

---

# COMP 6771 Image Processing: Assignment 2

---

Student name: YUNQI XU

Student id: 40130514

December 2, 2022

---

# **1 Review**

## **1.1 Review of Bilateral Filter**

Bilateral Filter is one of the most important filter method which presented by Tomasi in 1998. The bilateral filter smoothing image and preserve edges information at the meanwhile.

The main method that the bilateral filter utilized are two Gaussian filters. One is calcualted based on the Geometric closeness. Another is calculated based on their photometric similarity

## **1.2 Review of another paper**

# **2 Re-implement of Bilateral Filter**

In this section, we will firstly present the result of our re-implement method, and then compared the bilater filter with other baseline algorithm in terms of other low pass filters that usually blur the image but also blur edges

## **2.1 Result of the Re-implement algorithm**

In this section, we will use the images in the paper[cite here] to show our result that has successfully achieve the main goal which introduced by the paper.

Firstly, we present our result compared with the result indicated in the paper, with the same inputted parameters and the same pattern.

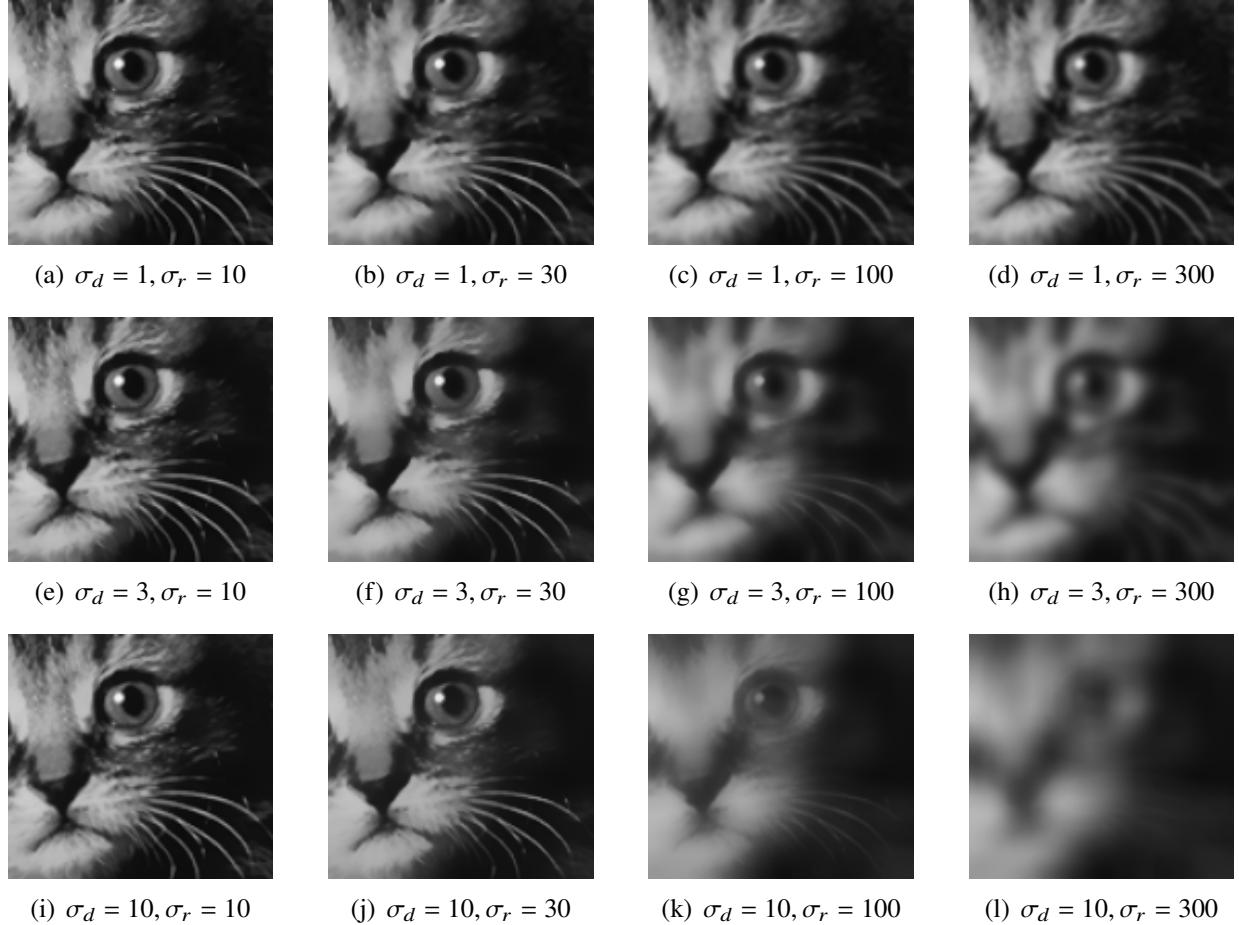


Figure 1: A detail figure with bilateral filters with various range and domain parameter values by implement code

The Fig. 1 presents the result of our implementation. In this experiment, we use `kernel_size = 25` and other parameters are totally the same as the paper, and we got the same trend of the blur as the paper did.

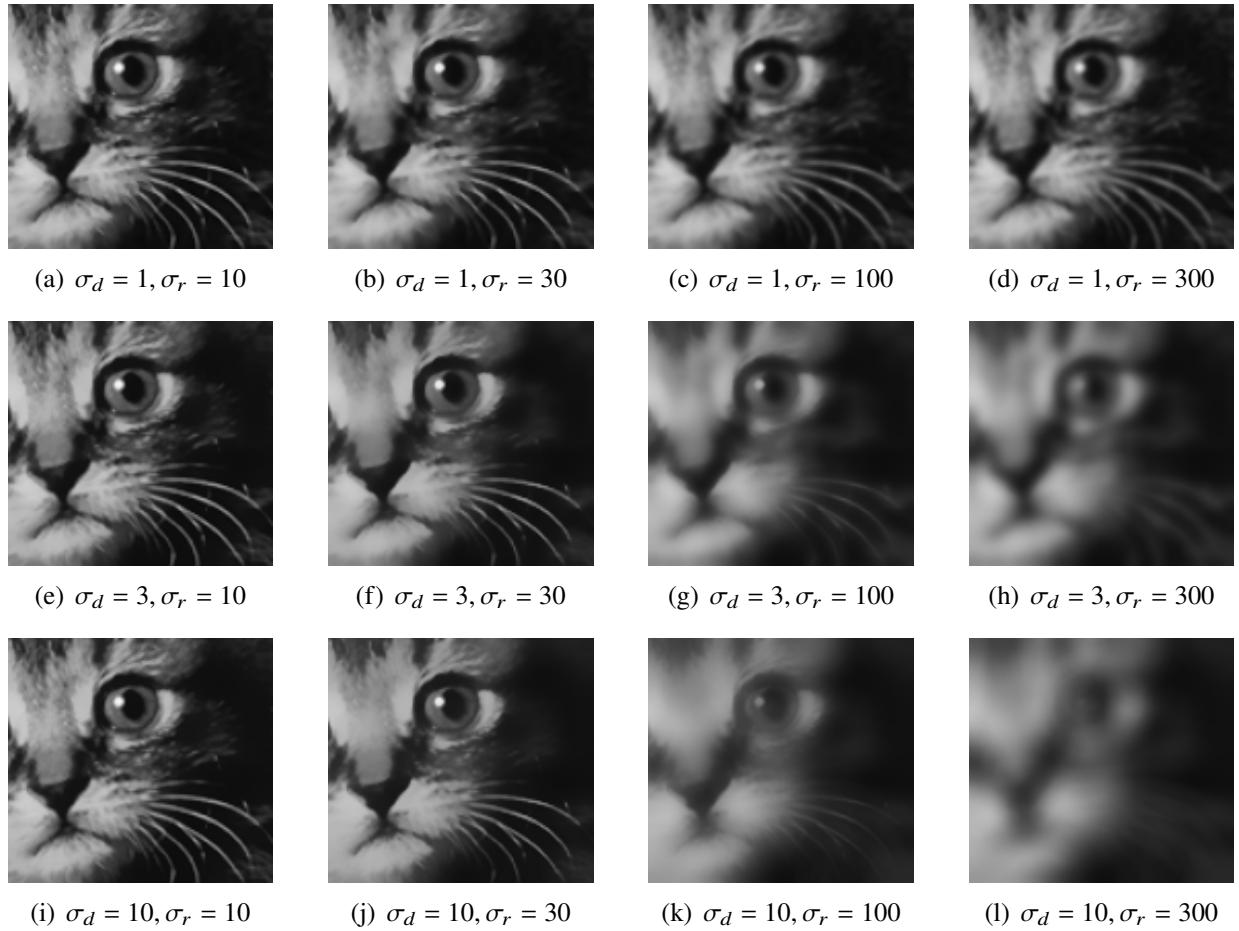


Figure 2: A detail figure with bilateral filters with various range and domain parameter values by Opencv python

Fig. 2 indicates that the similarity of output between our re-implement code and the build-in algorithm in python, in other ways prove the successful implement of our code. the output looks very similar.

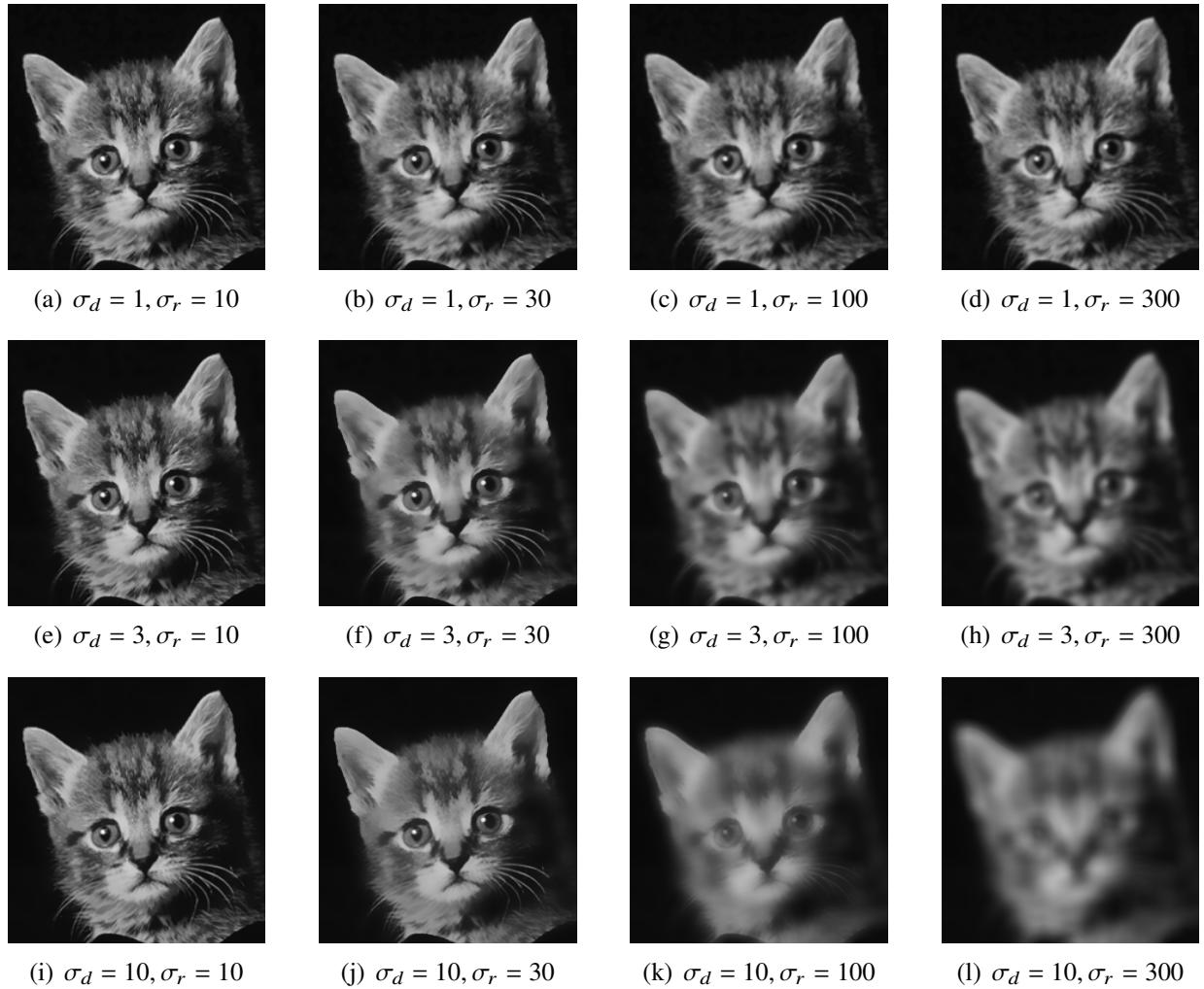


Figure 3: A detail figure with bilateral filters with various range and domain parameter values by re-implement code of cat

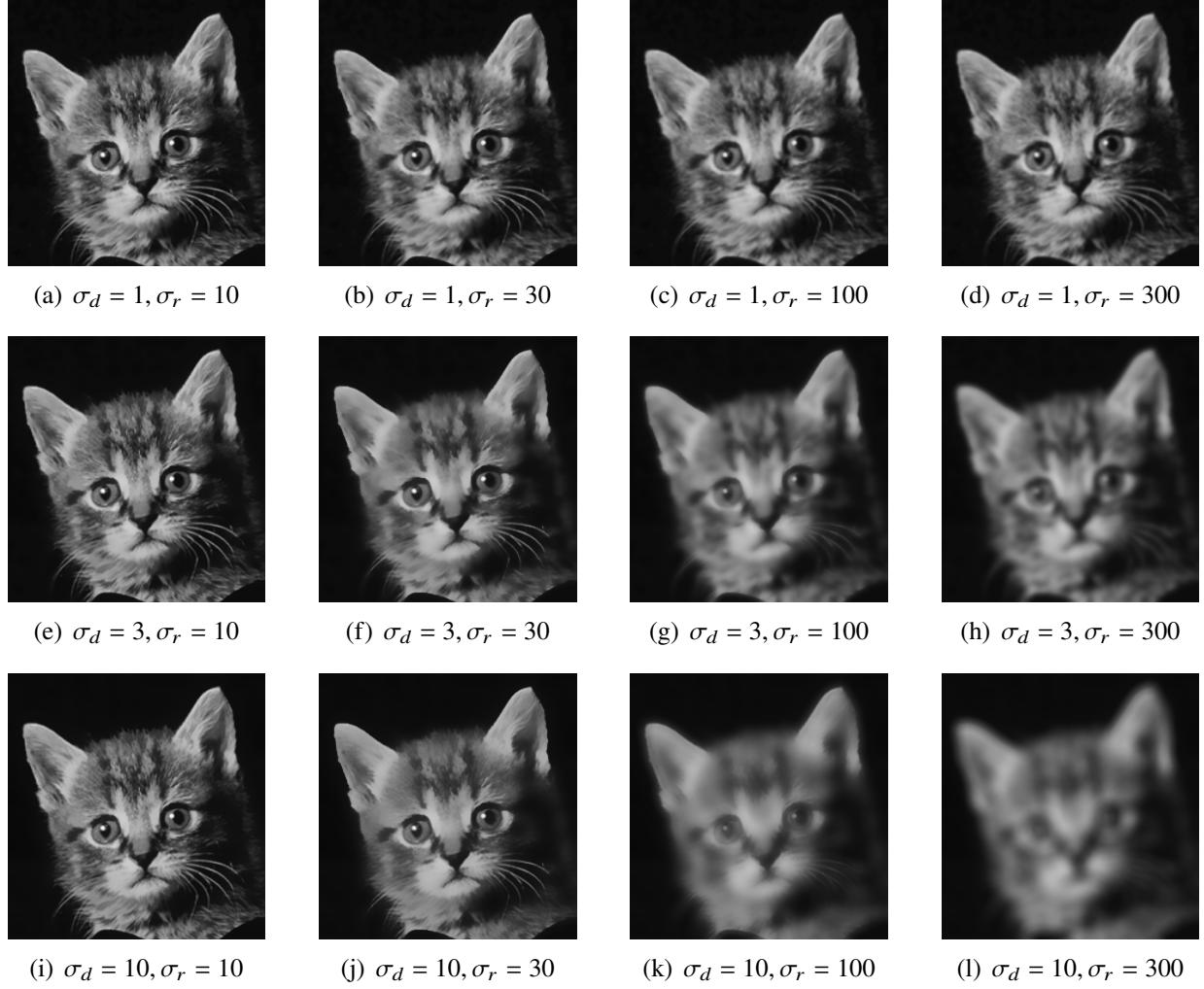


Figure 4: A detail figure with bilateral filters with various range and domain parameter values by OpenCV python of cat

Fig. 3 and 4 are also two image which prove the success of our re-implement code. In Fig. 5, we also present another images that presented on the paper. As it presents, the salt and pepper noise can be removed, and also the edge information can be kept as shown in Fig. ??



(a)  $\sigma_d = 1, \sigma_r = 10$



(b)  $\sigma_d = 1, \sigma_r = 30$



(c)  $\sigma_d = 1, \sigma_r = 100$



(d)  $\sigma_d = 1, \sigma_r = 300$

Figure 5: A detail figure with bilateral filters with various range and domain parameter values by OpenCV python of cat

These images above indicate some other experiments which utilized the images provided by the paper.

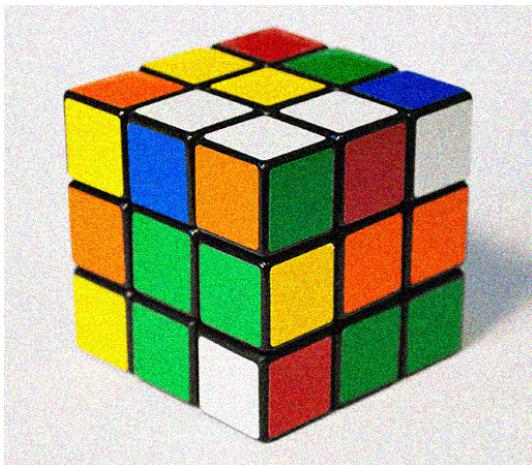
There are some other color (3-channels) images which also indicate the successful re-implement of our code for bilateral filters.



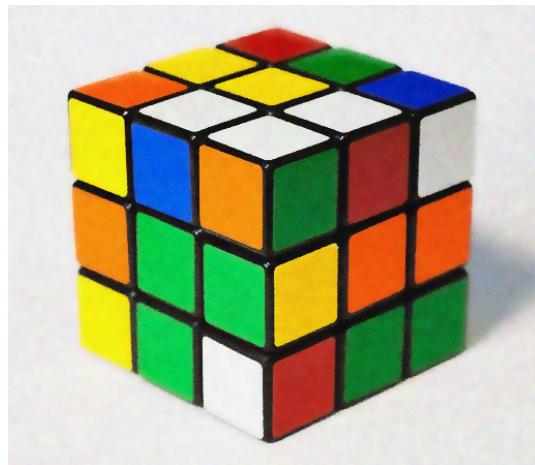
(a)  $\sigma_d = 1, \sigma_r = 10$



(b)  $\sigma_d = 1, \sigma_r = 30$



(c)  $\sigma_d = 1, \sigma_r = 100$



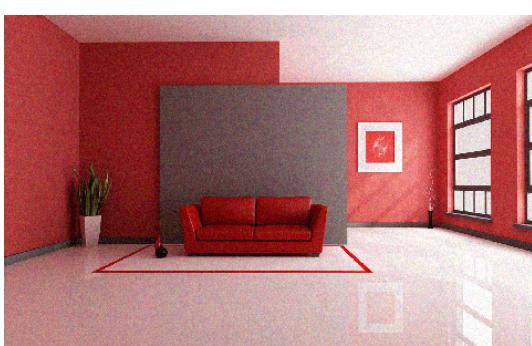
(d)  $\sigma_d = 1, \sigma_r = 300$



(e) sky



(f) sky code



(g) home



(h) home code

Figure 6: Color images filtered by Bilateral filter

## 2.2 Compare with other baseline algorithm

In this section, we compared the filter result of Bilateral filter with other baseline algorithm to present the advantages of our code. In this experiment, we not only compared the output result passed by different filters from human version level, but also calculate the PNSR[cite paper] from mathematical level. The equation of PNSR has been shwo in Equation:

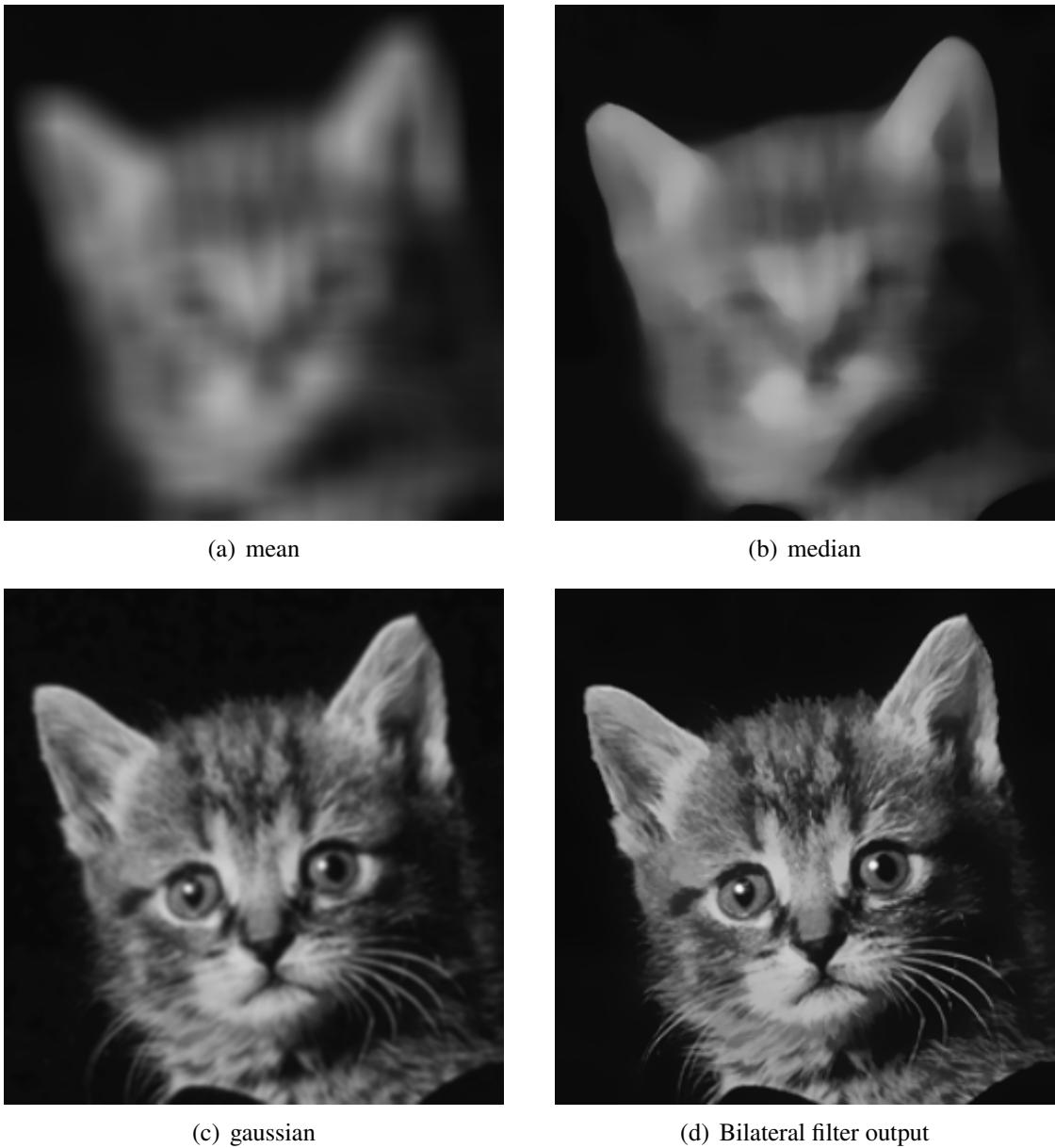


Figure 7: output compared with the baseline low pass filters

The result indicates that the Bilateral filter has advantages compared with other low pass filter such as median filter, mean filter and gaussian filter.

The Tabel. 1 presents the PSNR result compared with Bilater filter and other baseline filters.

In the experiment, we use  $kernel\_size = 25$  for all filters, but the same parameters as before in the paper. The result shows that the bilateral filter has advantages compared with other baseline low-pass

Method	Kernel_size	sigma_s	Sigma_r	PSNR
Bilateral Filter	25	1	10	42.74
			30	32.26
			100	32.59
			300	31.70
Bilateral Filter	25	3	10	40.05
			30	31.37
			100	25.90
			300	24.39
Bilateral Filteral	25	10	10	39.62
			30	29.72
			100	22.38
			300	20.31
Median filter	25	None	None	20.31
Mean filter	25	None	None	19.59
Gaussian filter	25	None	None	31.59

Table 1: The PSNR output of bailteral filter and baseline filters

filter. Only the Gaussian filter obtains  $PSNR = 31.59$  which is very close with some result of the bilater filter and over some bery blur bilateral filters. But still not good as the result with some very clean Bilater filters.