Hello, and good evening professor, teachers and fellows. My name is Laurence, 罗子琛.

My part is about the isotropic and anisotropic filters in Canny Edge Detection.

As we have introduced in the previous section, the process of Canny Edge detection can be divided into these steps, in which the second step is the “noise reduction”. Since edge detection is susceptible to noise in the image, and the noise can be mistaken as the edge, therefore, we should remove the noise in the image before doing the edge detection.

To remove noise in the input image, OpenCV normally recommends using a Gaussian filter. However, as we can see in the example source code from OpenCV, it uses a homogenous blur, which is also called normalized block filter, or a box filter.

The Gaussian filter is done by convolving each point in the input image with a Gaussian kernel and then summing them all to produce the output image.

And the Box filter is a spatial domain linear filter in which each pixel in the resulting image has a value equal to the average value of its neighboring pixels in the input image.

Although it has been a traditional or normal way to use the Gaussian filter, it has some disadvantages. First, it runs slower than box filter, which if run convolutionally, can also reach the similar result. Secondly, The Gaussian filter is one of the Isotropic Filters. And therefore, edges and noise are treated in the same way, which yields noise reduction as well as edge blurring. this is not preferable in edge detection.

To remedy the problem of traditional Gaussian filtering and other isotropic filters, anisotropic filtering has drawn more and more attention, and several categories of anisotropic filtering have been proposed.

The famous methods include Bilateral Filtering, Wavelet Transformation, Mean-median filter, and Anisotropic Diffusion.

Bilateral Filtering is generally the combination of domain and range filtering. It replaces the intensity of each pixel with a weighted average of intensity values from nearby pixels.

And Anisotropic Diffusion is base on the idea of viewing an image as a thermal field, where every pixel in it is a heat flow. The flow will depend on the relation between pixels. In this sense, while preserving the edge in the image, the noise is suppressed.

In the practice, we use the “marion\_airport” image as our source image, and here’s our result comparison.

As for the parameter for Canny Edge Detection fuction, we set the low threshold to be 70 and high threshold to be 140, and the size of aperture to be 3.

As the result, Box Filter and Gaussian Filter not only marked out the runways as the edge, but also marked the fields and roads as pseudo-edge. It’s obvious that by edge detection, our goal is to clearly mark out the airport runways, which is the main object, and isolated them from other things and the background. The Box Filter and Gaussian Filter fails to do so, but Bilateral Filter and Anisotropic Diffusion Filter have improved performance and better result.