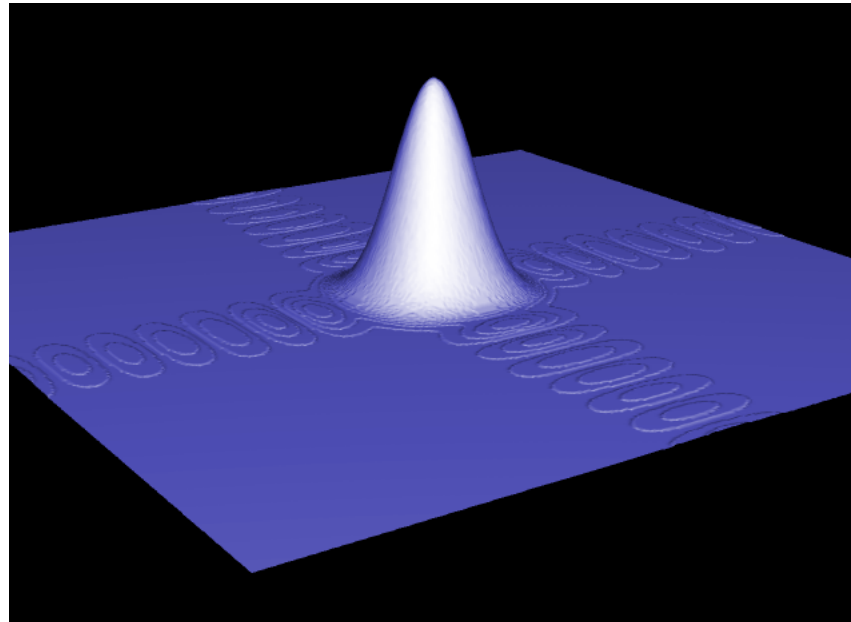


Gernot Hoffmann

Gabriel Filter



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# 1. Introduction

Blur in image processing is applied by a spacial low pass filter. Low pass filters calculate the new pixel value for each channel RGB or for Gray in the center of a box with  $m=(n+1)(n+1)$  weight factors by a weighted sum. For a uniformly colored area the original values are retained.

The simplest low pass is a box filter. All weight factors are one and the sum is divided by  $m$ . The quality is not convincing - pixels which have a greater distance from the center should contribute less to the sum.

Standard *Gaussssian* filters derive the weight factors from a *Gausssian* bell, as shown in [1]. The result has to be divided by the sum of the weight factors.

In [2] the *Gabriel* filter with  $n=3$  was recommended (7x7 kernel). It contains integer factors and many zeros, the calculation would be fast.

1	0	-5	-8	-5	0	1
0	0	0	0	0	0	0
-5	0	25	40	25	0	-5
-8	0	40	64	40	0	-8
-5	0	25	40	25	0	-5
0	0	0	0	0	0	0
1	0	-5	-8	-5	0	1

It will be demonstrated that the quality of the *Gabriel* filter is rather bad. A very simple *Gausssian* filter with binary weight factors delivers better results for image processing.

The title image shows a *Gausssian* filter in the frequency domain (FFT) - just an illustration.

## 2. Gabriel Filter

Best view zoom 200%

FIR filter for image blur [2].

Coefficients in one direction  
-1, 0, 5, 8, 5, 0, -1

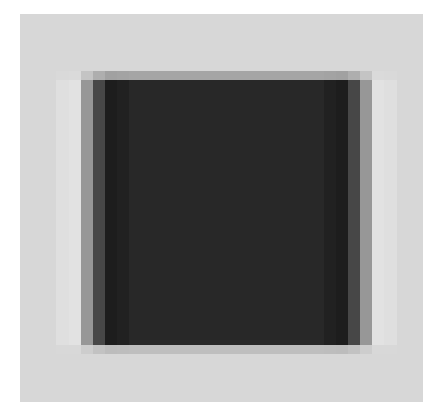
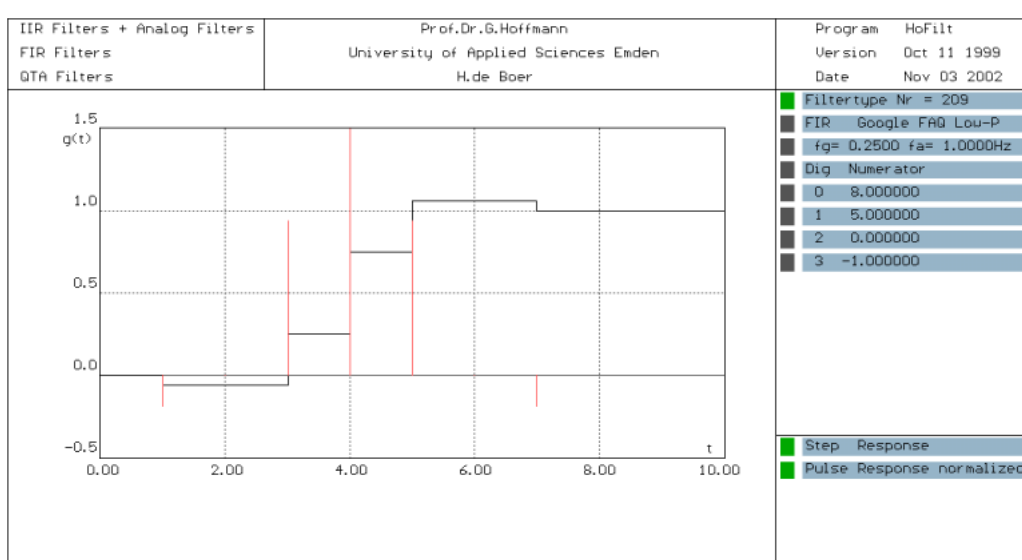
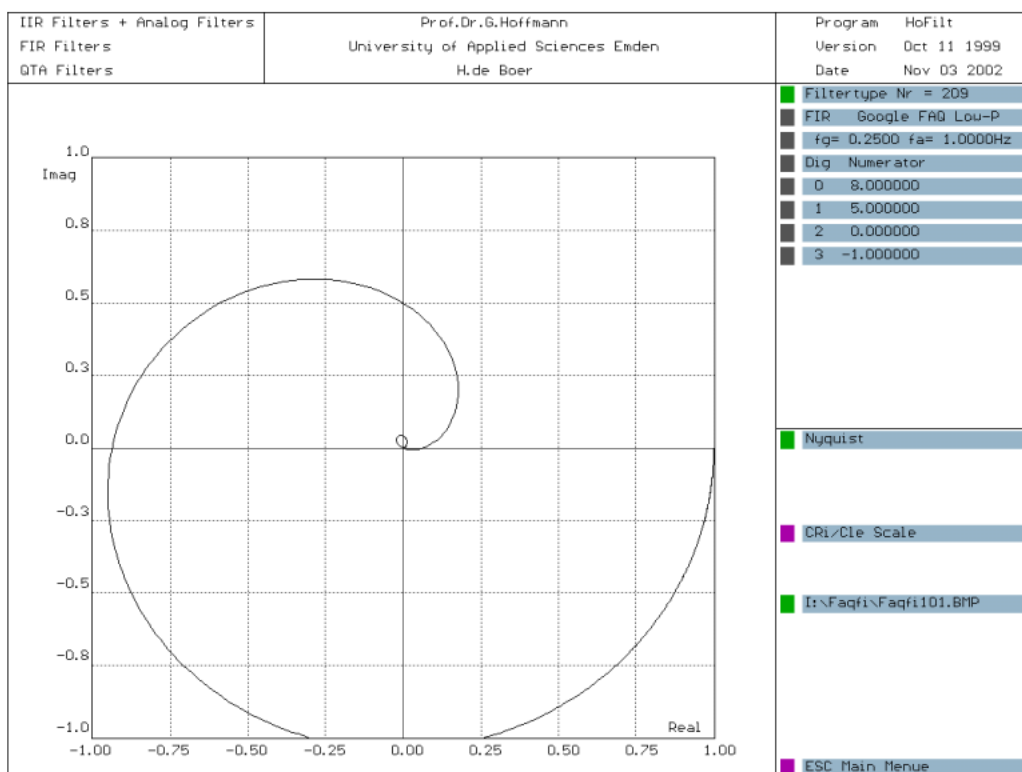
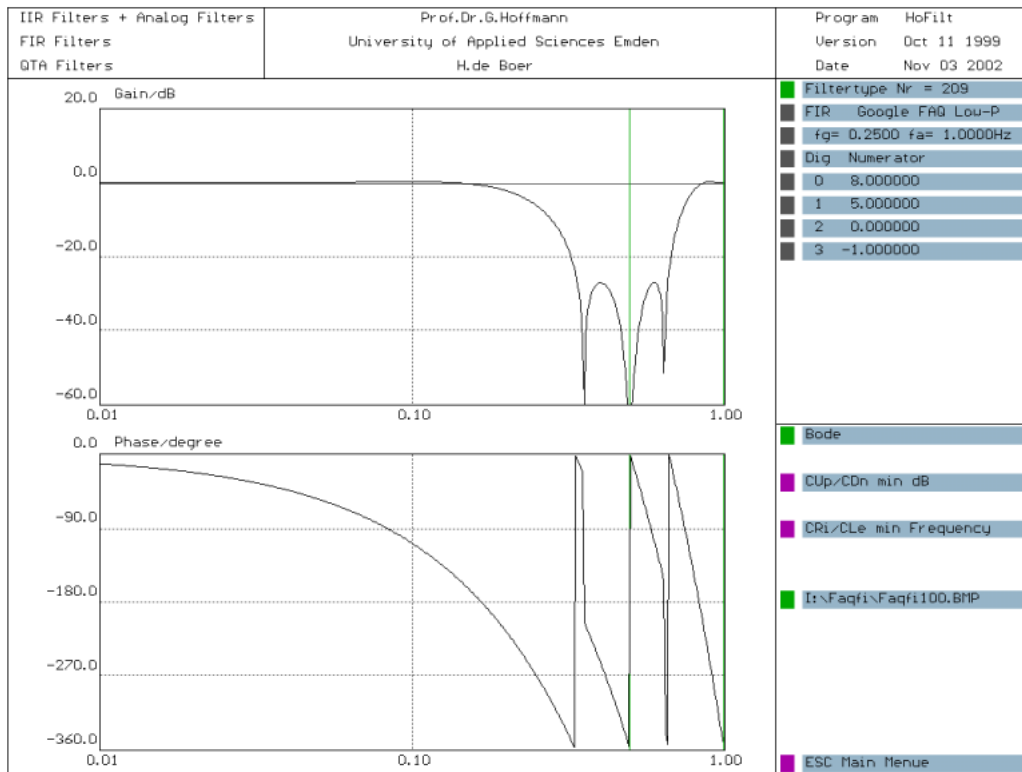
The gain versus frequency function is not flat in the pass band (for low frequencies).

Nevertheless, this filter is somewhat optimized. The gain in the rejection band is rather low: -30dB.

But the optimization criterion was obviously wrong for image processing.

The step response (in one direction) starts with negative values and ends with an overshoot.

This creates halos and additionally clipping can happen.



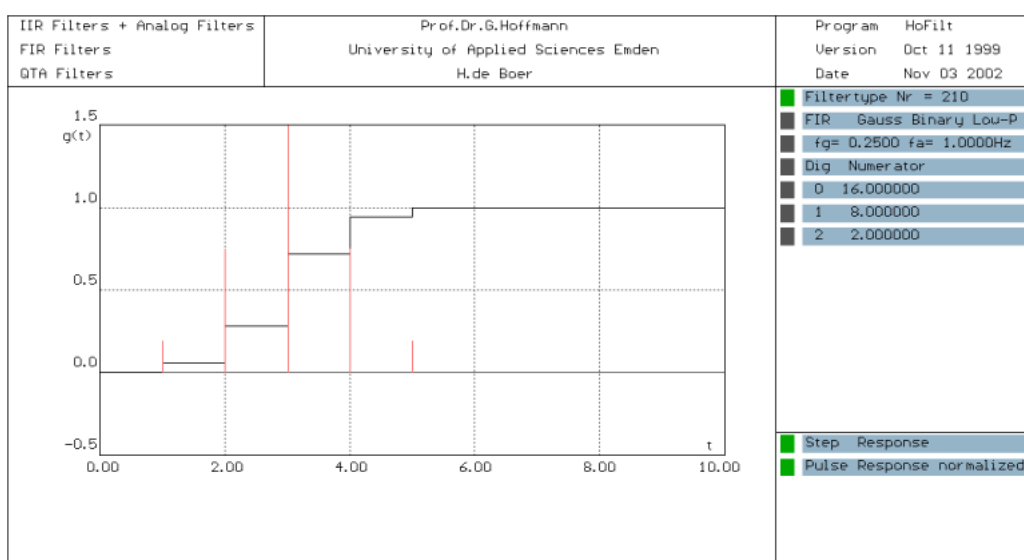
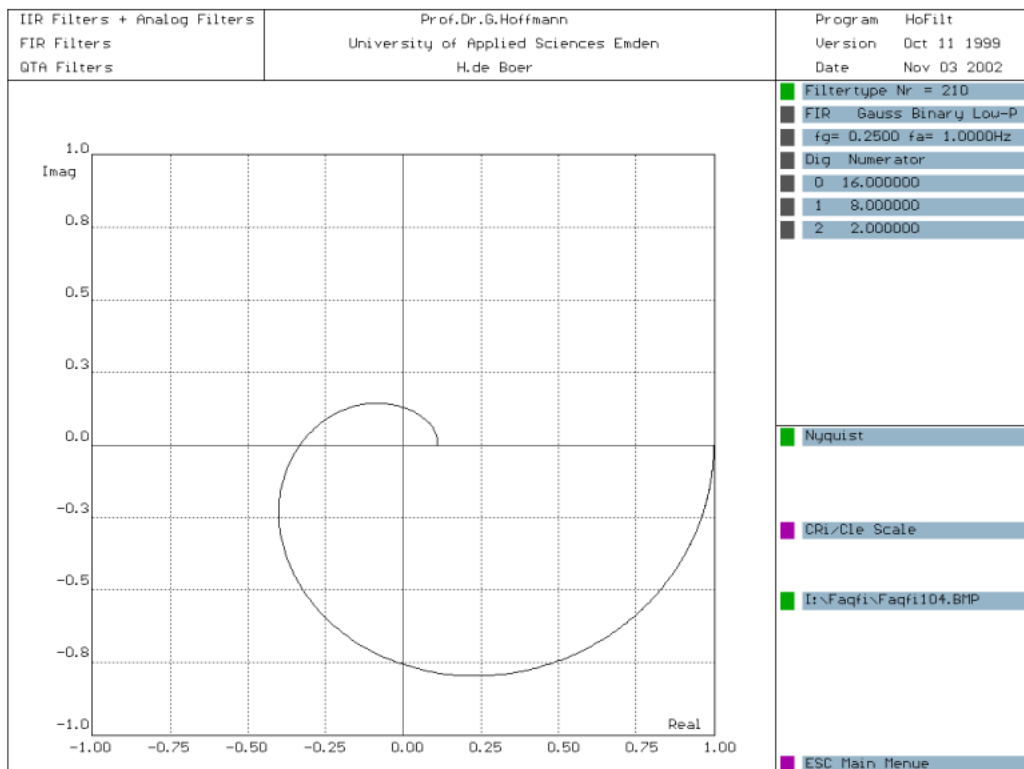
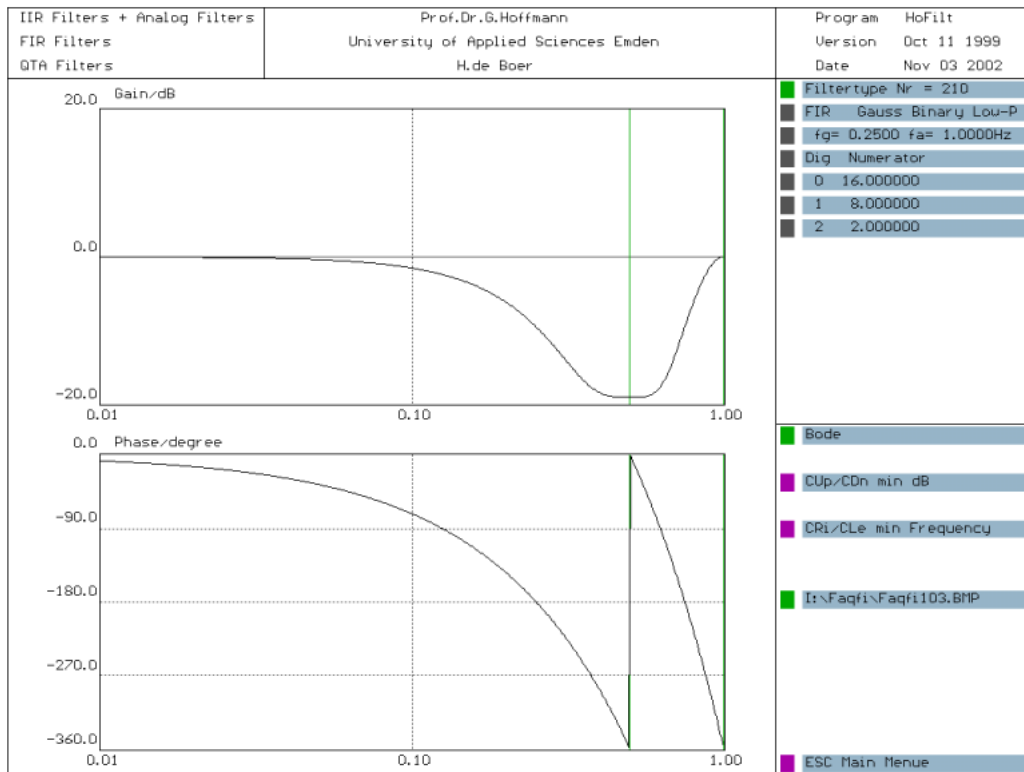
### 3. Gauss Binary Filter

Best view zoom 200%

FIR filter for image blur [1].

Coefficients in one direction  
2, 8, 16, 8, 2

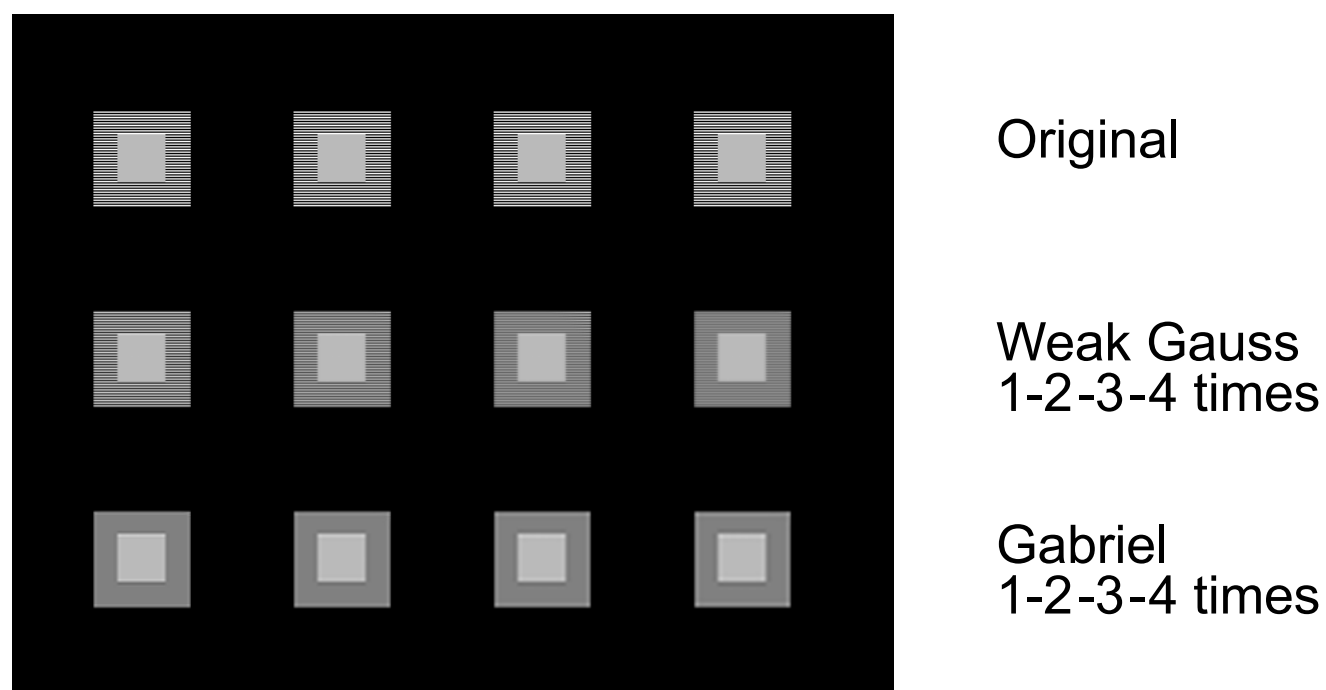
The gain versus frequency function is flat in the pass-band (for low frequencies) and in the rejection band. The attenuation in the rejection band is nearly -20dB, not bad for a 5x5 kernel.



## 4. Quality

Here we see the multiple application of the *Weak Gauss* filter and the *Gabriel* filter. The *Weak Gauss* filter has a 3x3 kernel. It is used for local filtering, interactive retouch. Multiple application is essential.

Best view zoom 200%  
No blur for images by Acrobat



## 5. References

- [1] Gernot Hoffmann  
Gaussian Filters  
<http://www.fho-emden.de/~hoffmann/gauss25092001.pdf>
  
- [2] Ken Turkowsky  
Filters for Common Resampling Tasks  
10.April 1990  
<http://www.worldserver.com/turk/computergraphics/ResamplingFilters.pdf>

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January 30 / 2005  
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