Abstract Title:

Improving the accuracy and quality of photogrammetrically derived high-resolution digital elevation models through the development of a raster-based progressive morphological filter

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High-resolution digital elevation models (DEMs) can be derived from stereo aerial photographs or satellite imagery by utilizing digital photogrammetric and stereo-autocorrelation techniques. Stereo auto-correlation algorithms measure the amount of parallax and calculate elevation values on a pixel-by-pixel basis for all pixels matched in a set of stereo images. Poorly matched pixel values result in erroneous elevation values or failed values which are exhibited in the output DEM as pits, spikes, and void areas.

To improve the quality of output DEMs, most software routines employ a low pass filtering technique to smooth elevation values. This technique reassigns a mean elevation value for a 3x3, 5x5, or 7x7 pixel window around all cell values. Calculating a mean elevation in a window containing a large pit or spike biases the values of all cells within that window and reduces, but does not eliminate the erroneous value. A progressive morphological filter was developed to target and filter only erroneous pit and spike data values in raw DEM data produced from a stereo auto-correlation process.

The progressive morphological filter iteratively compares individual raw elevation values to a set of focal neighborhood statistics and a user defined threshold value. Elevation differences between the raw value and the neighborhood statistics are compared to the threshold value. Raw values that exceed the threshold are replaced with a focal minimum, focal maximum, or focal median value based on the characteristics of the elevation value in question. The filter progresses through four stages whereby elevation values are compared to increasingly smaller neighborhoods and a progressively reduced threshold value. The result is that only elevation values that exceed the defined parameters are replaced; all other values remain unchanged and the overall output quality is improved without degrading the high resolution fidelity of the DEM.