A Novel Noise Removal Algorithm for Vertical Artifacts in Digital Elevation Models

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Abstract: In the light of a smarter planet, the interest of governments and corporations to predict natural disasters and their impacts on the society and businesses is becoming more relevant than ever. Moreover, the increasing availability of high resolution data to describe features of the Earth are allowing computer models to simulate the likelihood of such events with even greater levels of detail. Still, the processes involved in the data acquisition may lead to errors that could compromise the quality of simulations. Techniques such as analysis of stereo image pairs, for example, and inherent backscatter in radar, when used to produce digital elevation models (DEMs), may lead to image artifacts. This paper presents a novel algorithm to detect the presence of vertical artifacts in DEM data sets and to patch them, while keeping the data sets' spatial resolution properties. With a 7X7 grid sized moving window, the algorithm scans the DEM and compares it against a reference data set (which presents a lower spatial resolution than the DEM). On each scan, the elevation differences between the two are calculated to determine the existence of artifacts in the DEM. If a discrepancy is found, a patch function takes into account the global and local properties of the two data sets to determine the new values of the cells to be patched. The algorithm validation was performed against the second version of the ASTER GDEM (30-meter), having SRTM (90-meter, resampled to 30-meter resolution) as reference data set, for a domain covering the country of Brunei Darussalam. Post-processing validation and comparisons of the image products showed the effectiveness of the algorithm in removing the "noisy" artifacts, while at the same time preserving the spatial and height characteristics of neighboring cells. The final DEM product derived from the patching process shows that the algorithm can effectively salvage the high resolution properties of noisy data sets and enable their use for further computer simulations.

Keywords: noise removal, digital elevation model, algorithm, image processing, ASTER, SRTM, DEM