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Project Updates: Week 2

The goals for this week were to better understand the Gauss-Seidal method and how it applies to Horn-Schunck algorithm. As well as determine how to estimate partial derivatives of image brightness x, y, and t direction without using Gaussian kernels to find u and v.

From the paper and powerpoint reference on Horn-Schunck algorithm that Dr. Pallipuram provided us last week we have a better understanding of how to implement the above objectives. Finding the partial derivatives of the two images, in the horizontal, vertical, and time directions was mostly straightforward, as it did not involve the Gaussian kernels used previously. It merely relied upon the given equations in the original Horn-Schunck paper, and working backwards from these equations, we built kernels to convolve with the entire images, thus producing the needed I_x, I_y, and I_t images. The equations below are the ones given in the original Horn-Schunk paper that we used to find I_x, I_y, and I_t images:

$$I_x = 1/4(I_{i,j+1,k} - I_{i,j,k} + I_{i+1,j+1,k} - \ldots\ldots - I_{i+1,j,k+1})$$
$$I_y = 1/4(I_{i+1,j,k} - I_{i,j,k} + I_{i+1,j+1,k} - \ldots\ldots - I_{i,j+1,k+1})$$
$$I_t = 1/4(I_{i,j,k+1} - I_{i,j,k} + I_{i+1,j,k+1} - \ldots\ldots - I_{i+1,j+1,k})$$

In regards to Gauss-Seidal method, we found out that it is just an iterative method to solve linear systems of equations. This method will be used when we find average u and v. The u and v matrices will be initially set to zero but as we iterate through them using the Gauss-Seidal method we will then find the average of u and v. Every iteration for the next u and v is mathematically calculated by

$$u^{n+1} = \bar{u}^n - I_x \frac{I_x\bar{u}^n + I_y\bar{v}^n + I_t}{\alpha^2 + I_x^2 + I_y^2}$$
$$v^{n+1} = \bar{v}^n - I_y \frac{I_x\bar{u}^n + I_y\bar{v}^n + I_t}{\alpha^2 + I_x^2 + I_y^2}$$