

# Computer Vision I

## Project 3

Given: October 30, 2018, Due on November 13, 2018

### Dense Optical Flow

In this project you will implement the Lucas-Kanade method for estimating dense optic flow from a pair of images. The input is a pair of greyscale images taken from a video sequence, and the output will be two matrices containing the x and y components of the flow vector at each pixel.

To summarize the LK algorithm for computing flow:

1. Read image1 and image2, and convert to double flow greyscale image frames.
2. Compute the spatial intensity gradients  $I_x$  and  $I_y$  of image2. Recall that it is a good idea to smooth before taking the derivative, for example by using derivative of Gaussian operators.
3. Compute the temporal gradient  $I_t$  by subtracting a smoothed version of image1 from a smoothed version of image2.
4. For a given window size  $W$ , form a system of linear equations at each pixel by summing over products of gradients in its neighborhood, as specified by the Lucas-Kanade method. That is, at each pixel, you will have a set of equations:

$$\begin{bmatrix} \sum I_x^2 & \sum I_x I_y \\ \sum I_x I_y & \sum I_y^2 \end{bmatrix} = - \begin{bmatrix} \sum I_x I_t \\ \sum I_y I_t \end{bmatrix}$$

5. Solve for the flow vector  $[u, v]$  at each pixel. It is convenient to represent this vector field by two images, one containing the u component, and the other the v component of flow.
6. Display the flow vectors overlaid on the image. You can use matlab “quiver” to show the flow field.
7. Another way to represent optical flow is to color code the flow vectors: direction of the vector is coded by hue, and length of the vector is coded by saturation. Display your flow vectors using this method also.

#### 1. Project Requirements:

- (a) Write a program to implement the above algorithm. Create a two level pyramid and for each level of the pyramid compute the optical flow independently. Sample sequences to test your program will be available in blackboard.

- (b) **Write a report.** The report should include:
- i. Abstract, description of algorithms, experiments, values of parameters used (How does the size of  $W$  affect your results?), observations and conclusions.
  - ii. A FLOWCHART, input and optical flow images.
  - iii. An appendix with your source code