Optical Flow
Programming assignment - 3

November 22, 2017

Abstract

Implement optical flow between a pair of images using Horn-Schunck and lucas-kanade method.

1 Introduction

The horn schunck method estimates optical flow by assuming a smoothness constraint. This constraint doesn't allow the flow velocity to vary very rapidly.

The lucas kanade method estimates optical flow by assuming that the flow is constant in a local neighbourhood of pixels. This method assumes that the displacement of the image contents between two nearby frames is small less than one pixel.

2 Algorithmns

2.1 Using Horn–Schunck method

1. Import the two images in grayscale format. Assume initial velocity in x direction, u and in y direction, v is zero.
2. compute the average velocity of a pixel by averaging the velocities of the neighbourhood pixels.
3. Compute the image gradients in x and y direction using imgradientxy and across frames using finite difference by conv2 operator
4. For a particular alpha, calculate iteratively the following equation

$$u^{k+1} = \overline{u}^k - \frac{I_x(I_x\overline{u}^k + I_y\overline{v}^k + I_t)}{\alpha^2 + I_x^2 + I_y^2}$$

$$v^{k+1} = \overline{v}^k - \frac{I_y(I_x\overline{u}^k + I_y\overline{v}^k + I_t)}{\alpha^2 + I_x^2 + I_y^2}$$

2.2 using lucas-kanade method

1. Import the two images in grayscale format.
2. Resize the image if fthe displacement of the frames is more than one pixel.
3. Compute the image gradients in x and y direction using imgradientxy and across frames using finite difference by conv2 operator
4. Decide a window size. for a given window of image calculate the following:

$$v = (A^TA)^{-1}A^Tb$$

$$A = \begin{bmatrix} I_x(p_1) & I_y(p_1) \\ I_x(p_2) & I_y(p_2) \\ \vdots & \vdots \\ I_x(p_n) & I_y(p_n) \end{bmatrix} v = \begin{bmatrix} V_x \\ V_y \end{bmatrix} b = \begin{bmatrix} -I_t(p_1) \\ -I_t(p_2) \\ \vdots \\ -I_t(p_n) \end{bmatrix}$$

3 Implementation details

1. Estimating performance with different number of samples with fixed amplitude
   - The amplitude A is taken 1 and σ to be 1 and N is varied from 1 to 100.
2. Estimating performance with different amplitude and with fixed number of samples
   - The number of samples taken is 50 and σ to be 1 and the amplitude, A is varied from 0.5 to 20 in steps of 0.5.

4 Results

4.1 Using Horn–Schunck method

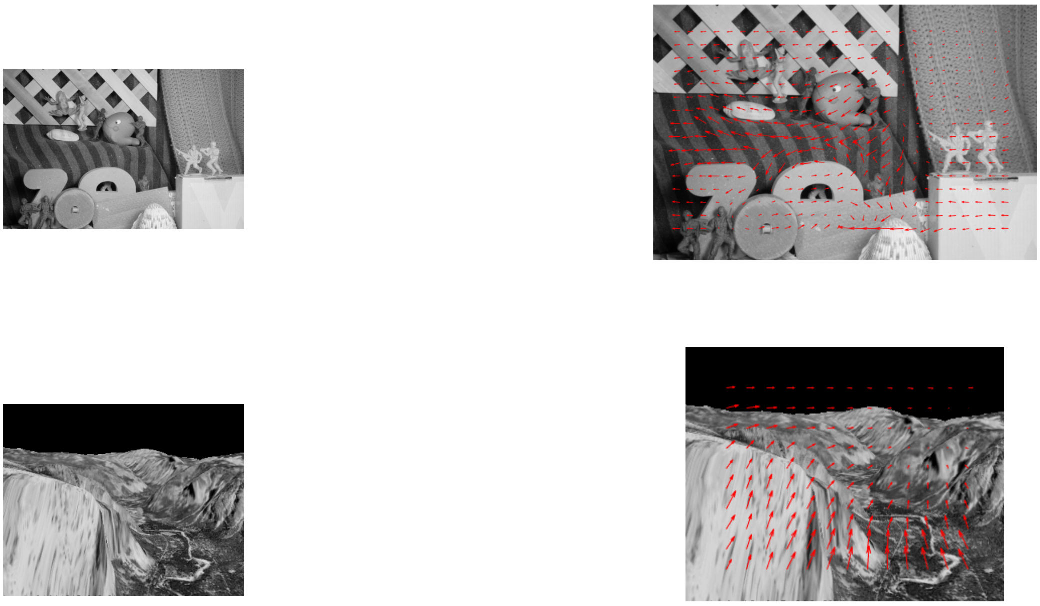

figure 1.1: lucas kanade optical flow

4.2 Using Lucas-Kanade method

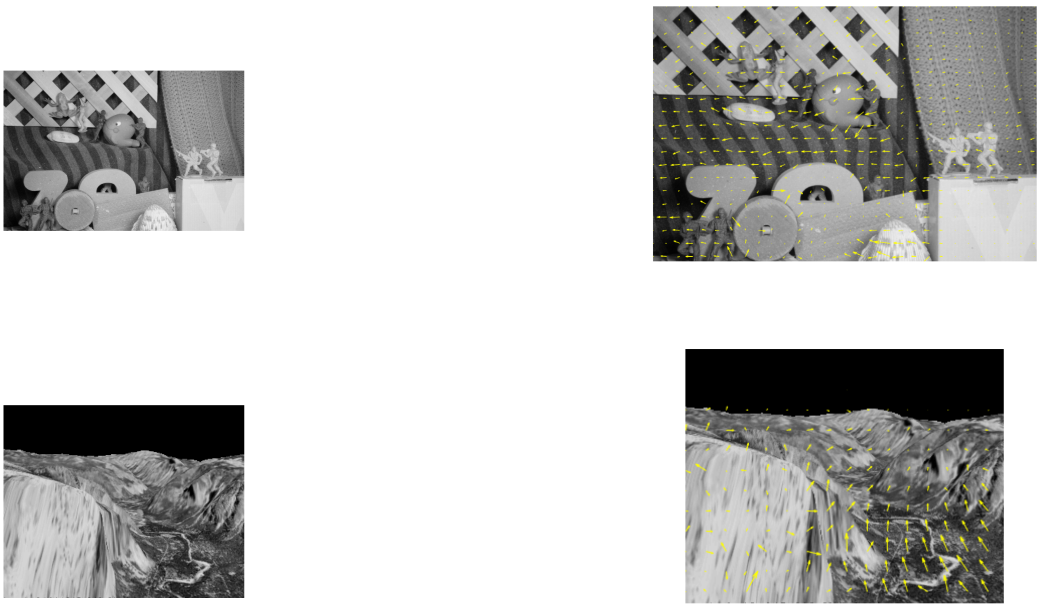

figure 1.1: Horn-schunck optical flow

References

[1] B.K.P. Horn and B.G. Schunck, "Determining optical flow." Artificial Intelligence

[2] //https://in.mathworks.com/matlabcentral/fileexchange/48744-lucas-kanade-tutorial-example-1?focused=3854179tab=example