## CS 512 HW 6 SUDIPTA SWARNAKAR

1)

a)

**3D Motion Vectors:** These are 3D vectors which tell us about moving a rigid object in a particular direction. Basically, these vectors tell us about how to move any rigid object.

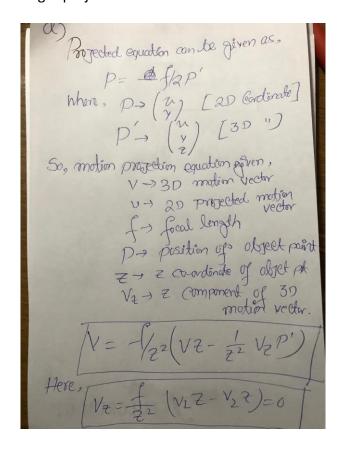
**2D Projected Motion Vectors:** This is the 2D project of a 3D motion in the form of a video or picture.

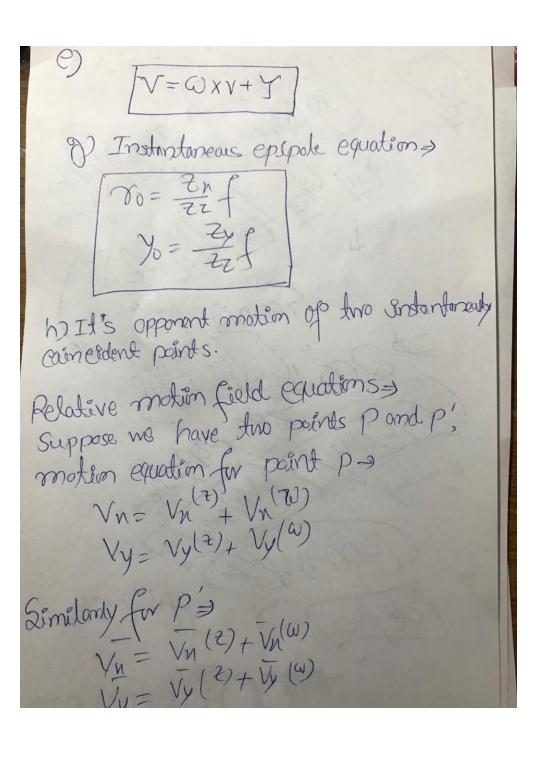
**2D Motion Vectors:** This is the optical flow which is basically noisy estimation of the true 2D projection. It can either zero or any values based on the 2D project motion.

Yes, it's possible that motion in 3D will not produce any optical flow vectors at all. We might have this scenario when the object is a point or it's quite far.

**b**) In this case, motion field will have parallel motion vectors. So the points which are close will have large project motion vectors.

c)In this case, the motion field will not be uniform. So the points close to runaway will have larger projected motion vectors.





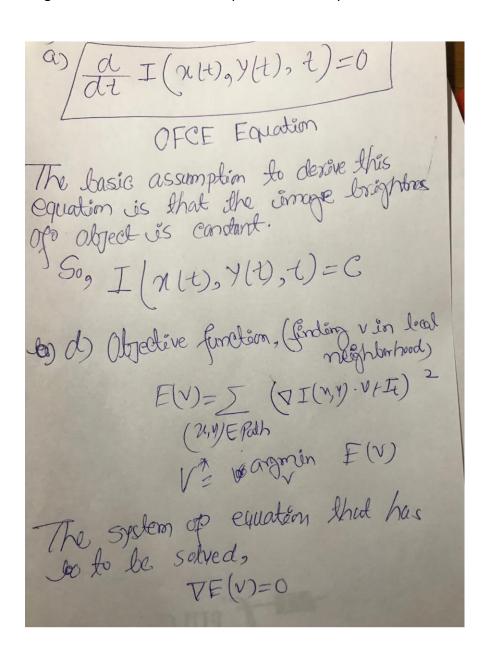
5) In pure handation motion, there is no rotation. So, w becomes o Un motion component. There is only translation matein which can Vn-Vn(2)= ZzN-ZRf le geven as, Vy-Yy(2)= Y2 y- 4, f Case I > Zeto Exemple > Whon plane es landing Case I > Zt = 0 Example > Driving a cor.

**Aperture Problem:** The aperture problem refers to the fact that the motion of a one-dimensional spatial structure, such as a bar or edge, cannot be determined unambiguously if it is viewed through a small aperture such that the ends of the stimulus are not visible.

We hope to recover the image difference with respect to time by taking frame difference between two frames as time derivatives.

## c) Block-based Optical Flow:

Block based methods don't use the second order derivatives to find optical flow but they use a neighborhood to estimate the optical flow at a specific location.



 $\begin{bmatrix} N_{+} \\ Y_{+} \end{bmatrix} = \begin{bmatrix} \sum I_{x}^{2} & \sum I_{y}^{2} \\ \sum A_{y} & \sum I_{y}^{2} \end{bmatrix} \begin{bmatrix} I_{-} & I_{y} & I_{+} \\ -I_{y} & I_{+} \end{bmatrix}$ The perpose of weighted block method is to give the highest weight to the center of the window.

It will decrease the neight as you to finther away,

E(V) = 2 w(M, y) (In. It + Iy. It + Iy) = 2 w(M, y) (In. It + Iy. It + Iy) = 2 I winty [ wiy? ] Nt] - Zwinty

I winty [ wiy? ] Yt] = - Zwinty

5) Global modion estimation (Hom-Schumi It solves all the optical flow vectors at some time and it eliminates all the motion vectors at the same time alse. To find this we used regularizat  $E(V(n,y,t)) = \int \int Eop^2(V(n,y,t) - \ell^2 E_s^2(V(n,y,t)))$ Here a is selected by user  $V^* = argmin E(V(n, y, t))$ EOF = (In. u+IyV+I+)2 Es = ||74112+117112 Loo Wont and Voyyt7

2) In order to find (U,V) mater vectors, We need an iterative salution. So, problem here is to find un, we so need wand Here we start with a guess for u, v and exterate to return values. To make an infra decession for anitial values we a either use Lucies-Konade er affine flar method.  $u^{n+1} = \overline{u}(n) - (\overline{I}_n \overline{u}(n) + \overline{I}_y \overline{v} + \overline{I}_t) \overline{I}_x$   $\overline{I}_x^2 + \overline{I}_y^2 + \overline{a}_z$ Vnth VM (InCVM+INJ IN+147492 We will use this equation in iterative to ford u and v.