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HW1

Q1

1.1 Harris corner detector is invariant to translation. Since a corner is a point whose local neighbourhood stands in two dominant and different edge directions. In other words, a corner can be interpreted as the junction of two edges, where an edge is a sudden change in image brightness. And since the corners describe 3D objects corners then the corners will remain the same even if we move our camera (translation)

1.2. Harris corner detector is invariant to rotation. Since a corner is a point whose local neighbourhood stands in two dominant and different edge directions. In other words, a corner can be interpreted as the junction of two edges, where an edge is a sudden change in image brightness. And since the corners describe 3D objects corners then the corners will remain the same even if we rotate our camera

1.3. Harris corner detector is not invariant to illumination. For image I with the derivatives I_x, I_y

And second derivatives matrix M . we know that for a change in the illumination we get that

$$I_{new} = a * I_{in} + b$$

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$$I_{x\_new} = a * I_x \qquad I_{y_{new}} = a * I_y \gg M_{new} = a^2 * M$$

Hence, we get that the eigen values of M_{new} and response image R_{new} are also scaled by a factor of:

$$\lambda_{i\_new} = a^2 * \lambda_i \qquad R_{new} = a^4 * R$$

And since the threshold remains the same then the response image we get after the change in illumination will not remain the same. Only for a=1 we will get that the Harris corner detector is invariant to illumination.

Q3

3.3 A Sobel operator calculates the partial gradients in the X and Y directions. The gradients would get high values on edges because they represent a shift in the frame colors (observed objects), for that the X and Y gradients would find the edges in the X and Y directions accordingly. The sobel operator uses a 3X3 kernel of the sort:

-1	0	1
-2	0	2
-1	0	1

For x. and:

1	2	1
0	0	0
-1	-2	-1

For y

Which are convolved with the original image to calculate approximations of the derivatives