Computer Vision, Spring 2019 - Homework 7

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Written Assignments

Problem 1

Optical Flow Constraint equation to estimate optical flow (u, v) at a point (x, y) is:

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

Now consider a structured environment where illumination can be controlled at a speed much faster than the motion of objects in the scene. Let us quickly capture the first frame with two intensities I_1 and I_2 and lets quickly change the intensity from I_2 to I_1 for the second frame as well.

Since the light source has moved much faster compared to the object, the relative motion of objects and therefore the optical flow (u, v) will be negligible compared to it. Now we have the each frame with two light intensities I_1 and I_2 captured which gives us the following constraint equations:

$$I_{x_1} u + I_{y_1} v + I_{t_1} = 0$$

$$I_{x_2} u + I_{y_2} v + I_{t_2} = 0$$

where $I_{x_1}, I_{y_1}, I_{t_1}$ are the gradients of I_1 and $I_{x_2}, I_{y_2}, I_{t_2}$ are the gradients of I_2 in x, y, t directions respectively.

We now have two equations in unknowns u and v and all the other terms are known. Therefore, we can **uniquely** determine the optical flow (u, v) at each image point (x, y) by solving these equations.