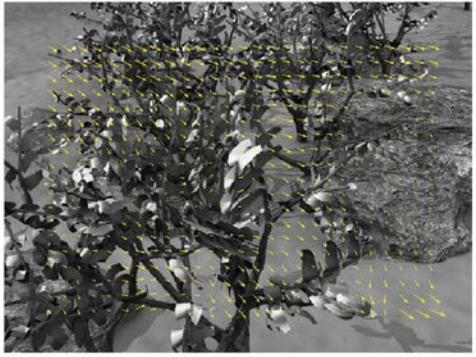
ENPM 673 – Perception in Autonomous Robots

Homework #3 – Spring 2018

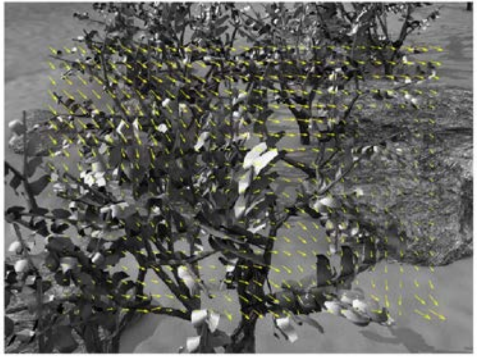
Part – 1:

The optical flow for the given dataset has been computed and the result has been shown below:

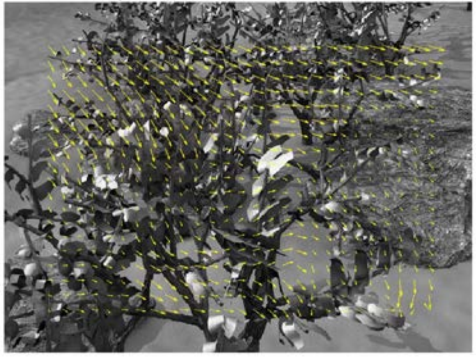
Optical Flow between Frame No.: 1 and 2



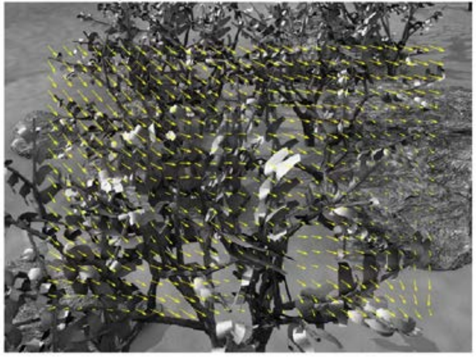
Optical Flow between Frame No.: 2 and 3



Optical Flow between Frame No.: 3 and 4



Optical Flow between Frame No.: 4 and 5



The Algorithm implemented is Lucas-Kanade Algorithm as follows:

1. Compute I_x by applying kernel $[-1,1;\ -1,1]$

2. Compute I_y by applying kernel $[-1,-1;\ 1,1]$, ie. the transpose of previous kernel.

3. Compute I_t by applying kernel [1,1;1,1] on Image1 and kernel [-1,-1;-1,-1] on Image2 and adding the output.

$$A = \begin{bmatrix} a & b \\ b & c \end{bmatrix} = \begin{bmatrix} \Sigma W^2 I_x^2 & \Sigma W^2 I_x I_y \\ \Sigma W^2 I_y I_x & \Sigma W^2 I_y^2 \end{bmatrix}$$

4. Then we get A by the windowed I_x and I_y for each window of specified size for the whole image.

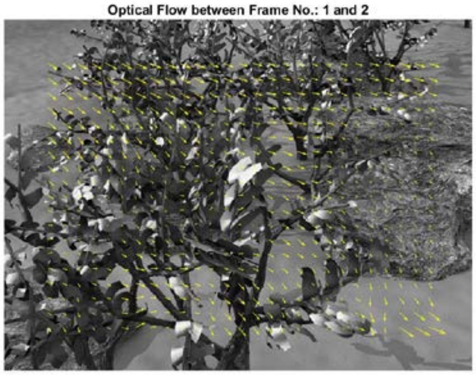
5. Compute b for the same window by using the I_t for that window.

6. Now using the pseudo inverse of A and multiplying it with b, we get the velocities in the x and y direction.

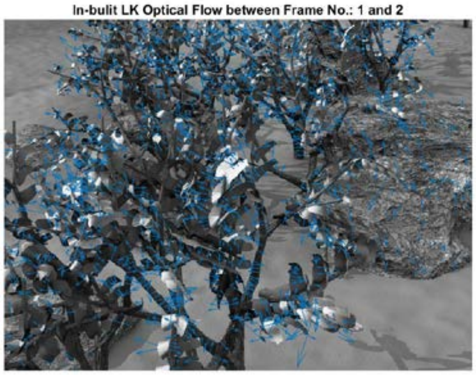
7. The obtained velocities are then plotted using quiver plot.

Part – 2

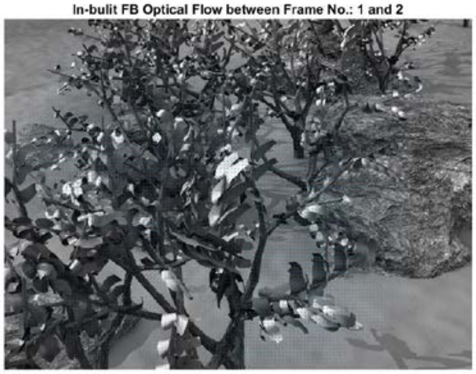
The output of the above implementation is then compared with the outputs obtained by using In-built functions to implement L-K, H-S and Farneback method.

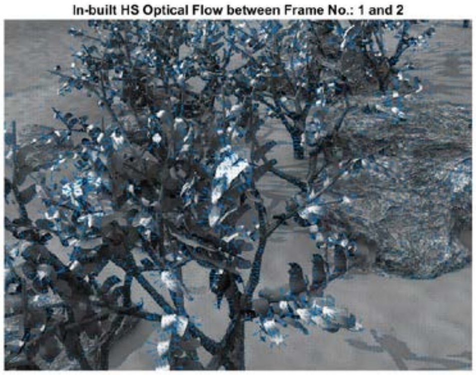


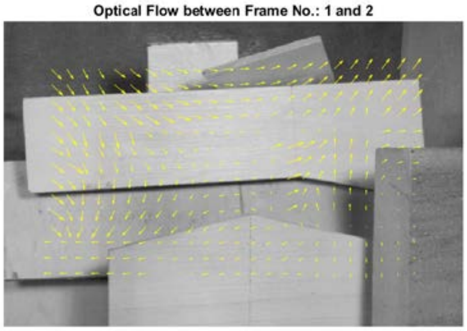
Part – 1 Output



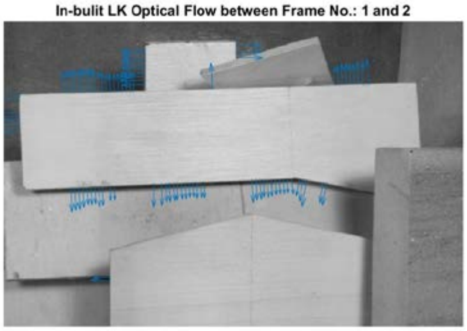
In-built function Output



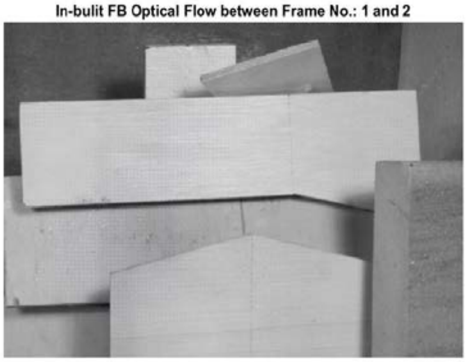


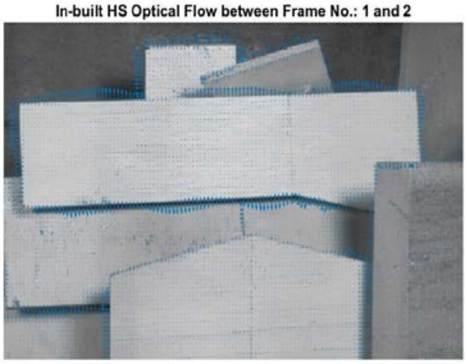


Part – 1 Output



In-built function Output





The Conclusion from the above results can me made that the function from part 1 searched the image for a defined window size, all over the image, except image edges.

Difference can be summarized as:

1. L-K algorithm did results better for the above two datasets. However, H-S algorithm has also resulted good for the edges for the ‘Wooden’ dataset. It can be verified that L-K and H-S method are good for detecting optical flow in images containing edges and small flow between pixels. FarneBack algorithm resulted in some small optical flow detection all over the image. It has searched densely throughout the image.

2. H-S Algorithm is more accurate than L-K, but with large number of iterations, it becomes slower.