Computer Vision
Assignment-2.

N.Harsha Vardhan
2019101122

1.1.1: Optical flow:-
-> Optical flow can be seen as displacement vector field b/w two images. showing how the pixels of one Image can be moved to form the same object in second Image.
-> For creating slow mo video. a low frame rate video (eg 24fps) is expanded to high frame rate (eg 50fps). now the Intermediate frames are filled with ~~frames~~ frames created using Optical flow. and the output looks slow-motioned.

1.3:- we could see painterly effect. In which at each frame paint stroke is generated for getting smooth motion. Extra frames are added in between. Interpolation is used to create this slowmotion.

1.4:- i) The actual motion field (2D motion field) is present and is in the direction of rotation (Horizontal). but the optical flow is zero. as the Illumination at each pixel doesnot change over the duration of rotation.

ii) Here the motion field is zero as the ball is stationary but optical flow is present as the light intensity at each pixel changes due to (light source motion).

1.2.1: 1) Brightness of the object after each frame remains constant

2) Time interval is very small

3) All the pixels in small area have same displacement.

1.2.2 We assume brightness (Illumination) remains constant :

$$I(x,y,t) = I(x+u\delta t,\ y+v\delta t,\ t+\delta t)$$

$I_x u + I_y v + I_t = 0.$

I_x = Gradient along x

I_y = Gradient along y

I_t = Temporal Gradient

Spatial term = $\Delta I \bar{V}$

$I_x u + I_y v$

data term = I_t.

1.2.3 $I(x,y,t) = I(x+\overset{\Delta x}{\cancel{u\delta t}},\ y+\overset{\Delta y}{\cancel{v\delta t}},\ t+\delta t)$

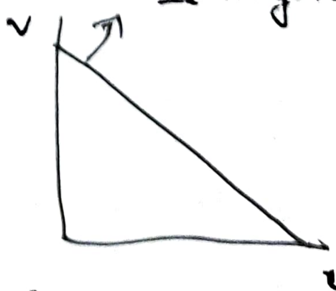
→ we have assumed $\overset{\Delta x}{\cancel{u\delta t}}$, $\overset{\Delta y}{\cancel{v\delta t}}$, δt are very small so we can use Taylor series expansion. So we can ignore the next terms in taylor series expansion

→ It reduces the complexity of problem without huge loss

1.2.4 optical flow constraint eqn

$I_x u + I_y v + I_t = 0$

$$I_x u + I_y v + I_t = 0.$$



all the (u,v)'s on the line in graph satisfy the above equation.

The flow can be decomposed as normal flow, parallel flow.

$$\hat{u}_n = \frac{(I_x, I_y)}{\sqrt{I_x^2 + I_y^2}}$$

2.3.1:-

→ For solution to exists in Lucas Kanade method, we need to get inverse of A^TA, so it needs to have rank 2. else sol^n to $Ax=b$ doesnot exists. Lucas Kanade method works best for corners. The tau 'τ' is to neglect places where there is no significant flow.

2.3.2:- I did not change the threshhold as I have considered only corners for flow calculations. and that threshold is taken care of at corners.

2.3.3:- For smaller windows, optical flow calculation is good as long as only small change is Present. Lucas method works for small windows. (Ass^n: Motion is const in small window region). but if motion is large we need large windows but they don't hold const motion assumption.

2.3.4: This fails if the equations for all the pixels in the window is same and. Presence of edge in window. ($\lambda_1 >>> \lambda_2$)

for A^TA to be well condition.

$\lambda_1, \lambda_2 >>> 0$ and $\lambda_1 \sim \lambda_2$.

2.3.5: → HSV (Hue separation Value) it separates Image intensity from the color Info.

→ HSV is more robust towards external lighting changes they vary very less

1.1.2: → We can see the character dodging the bullets in smooth flow. while the camera is moving.

→ Actually they placed multiple cameras around the character and captured Images with short Intervals and used optical flow to interpolate the Images from adjacent cameras to create a slow motion video.