Assignment A10: Optical Flow: Least Squares

CS 6320
Spring 2014

Assigned: 24 March 2014

Due: 2 April 2014

For this problem, handin the results (no lab report) in a pdf (include name, date, assignment and class number in pdf). You should handin the results pdf as well as the Matlab code used in the study. The code should conform to the style requested in the class materials.

In addition, please turn in a hardcopy of the results in class before the start of class on April 2, 2014.

Optical flow is a technique to determine motion in a series of image data. We are given a sequence of images showing a real life situation of a driver (source R. Klette, Auckland; these can be found in the class web site/data/optic-flow). Our goal is to implement an optical flow method that can measure the motion of objects.

Implement an optical flow method to determine the motion between consecutive images. The methodology is based on the basic assumption of brightness constancy $\nabla E \cdot v + \frac{\partial E}{\partial t} = 0$ Remember further that we need to calculate a solution for the velocity vector at every pixel using a pixel neighborhood. Note that this is a local estimate, where we can primarily only measure the normal flow (i.e., flow parallel to the image gradient and thus perpendicular to boundaries).

1. Choose two consecutive images from video sequence.
2. Apply smoothing to the images (remember that optical flow assumes smooth object boundaries, i.e., boundaries with larger smoothness than the spatial shift).

3. Calculate the temporal gradient image $\frac{\partial E}{\partial t}$ via the difference of the blurred versions of the two consecutive frames.

4. Calculate the spatial derivatives $E_x = \frac{\partial E}{\partial x}$ and $E_y = \frac{\partial E}{\partial y}$

5. Calculate the time gradient by the difference between consecutive frames, simply subtracting the two frames as $I(x, t+1) - I(x, t)$.

6. Display the original image and the spatial and time gradients.

7. Display the resulting flow vectors as a 2D image. Finad a way to overlay these vectors and the gray level image.

8. Look at the velocities of the moving objects and discuss your solution.