

# Problem3 Report

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## 1 Ideal Lowpass Filter

The ideal lowpass filter is defined as

$$H(u, v) = \begin{cases} 1 & D(u, v) \leq D_0 \\ 0 & D(u, v) > D_0 \end{cases}$$

here  $D_0$  is radius and  $D(u, v) = \sqrt{(u - P/2)^2 + (v - Q/2)^2}$  is the distance from  $(u, v)$  to the center.



The above figures are results of ideal lowpass filter. The first one is the original figure. The second to the sixth figure has different value of  $D_0$ , which is set by 10, 30, 60, 160 and 460.

## 2 Butterworth Lowpass Filter

The Butterworth lowpass filter is defined as

$$H(u, v) = \frac{1}{1 + [D(u, v)/D_0]^{2n}}$$

here  $D(u, v)$  and  $D_0$  have the same meaning above.



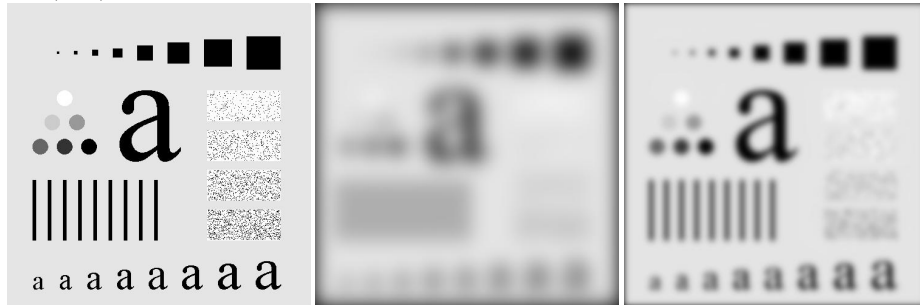
The above figures are results of Butterworth lowpass filter. The first one is the original figure. The second to the sixth figure has different value of  $D_0$ , which is set by 10, 30, 60, 160 and 460. The value of  $n$  is 2.

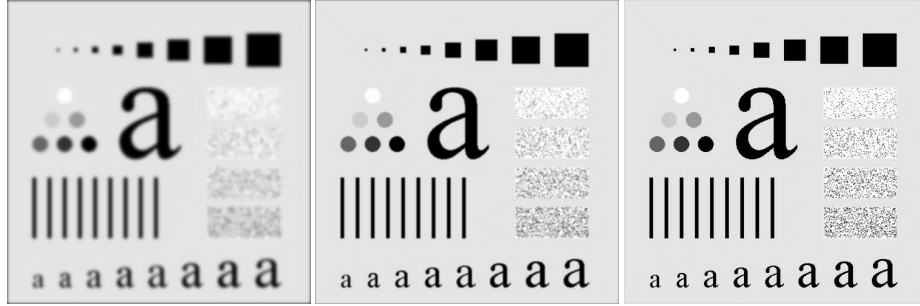
## 3 Gaussian Lowpass Filter

The Gaussian lowpass filter is defined as

$$H(u, v) = \exp(-D^2(u, v)/2D_0^2)$$

here  $D(u, v)$  and  $D_0$  have the same meaning above.





The above figures are results of Gaussian lowpass filter. The first one is the original figure. The second to the sixth figure has different value of  $D_0$ , which is set by 10, 30, 60, 160 and 460.

## 4 Highpass Filter

The highpass filter can be calculated by one minus the corresponding lowpass filter. The figures below show the result of highpass filter. The first row is ideal highpass filter, the second row is Butterworth highpass filter and the third row is Gaussian highpass filter. The figures from left to right have different value of  $D_0$  which is 30, 60 and 160.

