# Computer Vision 1 - Assignment 2
# Linear Filters: Gaussians and Derivatives

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## 1 1D Gaussian Filter

Our function takes the same arguments as the built-in fspecial, but it generates different output. On the one hand our function generates a vector of size $kernelLength$. On the other hand, the fspecial function returns a rectangular or squared matrix dependant on the hsize parameter.

## 2 Convolving an image with a 2D Gaussian

We use a value of $\sigma_x = 2$ and $\sigma_y = 2$ and a kernel length of 11. First we call the gaussian function defined in the prefious section to get two 1D filters, one with each $\sigma$. We multiply this 1D vector by its traspose to get a 2D gaussian filter.

To convolve the images and filters we use the built-it function $conv2$. After testing the different options we found out the following:

- "full": performs the full convolution. Visually, we note that the produced images have black frames on the edges since the dimensions are slightly (10 pixels) larger than the original image.
- "valid": performs convolution but omits padding
- "same": performs the convolution and returns an image that is the same size as the filter.

In order to check that both functions produce the same images we make a pixel per pixel comparison. We check that the absolute value of the difference among the values is less that a small value $\epsilon = 1e^12$. Hereby we show the original and filtered images using the "full" option:

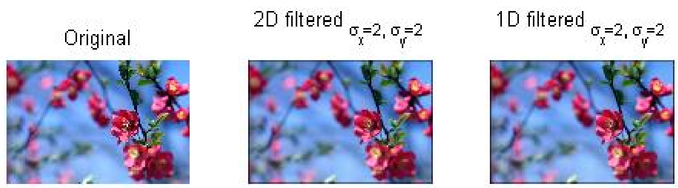


Figure 1: Comparison for flowers.jpg.

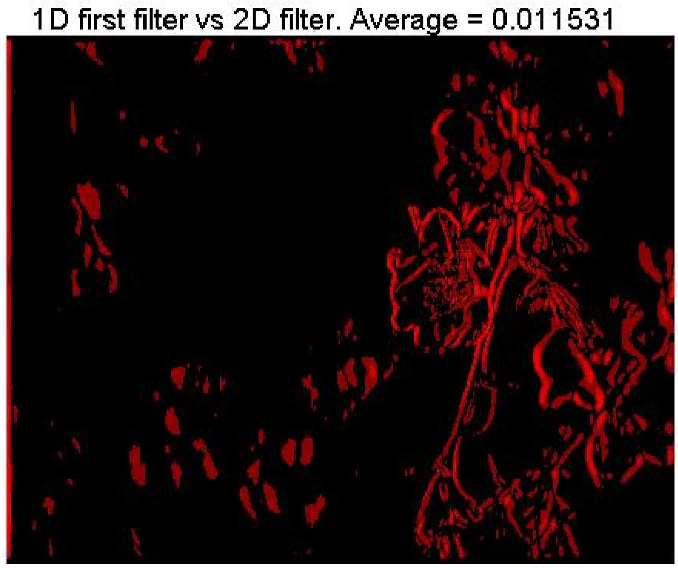


Figure 2: Heatmap showing the absolute difference per pixel between Step 1 of 1D filtering and 2D final filtered image for flowers.jpg. Reported mean error per pixel is 0.0115

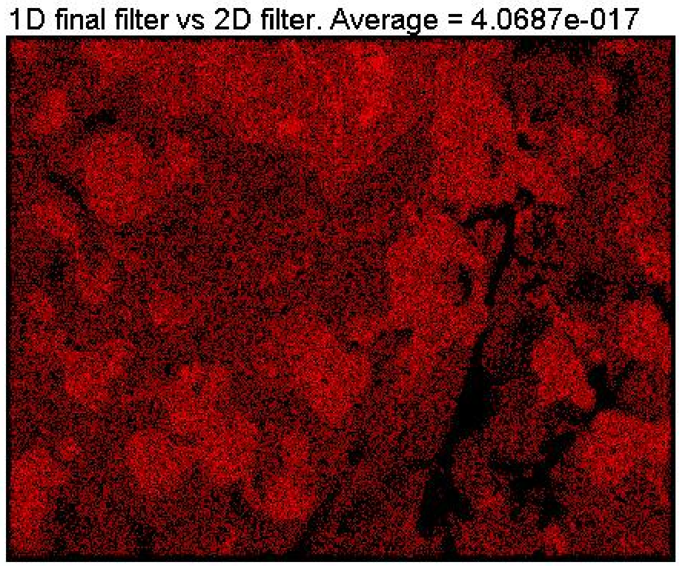


Figure 3: Heatmap showing the absolute difference per pixel between both final filtered images for flowers.jpg. Reported mean error per pixel is $4.0687e^{-}017$

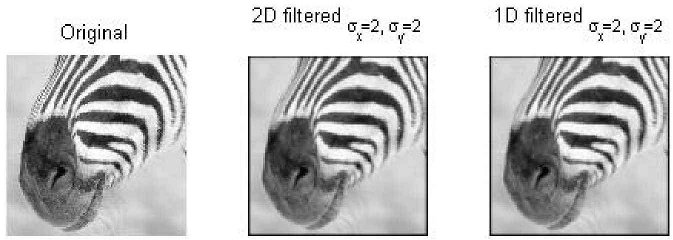


Figure 4: Comparison for zebra.png. Reported mean error per pixel is $5.5609e^{-}017$

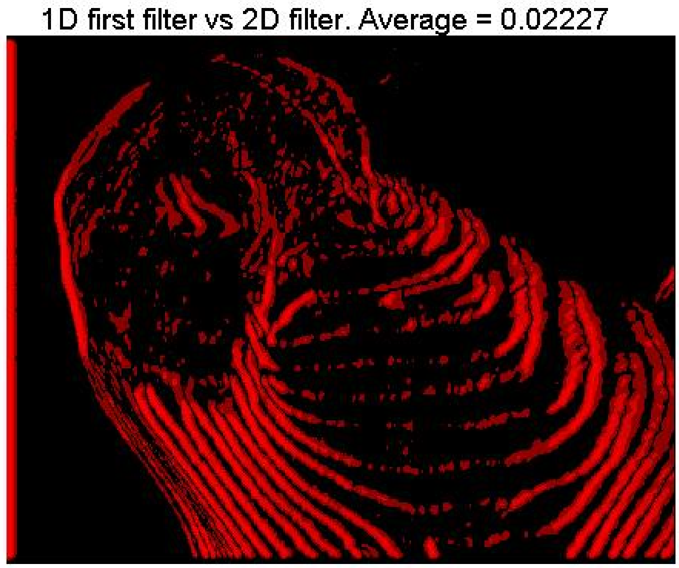


Figure 5: Heatmap showing the absolute difference per pixel between Step 1 of 1D filtering and 2D final filtered image for zebra.png. Reported mean error per pixel is 0.0223

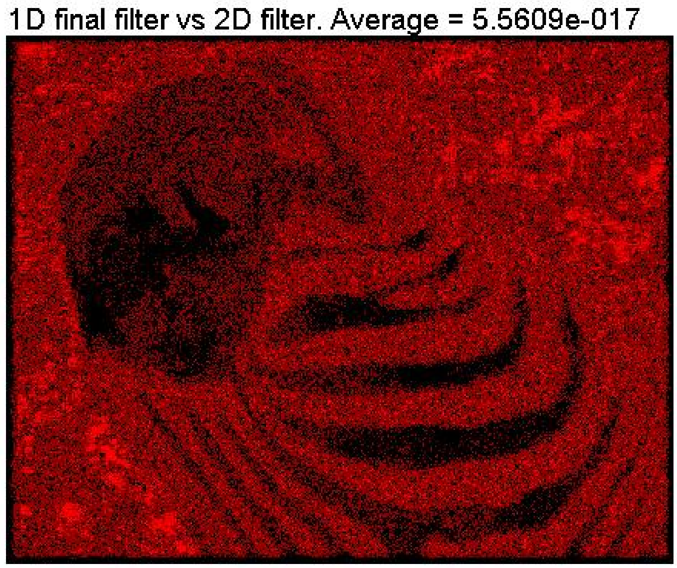


Figure 6: Heatmap showing the absolute difference per pixel between both final filtered images for zebra.png. Reported mean error per pixel is $5.5609e^{-}017$

Having kernel separability is helpful since the computation time is reduced.

## 3 Gaussian Derivative

The Gaussian derivative may be used to find edges in am image. An application could be countoruing an image.