

# Convolution Filters ver. 1

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This extension provides a large number of 9 element kernels for filtering Grid themes. It requires ESRI's Spatial Analyst extension and was developed using ArcView 3.0a and Spatial Analyst 1.1. This extension is for Windows 95, 98 and NT.

## **Installation**

This extension uses dialog designer therefore you will need a copy of avdlog.dll in your Bin32 directory and a copy of avdlog.dat in your Lib32 directory. These files are provided in the filters.zip.

This extension requires a dll called filters.dll which should be placed into your Bin32 directory.

Finally place the Filters.avx extension file into your Ext32 directory.

To enable the extension, from the project menu choose file->extensions and then check the Filters extension and press ok.

The extension place one new menu item on the View menu bar called Convolution Filters.

The filters provide include high frequency, low frequency, compass gradient, emboss, line detect, edge detect, Laplacian, and the non-linear edge detection filters Sobel and Robert's.

Using the extension is straight forward. Make the Grid Theme you want to filter the active theme and choose the Convolution Filter menu choice and then choose the category of filters you want to use. A list box will appear for the category and from it choose the filter you want to apply. You will be asked to enter the name for the new output grid. Once the name is entered a status dialog will appear and provide information on what is happening. As the new grid is being created the working status bar at the bottom of the ArcView window will keep you informed that the grid is being written. Once processing is complete you will be asked if you would like to add the new grid to a view and you should see a Success message in the status dialog.

## **Notes**

This filter extension will only work on Integer grid themes. If you try to filter a floating point grid you will receive an error message stating you can't filter floating point grids. To achieve the filtering of a floating point grid you must convert it to an integer grid.

Since 9 element kernel filters are the weighted average of 9 elements this causes a problem with the pixel in row 0, row N, col 0, and col M with N being the number of rows in the grid and M being the number of cols. Row 0, row N, col 0, and col M cannot be computed so I have chosen to leave the values of these rows and columns the same as the original values.

**The filter kernels available.**

**Low Frequency**

0.25	0.50	0.25	
0.50	1.00	0.50	Low Frequency 1
0.25	0.50	0.25	

1.00	1.00	1.00	
1.00	2.00	1.00	Low Frequency 2
1.00	1.00	1.00	

**High Frequency**

-1	-1	-1	
-1	9	-1	High Frequency 1
-1	-1	-1	

1	-2	1	
-2	5	-2	High Frequency 2
1	-2	1	

**Compass Gradient Masks (Pratt, 1991 ; Jain, 1989)**

1	1	1	
1	-2	1	North
-1	-1	-1	

1	1	1	
-1	-2	1	NE
-1	-1	1	

-1	1	1	
-1	-2	1	East
-1	1	1	

-1	-1	1	
-1	-2	1	SE
1	1	1	

-1	-1	-1	
1	-2	1	South
1	1	1	

1	-1	-1	
1	-2	-1	SW
1	1	1	

1	1	-1	
1	-2	-1	West
1	1	-1	

1	1	1	
1	-2	-1	NW
1	-1	-1	

**Edge Detect (Richards, 1986)**

-1	0	1	
-1	0	1	vertical
-1	0	1	

-1	-1	-1	
0	0	0	horizontal
1	1	1	

1	1	1	
-1	0	1	diagonal 1
-1	-1	0	

1	1	1	
1	0	-1	diagonal 2
1	-1	-1	

**Laplacian (Jahne, 1991; Pratt, 1991)**

0	-1	0	
-1	4	-1	Laplacian 1
0	-1	0	

-1	-1	-1	
-1	8	-1	Laplacian 2
1	-1	-1	

1	-2	1	
-2	4	-2	Laplacian 3
1	-2	1	

1	1	1	
1	-7	1	subtract Laplacian edges
1	1	1	

0	-1	0	
-1	5	-1	Laplacian Add Back
0	-1	0	

**Lines (Chittineni, 1983)**

-1	-1	-1	
2	2	2	E-W
-1	-1	-1	

-1	-1	2	
-1	2	-1	NE-SW
2	-1	-1	

-1	2	-1	
-1	2	-1	N-S
-1	2	-1	

2	-1	-1	
-1	2	-1	NW-SE
-1	-1	2	

### Emboss

0	0	0	
1	0	-1	East
0	0	0	

0	0	1	
0	0	0	NW
-1	0	0	

0	0	0	
-1	0	1	West
0	0	0	

0	-1	0	
0	0	0	North
0	1	0	

0	1	0	
0	0	0	South
0	-1	0	

0	0	-1	
0	0	0	WN
1	0	0	

1	0	0	
0	0	0	SE
0	0	-1	

-1	0	0	
0	0	0	ES
0	0	1	

### Non Linear Edge Detect

Sobel (Jain, 1989)

-1	0	1	
-2	0	2	= X
-1	0	1	

1	2	1	
0	0	0	= Y
-1	-2	-1	

Robert's (Peli and Malah, 1982)

0	0	0	
0	1	0	= X
0	0	-1	

0	0	0	
0	0	1	= Y
0	-1	0	

Chittineni, C. B., 1983, "Edge and Line Detection in Multidimensional Noisy Imagery Data," IEEE Transactions on Geoscience and Remote Sensing, GE-21: 163-174.

Richards, J. A., 1986, Remote Sensing Sigital Image Analysis. New York: Springer-Verlag, 281p.

Peli, T. and D. Malah, 1982, "A Study of Edge Detection Algorithms," Computer Graphics and Image Processing, 20:1-21.

Jain, A. K., 1989, fundamentals of Digital Image Processing. Englewood Cliffs, NJ: Prentice-Hall, pp. 342-357.

Jahne, B., 1991, Digital Image Processing, New York: Springer-Verlag, 383p.

Pratt, W. K., 1991, Digital Image Processing, 2nd ed. New York: Wiley, 698 p.