

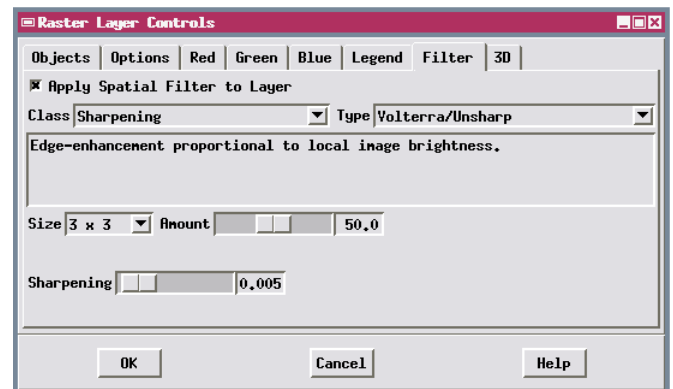
## Spatial Display

# Inline Filtering of Images

You can sharpen or apply a wide range of other image filters to each raster layer as an integrated part of the display process in your TNT product. The filter you select or design is applied to the portion of the raster layer you are currently viewing without permanently altering the source raster object. Whenever you pan or zoom, the filters you have assigned are reapplied to their respective raster layers as the view is redrawn.

Integrated filters are provided for sharpening, smoothing (noise removal), and edge detection. There are also filters specifically designed for removing speckle noise in radar images. There are several different filter variants in each category (see list of all available filters below).

You can apply integrated filtering to each raster layer in the view, including grayscale rasters, color-composites, or multi-raster layers such as RGB or RGBI displays. Integrated filtering



Use the controls on the Raster Layer Controls window's Filter tabbed panel to choose a category and type of filter and set the specific parameters for that filter. You can quickly turn filtering on or off using the toggle button at the top of the panel.



Example of integrated image filtering applied to an RGB display of three bands of a Landsat scene with bands selected to provide a color infrared display in which vegetation appears red. The illustrations show a forested area with a history of clear-cut logging. Mature forest is dark red, regrown clear-cuts are lighter red, and the lightest red and gray patches are the most recently-cut areas. The illustration on the left shows the raw display with no filtering. The other two illustrations show results using a 3 x 3 high-pass sharpening filter, as follows: the center illustration is a combination of 40% filtered image and 60% original image (Amount slider set to 40), while the right-hand illustration is a combination of 80% filtered image and 20% original image (Amount slider set to 80).

### Integrated Filters in Display

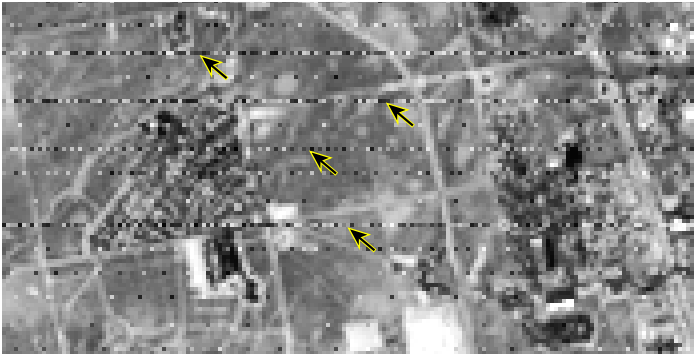
<b>Sharpening</b>	<b>Smoothing and Noise Removal</b>
High Pass	Low Pass/Average
High Boost	Median
Volterra/Unsharp	Modal
Local Contrast	Olympic
Lower-Upper-Middle	Multi-Level Median
Comparison and Selection	P-Median
WMMR-MED	Adaptive Mean P-Median
User-Defined	User-Defined
<b>Edge Detection</b>	<b>Radar</b>
Standard Deviation	Sigma
Range	Frost
Gradient: Sobel	Lee
Gradient: Roberts	Kuan (Adaptive Noise Smoothing)
Gradient: Prewitt	
Gradient: User-Defined	

Descriptions for many of these filters can be found in the tutorial booklet entitled *Filtering Images*.

is fast and efficient because it is implemented as a stage in MicroImages' internal pipeline processing. You can select the filter to be applied to each layer and set its parameters on the Filter tabbed panel of the Raster Layer Controls window.

You can change the default settings of your selected filter to customize it. For most filters you can choose a filter size in the range from 3 x 3 cells to 11 x 11 cells. You can also combine the filtered image with the unfiltered image in varying degrees, as in the illustration above. The Amount slider allows you to adjust the proportion of the display contributed by the filter, (0 = no filtering result and 100 = pure filter results). Additional controls are provided to set unique parameters of some filters. Your filter settings are automatically saved with the raster object along with other display parameters (such as contrast enhancement), and are used automatically in any subsequent use in any view until you alter these settings.

(over)

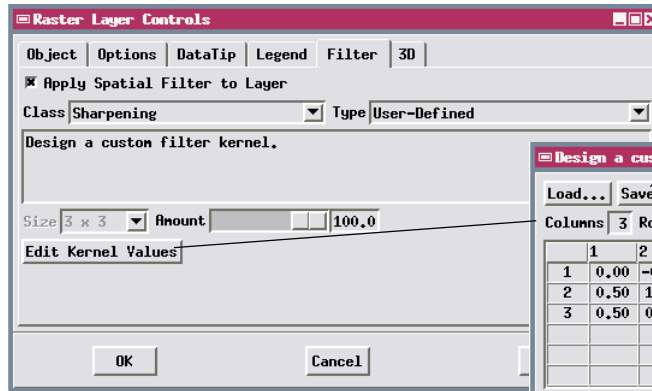


Left, portion of a Landsat image band with some noisy scan-lines (arrows). Right, same image displayed with integrated P-Median filter (Smoothing and Noise Reduction) applied with a 3 x 3 cell filter window. The Amount slider was set to 100, so this display

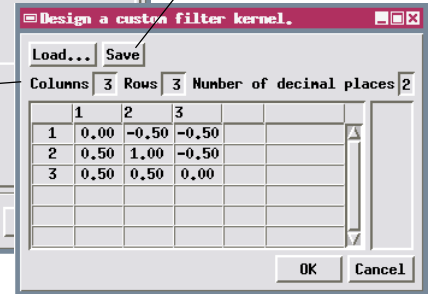


is the pure filtered image result. The scan-line noise is greatly reduced by the smoothing effects of the P-Median filter, while considerable edge and line detail is preserved along the roads and field boundaries.

Each filter category (except Radar) offers a User-Defined option in which you can not only choose the size and shape of the filter kernel but also edit the weighting coefficients used in the kernel. Thus you can design custom filters for specialized purposes and save and reload these custom filters for use with any raster layer. For example, the sample 3 x 3 custom filter kernel illustrated to the right is designed to sharpen edges for linear features with a northwest-southeast trend, such as the rock fracture patterns in the color satellite image shown below.



Use the Save button on the custom filter kernel window to save the filter kernel as an object in a Project File.



Left, color satellite image (15-m cell size) of desert area with exposed rock layers exhibiting northwest-trending vertical fractures. Right, same image displayed with integrated filtering



using a custom sharpening filter (filter kernel shown in the illustration above) designed to enhance edges with a northwest trend



Left, an elevation raster with color palette displayed with partial transparency over a shading raster to provide a color shaded-relief display. Right, the same raster layers are displayed with a



5 x 5 Volterra/Unsharp sharpening filter applied only to the shading raster layer, producing a crisper image of the terrain.