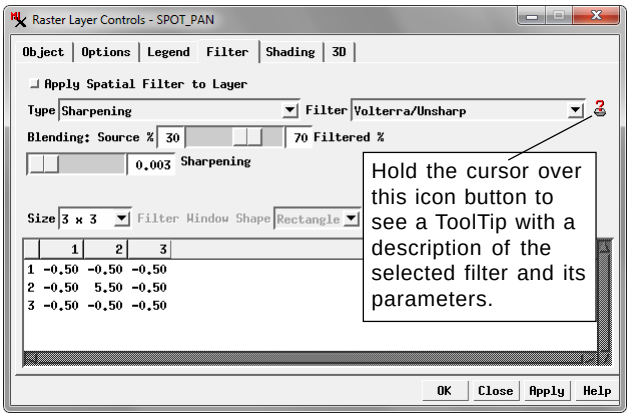
Inline Filtering of Images

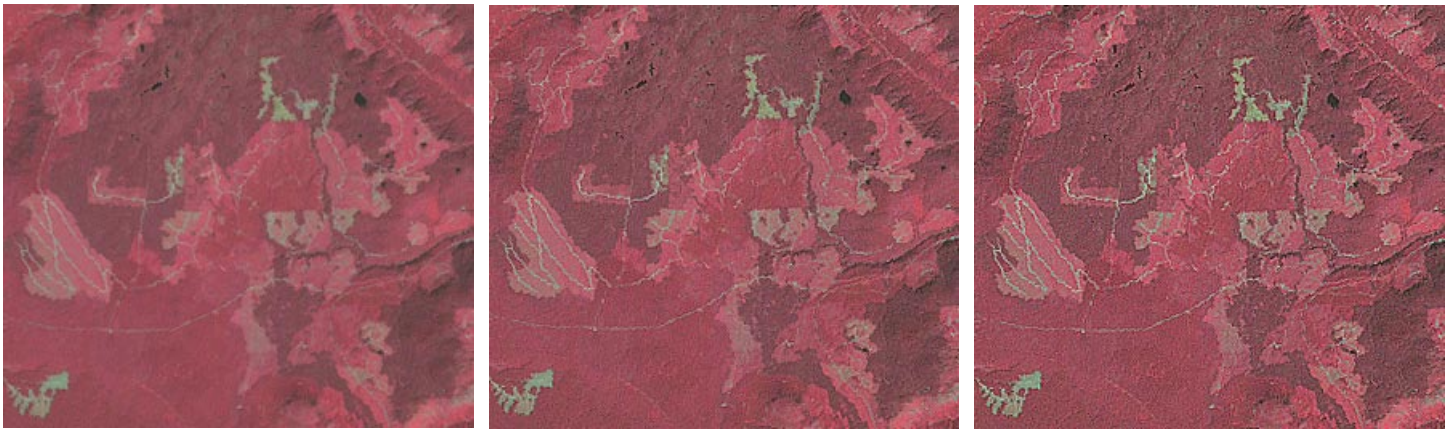
You can sharpen or smooth any raster layer display, or apply other types of image filters, as an integrated part of the display process in TNTgis. The filter you select or design is applied to the portion of the raster layer you are currently viewing without permanently altering the source raster object(s). 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 specificially designed for removing speckle noise in radar images, and gray level co-occurrence matrix texture filters. 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 is fast and efficient because it is implemented as a stage in MicroImages' image 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.



Use the controls on the Raster Layer Controls window's Filter tabbed panel to choose a category and 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 (Blending set to 40%), while the right-hand illustration is a combination of 80% filtered image and 20% original image (Blending set to 80%).

Integrated Filters in Display

Smoothing/Noise Removal
- Low Pass/Average
- Median
- Modal
- Olympic
- Multi-Level Median
- P-Median
- Adaptive Mean P-Median
- Gaussian Blur
- User-Defined

Edge Detection
- Standard Deviation
- Range
- Teager
- Laplacian
- Laplacian with diagonals
- Gradient: Sobel
- Gradient: Roberts
- Gradient: Prewitt
- Gradient: User-Defined

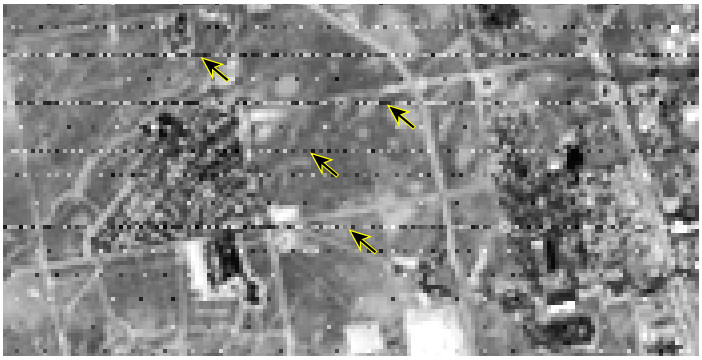
Sharpening
- High Pass
- High Boost
- Volterra/Unsharp
- Lower-Upper-Middle
- Comparison and Selection
- WMMR-MED
- User-Defined

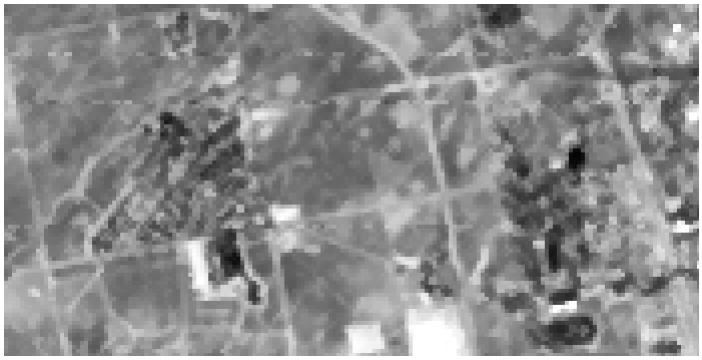
Radar
- Sigma
- Frost
- Lee
- Kuan (Adaptive Noise Smoothing)

Gray Level Co-occurrence
- Mean
- Contrast
- Dissimilarity
- Homogeneity
- Angular Second Moment
- Entropy
- Variance
- Correlation

For most filters you can choose a predefined filter size in the range from 3 x 3 cells to 21 x 21 cells, or edit the Size field to set custom filter kernel dimensions, and choose between a rectangular or circular window shape. You can also blend the filtered image with the original image in varying degrees, as in the illustration above. The Blending slider allows you to adjust the proportion of the display contributed by the filter between 0 and 100%. 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 display until you alter these settings.

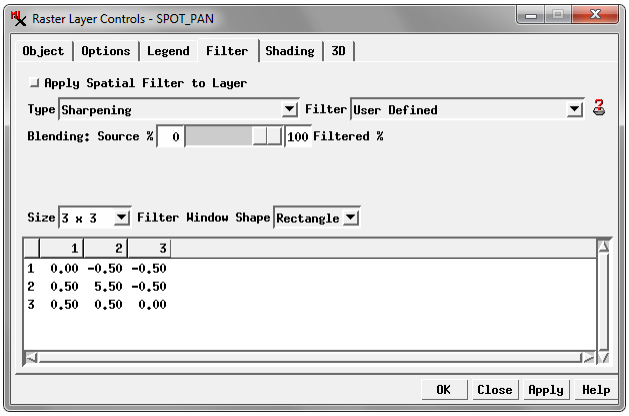
(continued)



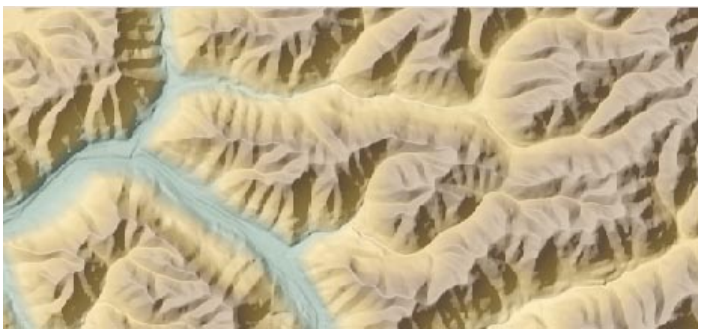


Left, portion of a Landsat image band with some noisy scan-lines (arrows). Right, same image displayed with integrated P-Median filter (Smoothing and Noise Reduction) applied with a 3 x 3 cell filter window. The Blending slider was set to 100, so this display is the pure filtered image result. The scan-line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

The sharpening, smoothing, and edge-detection categories offer 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. (Choose a starting filter type, then edit the coefficients, which automatically sets the User-Defined option.) Thus you can design custom filters for specialized purposes. For example, the sample 3 x 3 custom filter kernal 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.



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.