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ECPE 124
11/22/2016

Project Updates: Week 3

The goals for this week were to translate the partial derivative equations into matlab to find Ix,Iy, and It. As well as translate the equations to find the averages of u and v. We were successful in these translations because the original Horn-Schunk paper explains the derivations and equations in a great length. The equations were also showed in their simplified version in the paper that it was an easy translation to matlab.

The equations for the partial derivatives Ix,Iy,and It that are shown in the original Horn-Schunk are the following:

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

These equations were translated into matlab in the following manner. Image1 and Image2 were convolved by a symmetric 2x2 kernel for x, y, and t which then lead to the addition of the convolutions for both Image1 and Image2 with the respective kernels.This is shown in the function we created below :

```
function [Ix, Iy, It] = PartialDerivatives(Image1, Image2)
    kernel_x = 1/4*[-1 1; -1 1];
    kernel_y = 1/4*[-1 -1; 1 1];
    kernel_t1 = 1/4*ones(2,2);
    kernel_t2 =- 1/4*ones(2,2);

    Ix = convolve(Image1, kernel_x) + convolve(Image2, kernel_x);
    Iy = convolve(Image1, kernel_y) + convolve(Image2, kernel_y);
    It = convolve(Image1, kernel_t1) + convolve(Image2, kernel_t2);
end
```

The equation to find the averages of u and v that were discussed in the paper are shown below:

$$\widehat{u}_{i,j,k} = 1/6\ (u_{i-1,j,k} + u_{i,j+1,k} + u_{i+1.j.k} + u_{i,j-1,k}) + 1/12(u_{i-1,j-1,k} + u_{i-1,j+1,k} + u_{i+1,J+1,k} + u_{i+1,j-1,k}\ )$$
$$\widehat{v}_{i,j,k} = 1/6\ (v_{i-1,j,k} + v_{i,j+1,k} + v_{i+1,j,k} + v_{i,j-1,k}) + 1/12(v_{i-1,j-1,k} + v_{i-1,j+1,k} + v_{i+1,j+1,k} + v_{i+1,j-1,k})$$

The u and v average equations are translated into matlab by creating a 3x3 kernel and convolving it by u and v respectively to get the average u and v. This is shown in the function we created shown below:

```
function [ Avg_u,Avg_v ] = Avg_uv(u,v)

kernel=[1/12 1/6 1/12;1/6 -1 1/6;1/12 1/6 1/12];

Avg_u=convolve(u,kernel);
Avg_v=convolve(v,kernel);

end
```