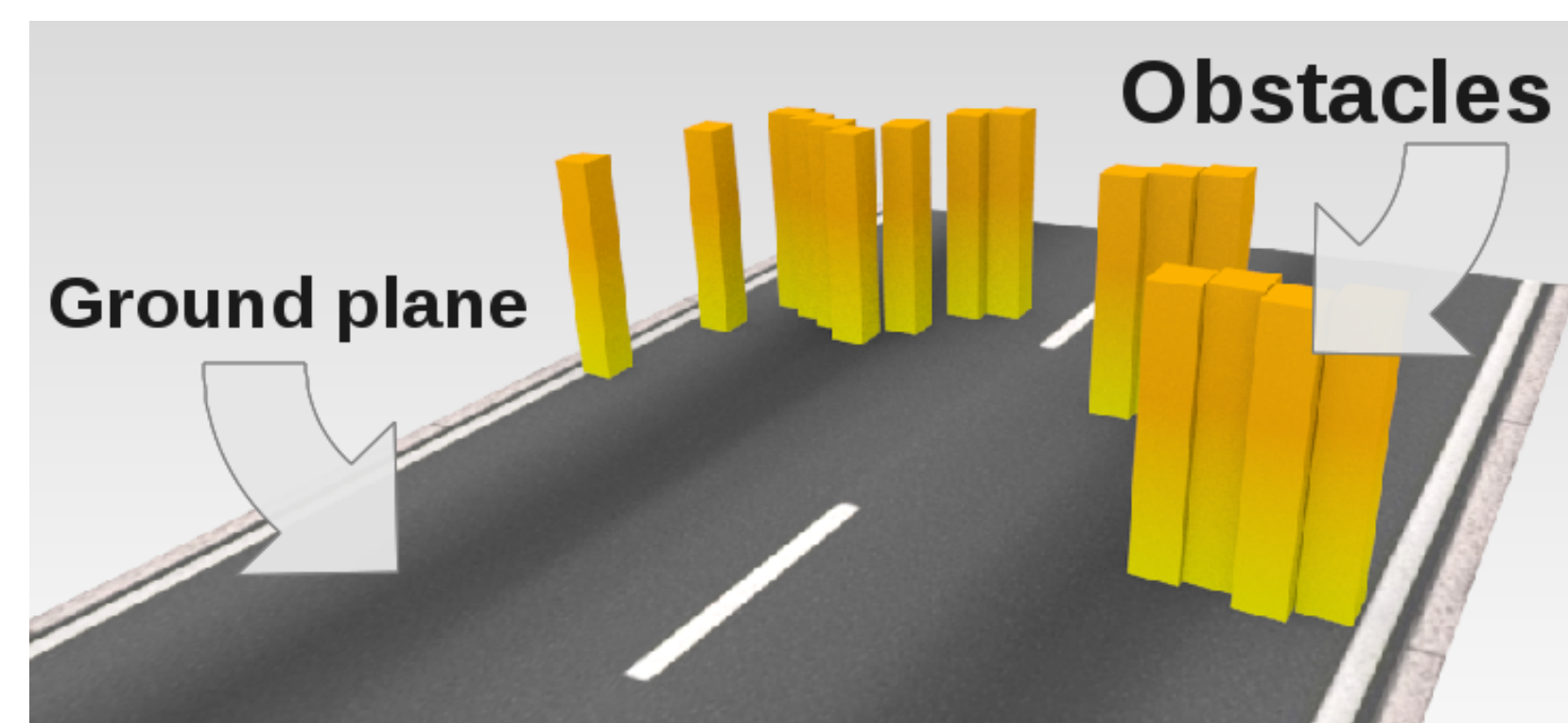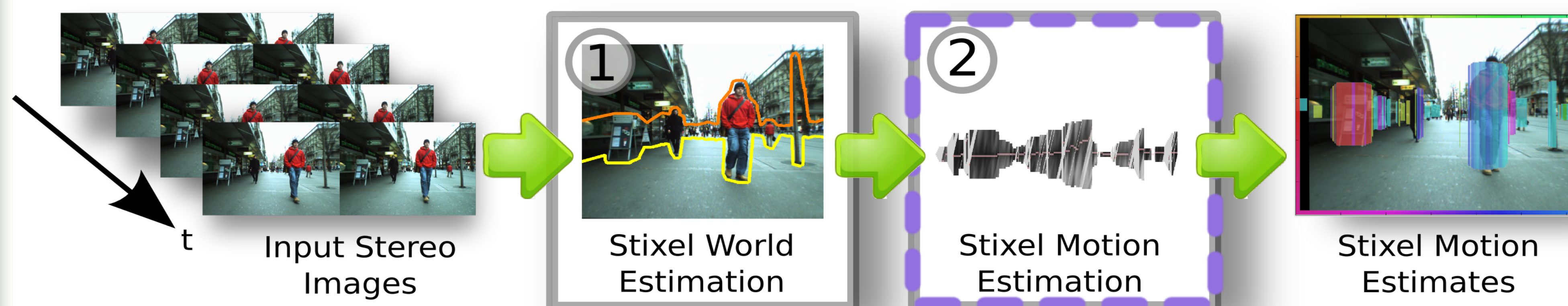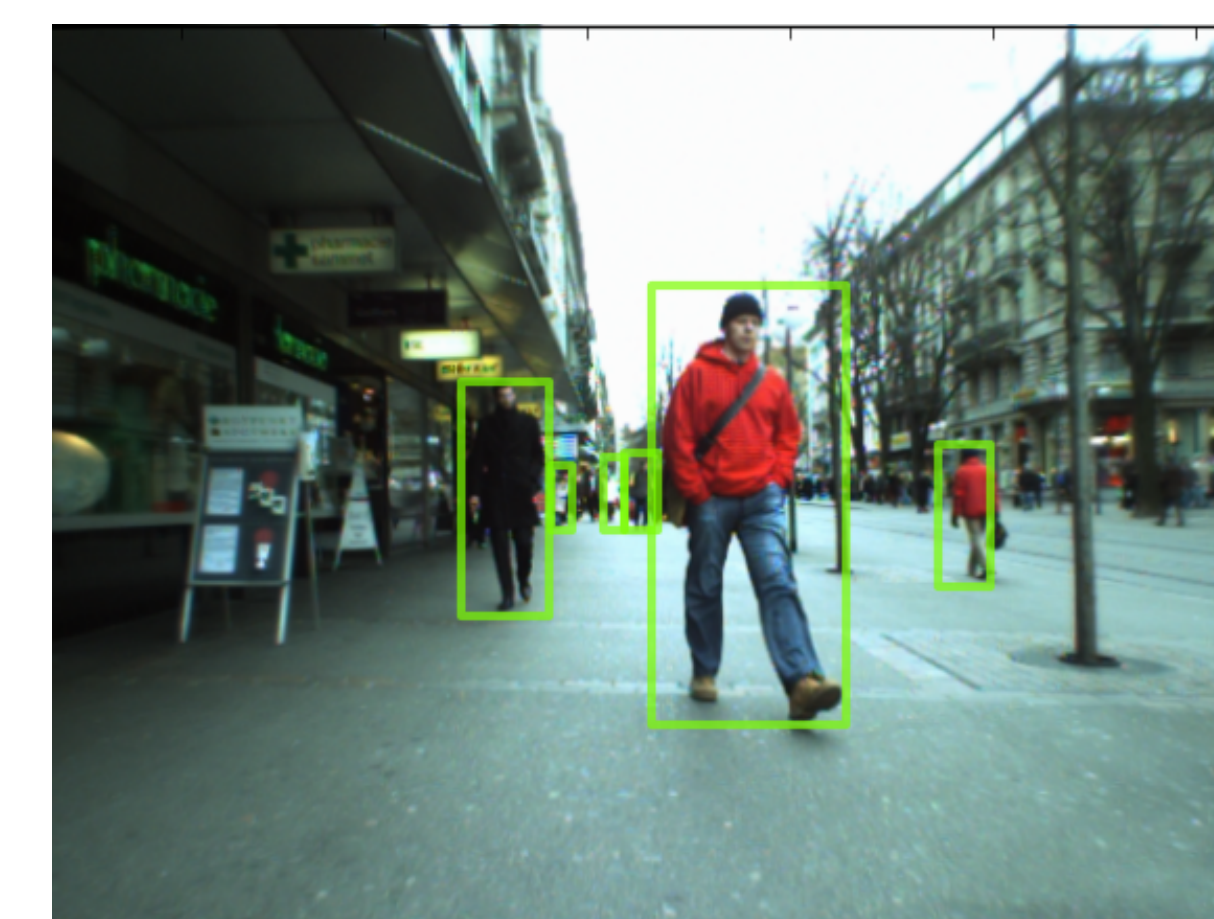
u coordinate

Evaluation Methodology

This is the first work to provide a quantitative evaluation of stixels motion estimation.

Annotated pedestrian bounding boxes are used as proxy for evaluation.

For each frame, bounding box positions up to Δ frames in the future are predicted.

"Recall vs Δ frames" curves are used for comparison.

Results

Recall versus Δ frames over Bahnhof sequence, considering all windows with height > 40 [pixels]

- greedy tracker ground truth
- optical flow tracker
- **stixels tracker**
- icp tracker
- fixed ground truth

Fair quality, at high speed.

Lower than high quality optical flow, but comparable to icp tracker.

Stixels motion (backward), frame 70 to 100

Stixels motion (backward), frame 230 to 260

Ground truth annotations, frame 70 to 100

Ground truth annotations, frame 230 to 260

Frame 100

Frame 260