HW#2	Optical Flow

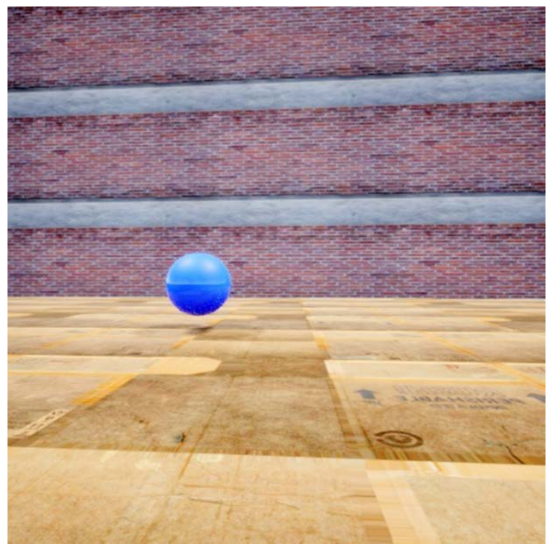
Homework Assignment #2

Problem: Ego Motion Compensation

Consider a pinhole camera performing a yaw rotation in a static environment. The frames captured by the camera are provided in the "data" folder. Figure 1 shows the frames at two-time steps. The angular velocity of the camera is a constant (yaw rate θ = 3 degree/second). The optical flow equation for pure rotational motion is given as,

$$\dot{\mathbf{p}}_{i,j} = \mathbf{H}_{i,j}\boldsymbol{\omega}, \qquad \boldsymbol{\omega} = [0 \quad \theta \quad 0]^T$$

(a)



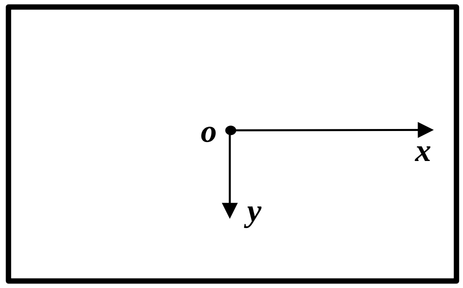
(b)

Figure 1. (a) Frame at time step 1. (b) Frame at time step 3.

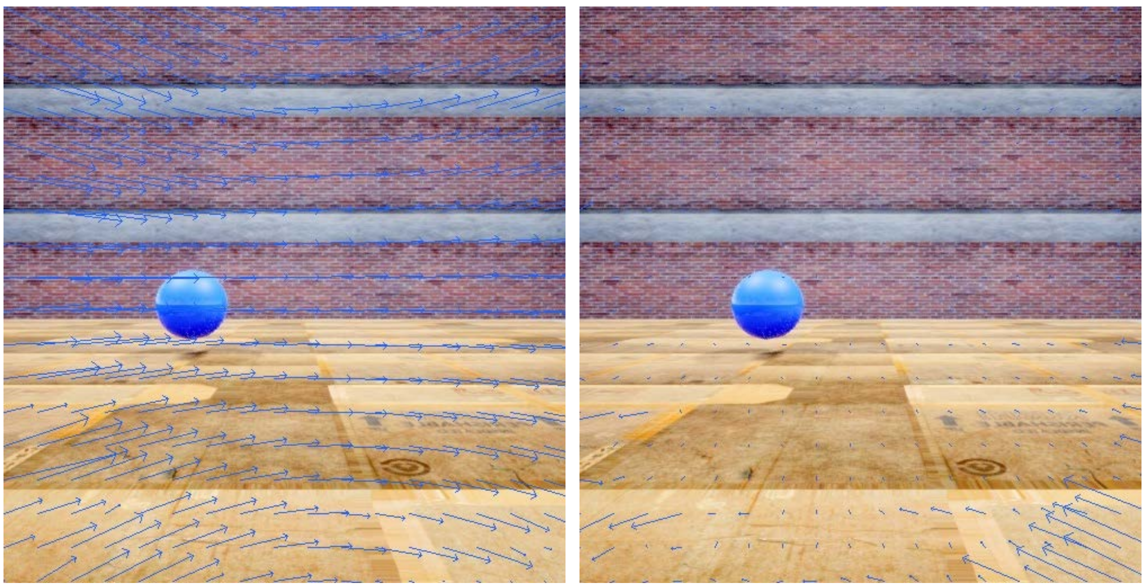
Now, construct a matrix $\mathbf{H}_{i,j}$ in the provided python file using below equation.

$$\mathbf{H}_{i,j} = \begin{bmatrix} \frac{x_i y_j}{\lambda} & -\lambda - \frac{x_i^2}{\lambda} & y_j \\ \lambda + \frac{y_j^2}{\lambda} & -\frac{x_i y_j}{\lambda} & -x_i \end{bmatrix} = [\begin{matrix} H_{i,j}^1 & H_{i,j}^2 & H_{i,j}^3 \\ H_{i,j}^4 & H_{i,j}^5 & H_{i,j}^6 \end{matrix}]$$

where λ is the focal length of the camera, it is provided in the file. (x_i, y_j) is the image coordinate of the pixel at i^{th} row and j^{th} column. The image coordinate system used in this problem is,



After building the matrix, the optical flow caused by the ego-motion of the camera can be computed using the provided code. Finally, it will be subtracted off the Farneback optical flow, and the result should look like below:



(a) (b)

Figure 2. (a) Farneback Optical Flow. (b) Subtracted Flow