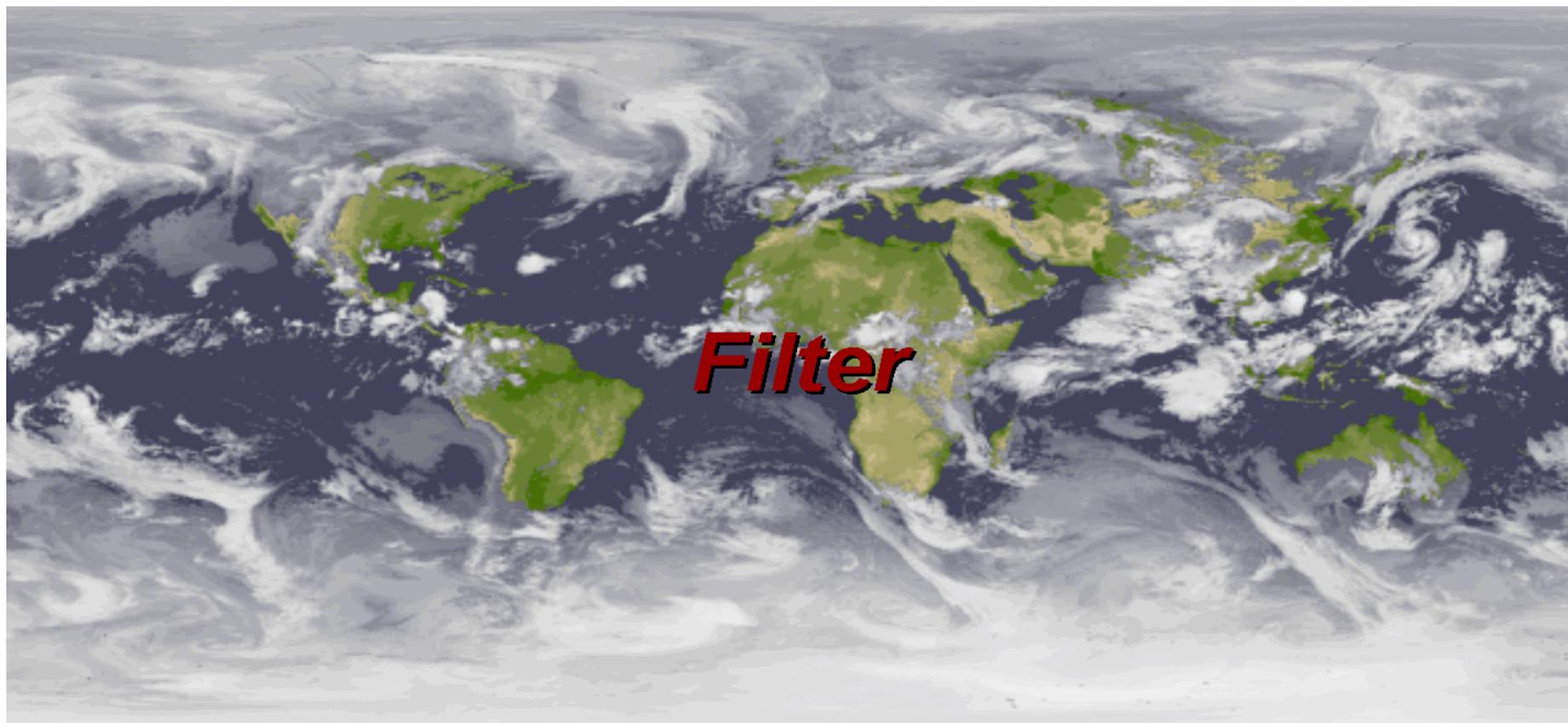
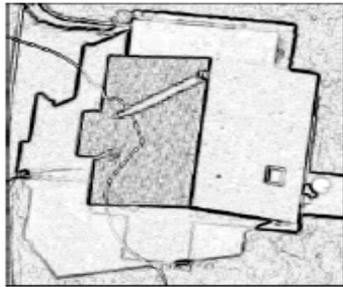
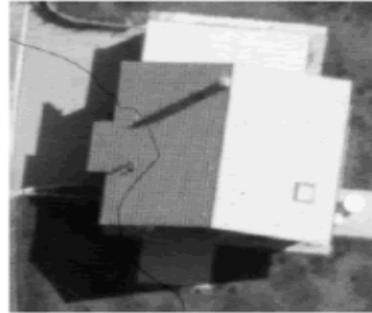


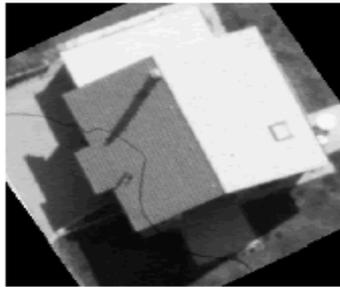
# Fernerkundung **Filter**



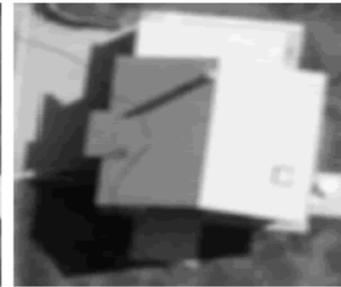
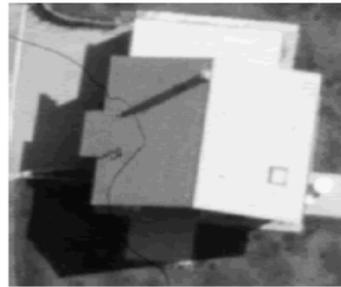
# Fernerkundung **Filter**



Kanten



rotiert



Glättung



# Fernerkundung **Filter**

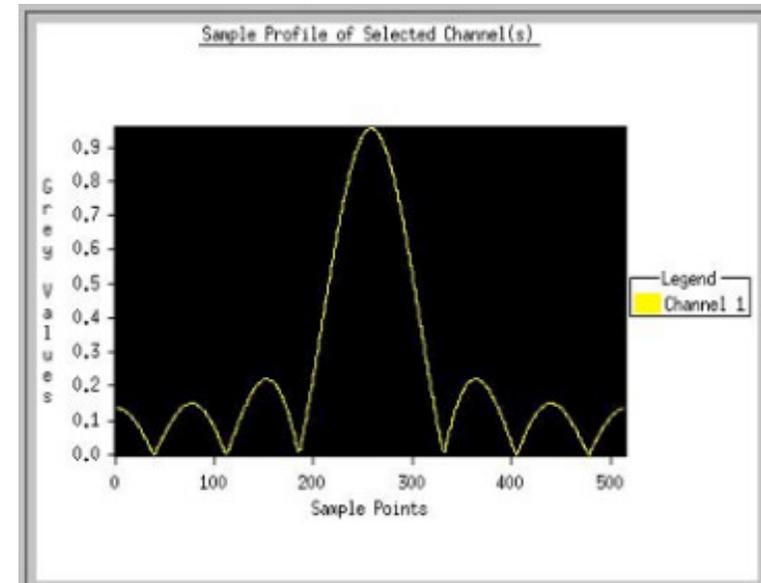
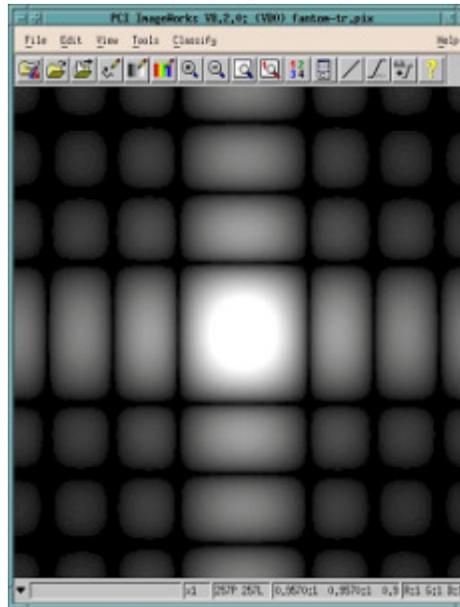
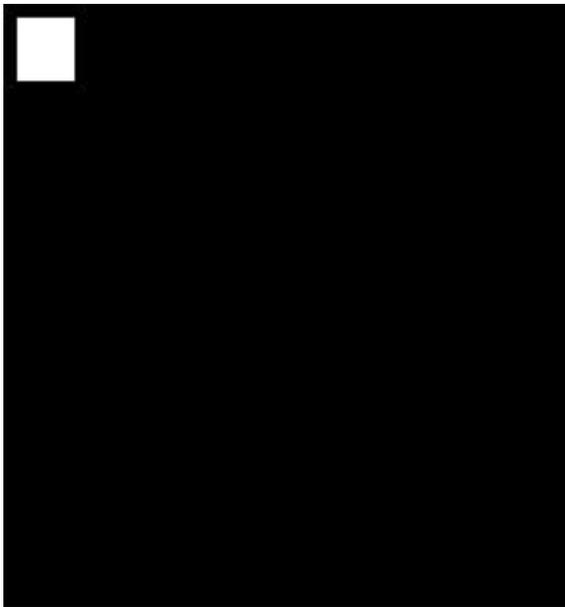
## Filter

- Ortsraum
- Frequenzraum
- Hochpass
- Tiefpass
- Bandpass
- lineare
- nicht lineare
- adaptive
- nicht adaptive
- separierbare
- nicht separierbare
- Glättungsfilter
  - Rechteck, Binomial, ...
  - Median, ...
  - anisotrope Diffusion, ...
- Filter zur Merkmalsextraktion
  - Gradienten (Roberts, Sobel, ...)
  - Krümmungen (Laplace, ...)



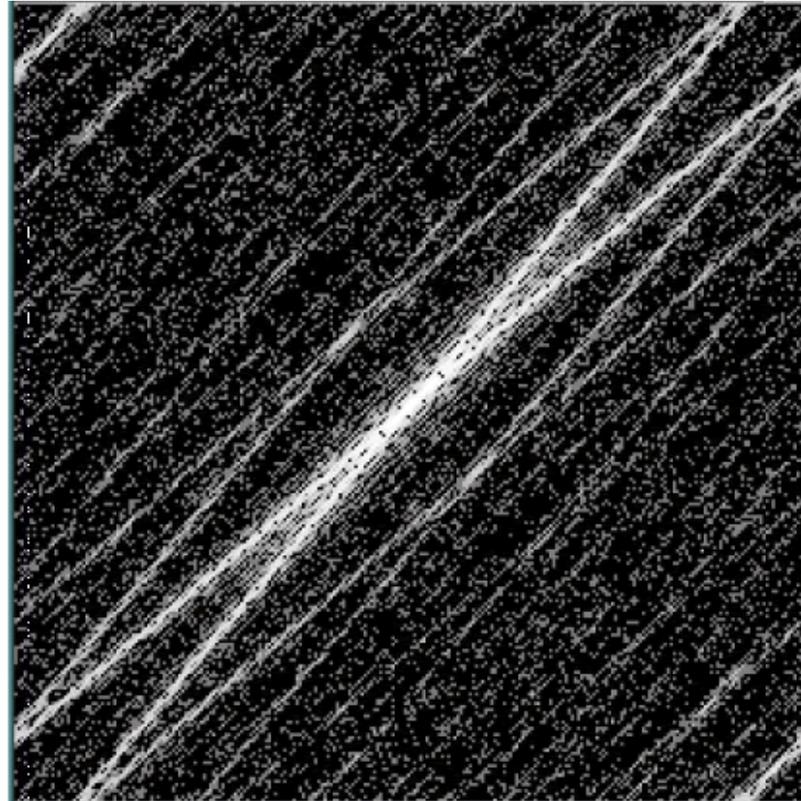
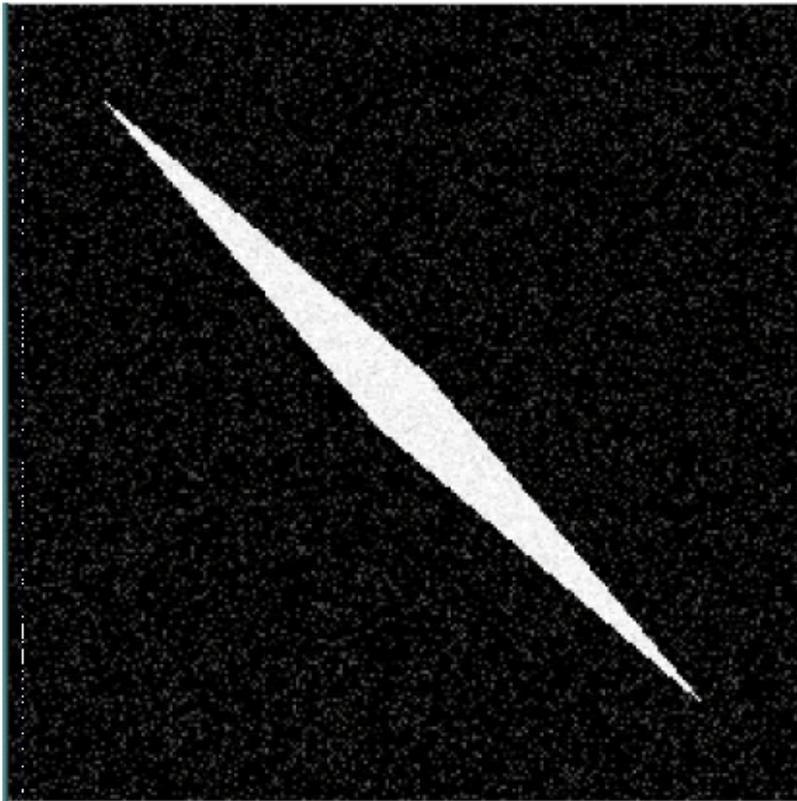
# Fernerkundung **Filter**

Beispiel FFT: Quadrat (Ortsraum --> Frequenzraum)



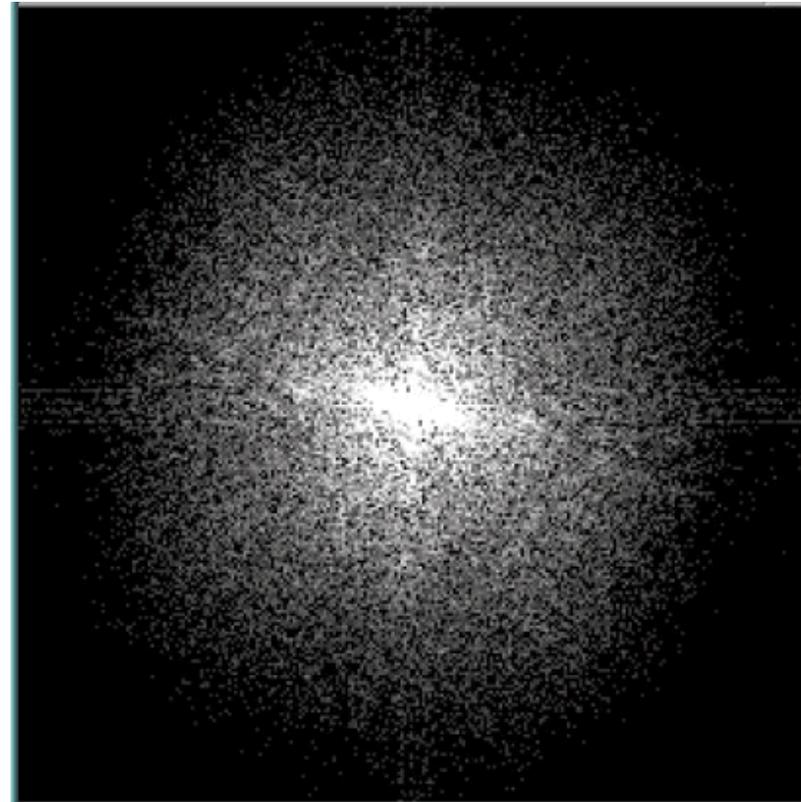
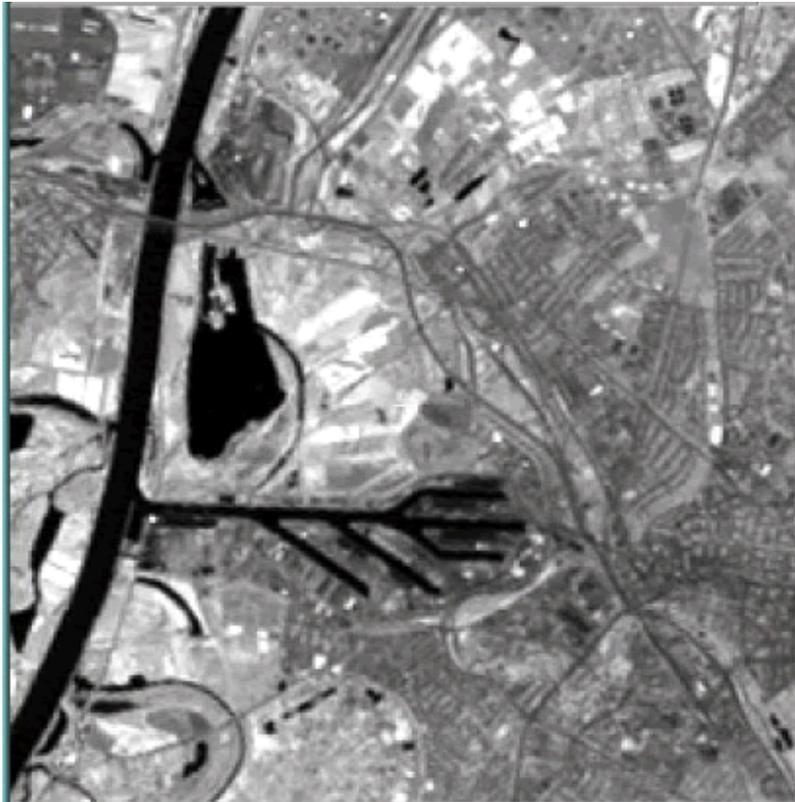
# Fernerkundung **Filter**

Beispiel FFT: Kompassnadel



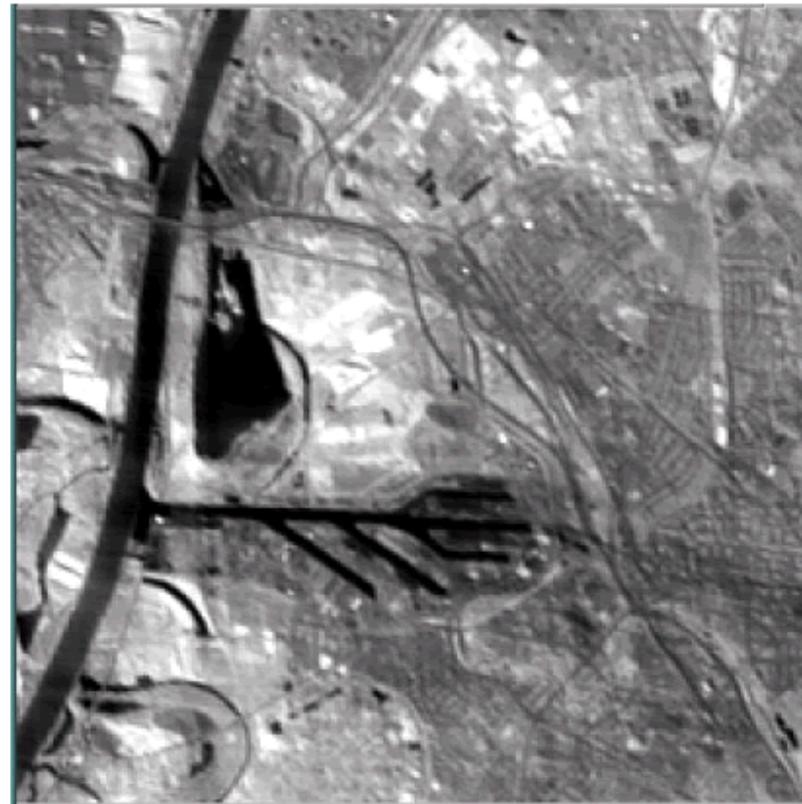
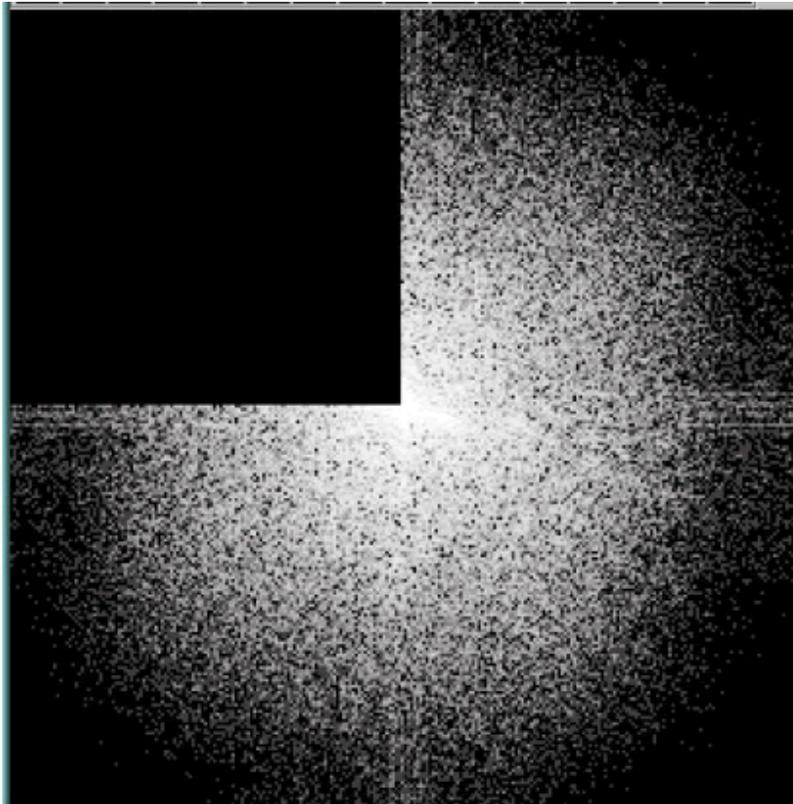
# Fernerkundung **Filter**

Beispiel FFT: LANDSAT TM5 Karlsruhe



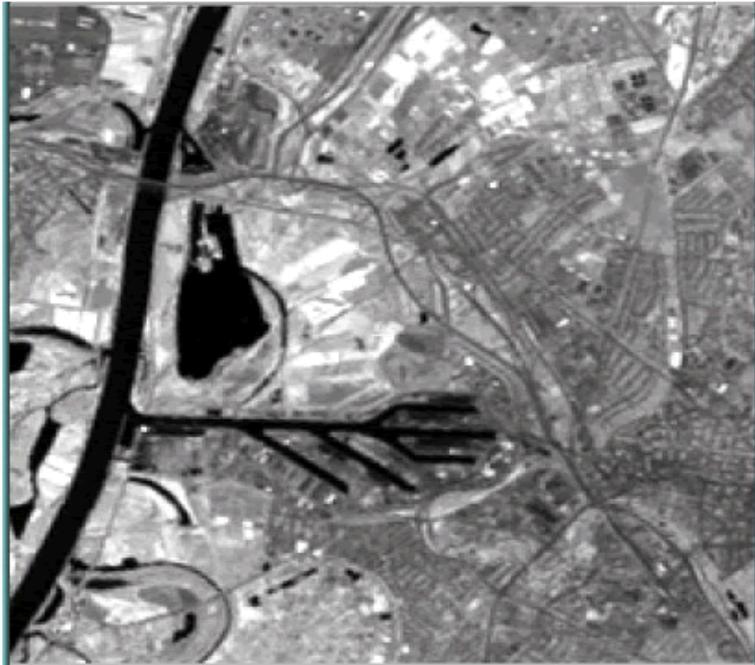
# Fernerkundung **Filter**

Beispiel inverse FFT: gestörtes Fourier Spektrum

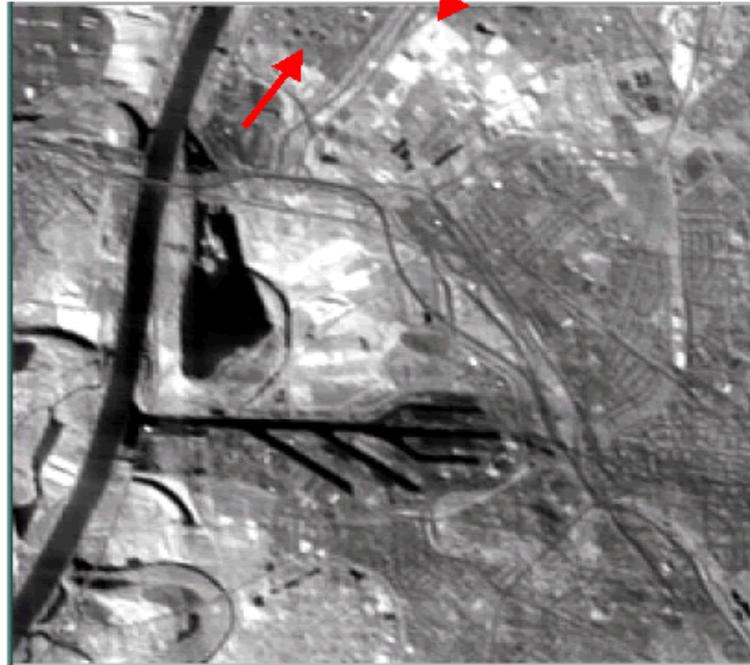


# Fernerkundung **Filter**

Beispiel FFT: LANDSAT TM5 Karlsruhe



Originalbild



gestörtes Bild

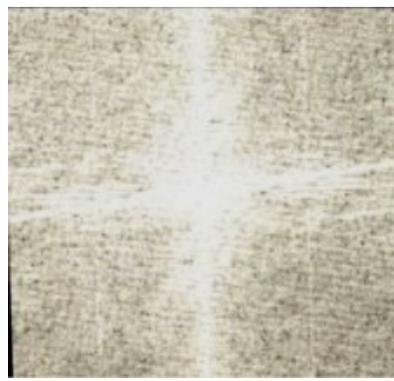


# Fernerkundung **Filter**

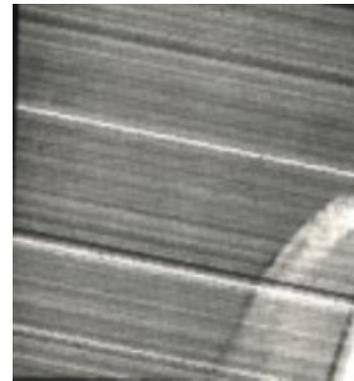
## Filterung im Frequenzraum: Beispiel 2D



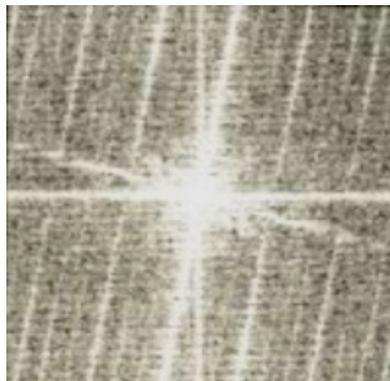
a



b



c



d

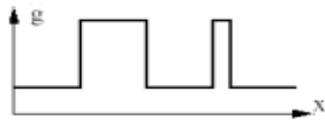


e

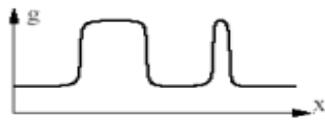
- a = verrauschtes Bild
- b = Amplitudenspektrum
- c = gedrehtes Bild
- d = resultierendes  
Amplitudenspektrum
- e = gefiltertes Bild

# Fernerkundung **Filter**

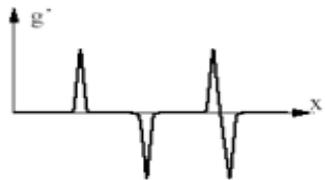
## Beispiel: Kantenextraktion



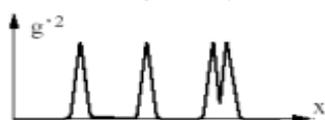
ideale Kanten und Linie



reale Kanten und Linie



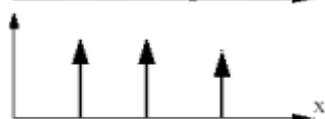
Gradient



quadrierter Gradient



gemittelter quadrierter Gradient

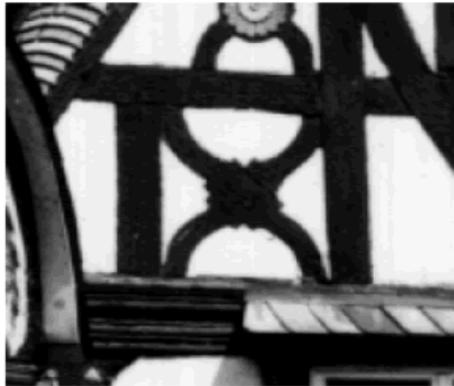


Unterdrückung von Nichtmaxima



# Fernerkundung **Filter**

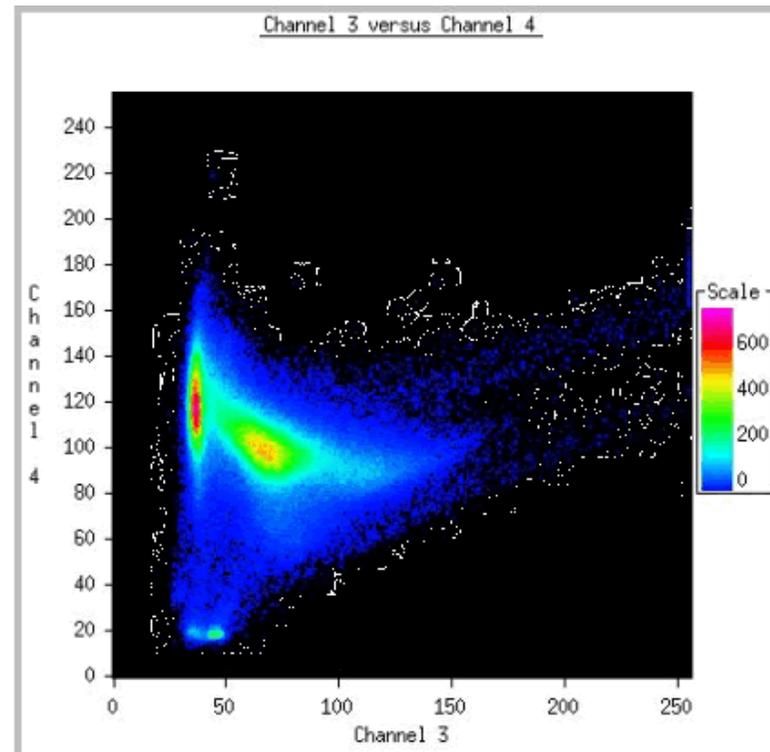
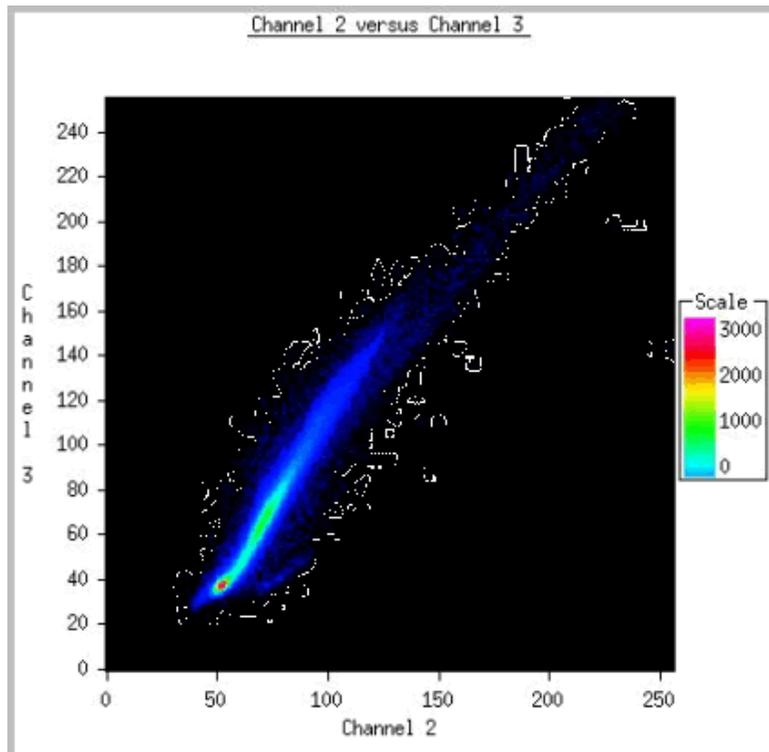
Beispiel: Kantenextraktion



# Fernerkundung **Filter**

## Hauptkomponenten-Transformation

(Principle component transformation, Hotelling transformation, Eigenvector transformation)



# Fernerkundung **Filter**

## LANDSAT

Eingangsdaten für HKT

3 Kanäle

### Kovarianzmatrix

Covariance matrix for input channels:

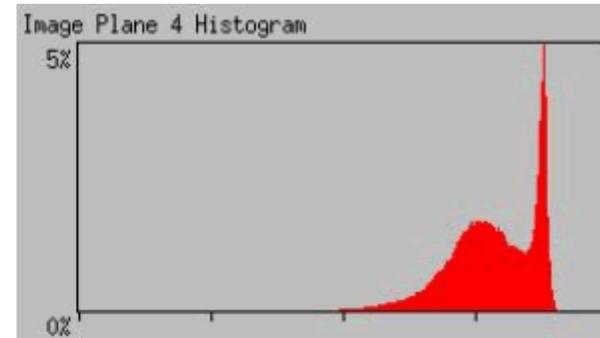
	1	2	3
1	179.653		
2	129.754	101.690	
3	207.988	163.581	276.619

Eigenchannel	Eigenvalue	Deviation	
1	540.9470	23.2583	96.95%
2	14.5715	3.8173	2.61%
3	2.4434	1.5631	0.44%



# Fernerkundung **Filter**

Ergebnis der HKT (Eingangsdaten 3 Kanäle)

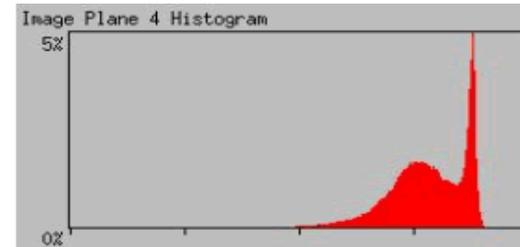
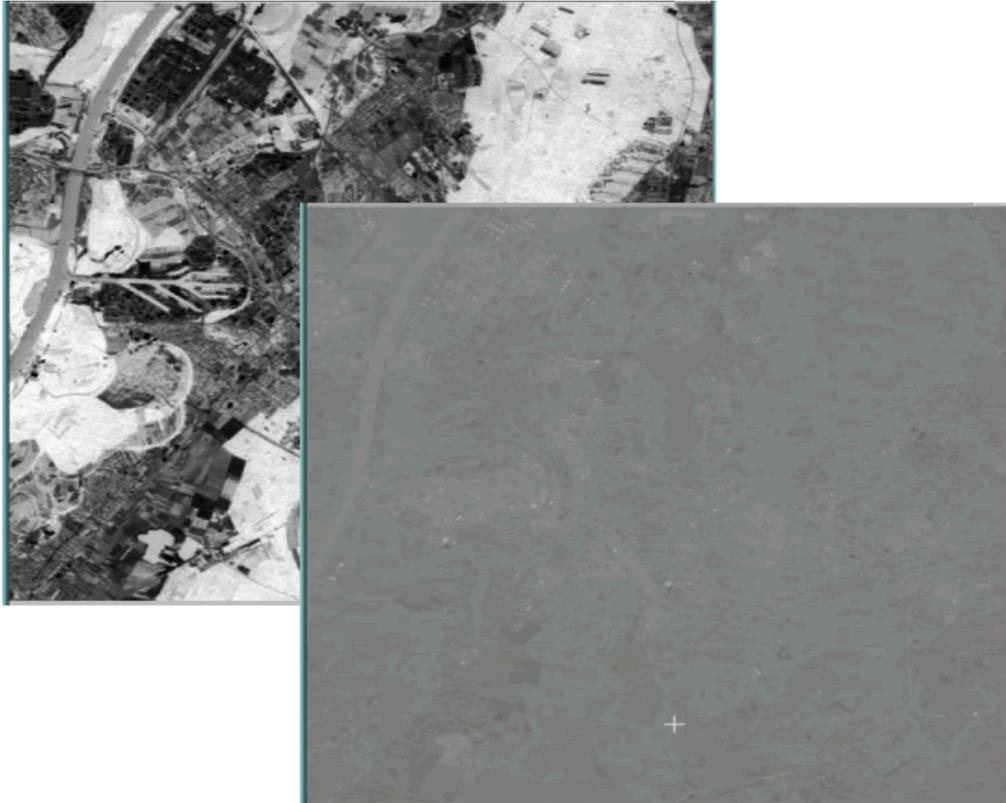


Covariance matrix for input channels:

	7	8	9
7	524,257		
8	1,162	14,668	
9	0,329	0,009	2,531

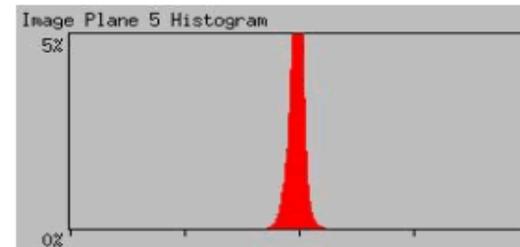
# Fernerkundung **Filter**

Ergebnis der HKT (Eingangsdaten 3 Kanäle)



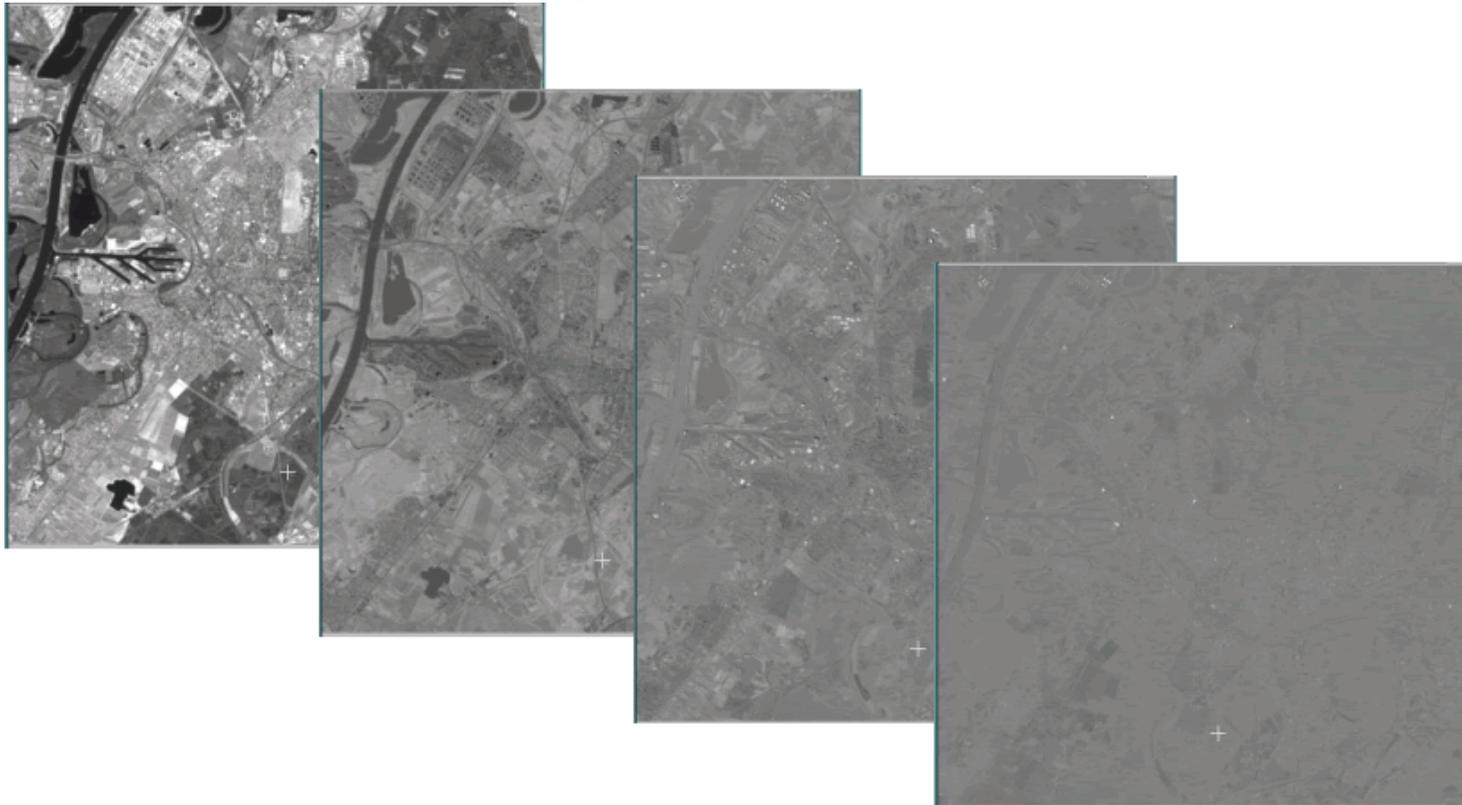
Covariance matrix for input channels:

	7	8	9
71	524.257		
81	1.162	14.668	
91	0.329	0.009	2.531



# Fernerkundung **Filter**

Ergebnis der HKT (Eingangsdaten 6 Kanäle)



# Fernerkundung **Filter**

## Kovarianzmatrizen

Eingangsdaten  
nach HKT

Covariance matrix for input channels:

	1	2	3	4	5	6
1	179.65					
2	129.75	101.69				
3	207.99	163.58	276.62			
4	-34.12	-11.76	-24.37	192.83		
5	247.34	209.22	370.44	163.64	1003.79	
6	211.92	165.21	286.12	-2.92	555.94	403.88

Eigenchannel	Eigenvalue	Deviation	%Variance
1	1685.1168	41.0502	78.07%
2	346.3581	18.6107	16.05%
3	92.6349	9.6247	4.29%
4	20.6873	4.5483	0.96%
5	11.6960	3.4199	0.54%
6	1.9711	1.4040	0.09%

Covariance matrix for input channels:

	11	12	13	14	15	16
11	1627.47					
12	4.83	346.28				
13	-4.82	0.01	92.65			
14	-4.35	0.05	-0.02	20.79		
15	-0.91	0.05	0.00	-0.01	11.79	
16	-0.05	0.00	0.00	-0.01	0.00	2.05

# Fernerkundung **Filter**

Beispiel: „Pan-Sharpning“ durch Principal Component Substitution

