**CSC249/449MachineVision: Homework1**

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**Problem 3**

1.

(1) Box Filter

(2) Sobel Filter

2.

**Problem 4**

Laplacian filter is a filter that takes image derivatives so that it is very sensitive to noise. Therefore, applying a low-pass filter such as Gaussian to smooth the image before computing the gradient is desirable. Laplacian of Gaussian operation is a two-step process which will use Gaussian filter and then applying Laplacian.

**Problem 5**

1.

By applying first order Taylor expansion, we get:

So,

The 3D structure tensor is:

Because it is a symmetric matrix, its eigenvalues , ,  are real.

For criterion, as , , are in decreasing order, so the is the smallest value. According to Harris operator for 2D corner , 3D corner criterion could be and the should be . In my opinion, the eigenvalue of time dimension actually represents the position change among frames. Therefore, when the video is static, 3D corner will become a 2D corner.

2.

To be a 3D corner, all three should be large enough which means a 3D corner should be a 2D corner in every frame of a video. In other words, 3D corner will always be detected as a corner. This also meet the criterion that the smallest should be large enough no matter the is for time dimension or other two dimensions (remember in Harris 2D corner detector, both and are required to be large).

Specifically, a desk corner is detected at 1s in a video at position (1, 1), then it changes its position to (1, 2), but remains as a corner. The position change is denoted by . If it remains a corner no matter it position change, it can be considered as a 3D corner. Or, the desk corner is detected at 1s at position (1, 1), but it has disappeared later. It cannot be considered as a 3D corner.