All lab assignments must be done individually. You should submit your codes to SUCourse+ during the lab hours (In-Lab Code Submission) and you should submit your lab-reports within one week after the lab (Post-Lab Report).
Grading : In-lab Codes has a weight of 20% and Post-lab Reports has a weight of 80%. Your programs should be modular, bug-free, commented in MATLAB, self- explanatory. Also, your report should include necessary comments and discussions. Please note that if you miss the lab, you will get automatically zero (even if you submit post-lab report)

Important Note: Submit all your codes and the resulting images you used in the lab to SUCourse as a single zip file. Deadline for submission to SUCourse is **until the end of the lab**.

Things to do:

In this lab, you will write a program ("lab6OFMain.m") and a function ("lab6OF.m") to calculate the optical flow throughout a video.

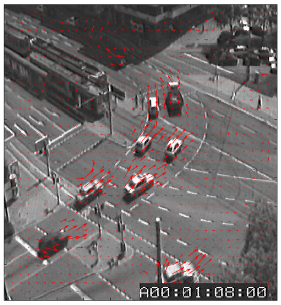
Optical flow is the distribution of the apparent velocities of objects in an image. By estimating optical flow between video frames, one can measure the velocities of objects in the video. These velocities can be estimated by:

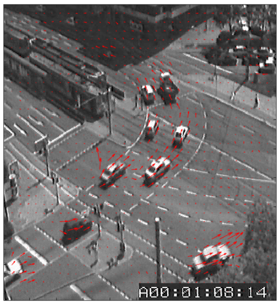
$$G = \begin{bmatrix} \sum\limits_{p \in W} I_x^2 & \sum\limits_{p \in W} I_x I_y \\ \sum\limits_{p \in W} I_x I_y & \sum\limits_{p \in W} I_y^2 \end{bmatrix} \quad b = \begin{bmatrix} \sum\limits_{p \in W} I_x I_t \\ \sum\limits_{p \in W} I_y I_t \end{bmatrix}$$

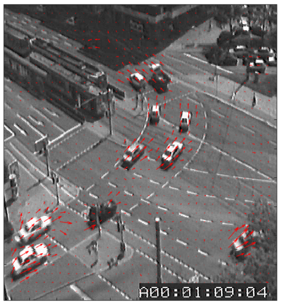
$$u = [Vx; Vy] = -G^{-1} b$$

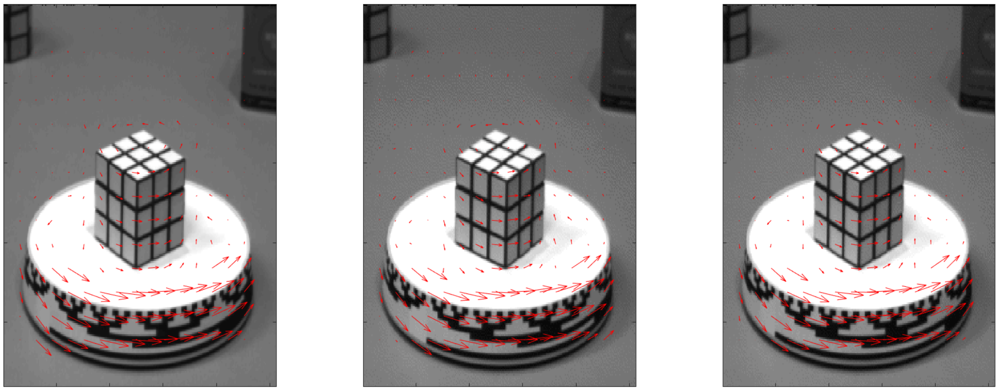
where; I_x and I_y are spatial gradients in X and Y directions, I_t is the gradient in temporal direction, V_x and V_y are velocity vectors.

Your resulting images will look as follows:









- Write the main program ("lab6OFMain.m") as follows:

```
clear all; close all; clc;
% Load the files given in SUcourse as Seq variable
[row,col,num]=size(Seq);
% Define k and Threshold
for j=2:1:num
  ImPrev = Seq(:,:,j-1)
  ImCurr = Seq(:,:,j)
  lab6OF(ImPrev,ImCurr,k,Threshold);
  pause(0.1);
end
```

- Write the function ("lab6OF.m") to calculate the optic flow of the input images as follows:

```
function lab6OF(ImPrev,ImCurr,k,Threshold)
% Smooth the input images using a Box filter
% Calculate spatial gradients (Ix, Iy) using Prewitt filter
% Calculate temporal (It) gradient

[ydim,xdim] = size(ImCurr);
Vx = zeros(ydim,xdim);
Vy = zeros(ydim,xdim);
G = zeros(2,2);
b = zeros(2,1);

for x=k+1:k:xdim-k-1
  for y=k+1:k:ydim-k-1
    % Calculate the elements of G and b

    if (min(eigenvalues of G) > Threshold)
      % Calculate u

      Vx(y,x)=u(1);
      Vy(y,x)=u(2);

    end
  end
end

cla reset;
imagesc(ImPrev); hold on;
[xramp,yramp] = meshgrid(1:1:xdim,1:1:ydim);
quiver(xramp,yramp,Vx,Vy,10,’r’);
colormap gray;
end
```

Post Lab

Provide resulting images for each step. Explain the procedure that you follow. Compare the performances of optical flow algorithm with different window sizes ($k = 10$, $k = 20$, $k = 30$) and smoothing filters (Box and Gaussian). Discuss and comment on your results.

Deadline for post lab report submission to SUCourse+: **18 December 2020, 23:55**.