**Project # 1: Spatial and Frequency Filtering**  
*CSC 391: Computer Vision*  
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**3.2.1 Smoothing and denoising**

Below are the result of using the Gaussian and median filters of different sizes on the noisiest puppy image. As we can see, the larger the filter the smoother the image becomes so the less information we have about the subject for both filters. Comparing the 27 x 27 Gaussian filter with the 27 x 27 median filter, the Gaussian filter appears to make the whole image look equally blurry while the median filter appears smooth in areas of similar colors and intensities, and maintains sharp edges in areas such as where the white blanket touches the dark background, or where the puppy’s dark ear is next to its white fur. So the median filter appears to maintain sharp edges where there’s a clear distinction between different values, but only if these are large areas; if we look at where the puppy’s eyes are, it’s hard to see where exactly they are, which may be a result of the size of the filter.

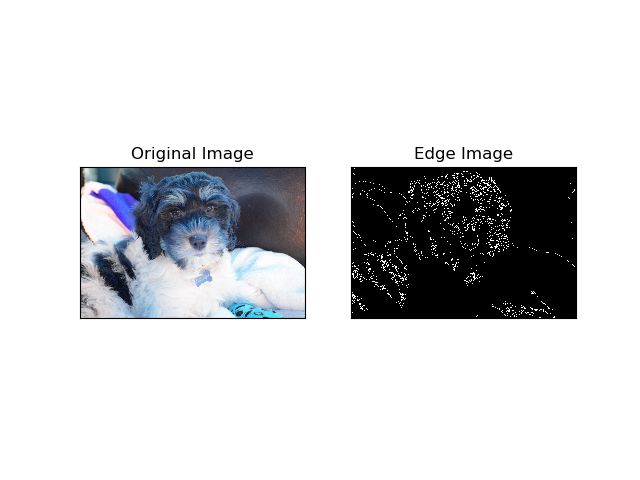
|  |  |
| --- | --- |
| **Gaussian Filter** | **Median Filter** |
| 3 x 3 | 3 x 3 |
| 9 x 9 | 9 x 9 |
| 27 x 27 | 27 x 27 |

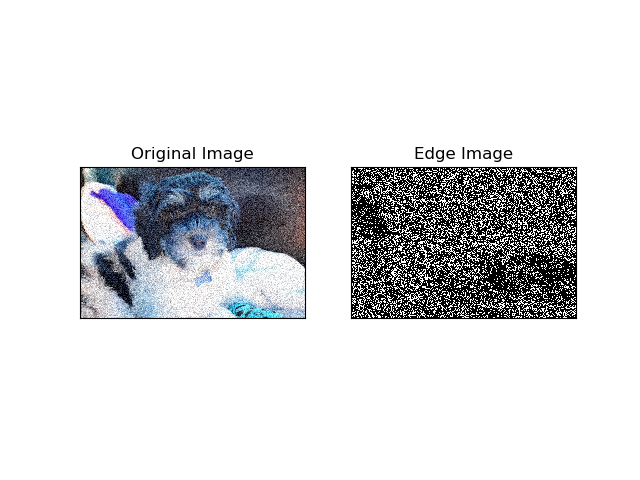
If we look at how running these filters on less noisy images and compare, we can see that the results from the Gaussian filter are pretty similar, whereas with the median filter on the less noisy image, we can see even more edges such as the top of the puppy’s head and in the puppy’s shadow, and edges that we see in the noisier image are even more sharp in the less noisy image.

|  |  |
| --- | --- |
| **27 x 27 Gaussian Filter** | **27 x 27 Median Filter** |
| 0.02 Noisy Image | 0.02 Noisy Image |
| 0.50 Noise Image | 0.50 Noisy Image |

**3.2.2 Edge detection**

Using the Canny edge detector with the non-noisy image, we can see outlines of the puppy’s ear, nose, coat, and the blanket. With the noisy image, however, edge detection appears to be random noise.





With the field images, while vegetation appears quite noisy, it is easy to distinguish where there is a body of water or a road.

