Imageodesy: A Tool for Mapping Subpixel Terrain Displacements in Satellite Imagery

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Imageodesy is a method of mapping subpixel terrain displacements that occur between acquisitions of two satellite images (*Episodes,* v. 15, p. 56-61). The Landers, California, earthquake of 28 June 1992 provided the first clear opportunity to apply imageodesy to detailed mapping of horizontal strain associated with a seismotectonic event.

Visual comparison of images acquired by SPOT satellites before and after the Landers earthquake clearly depict spatial differences related to fault displacements. These can be seen as motion when presented in a rapidly alternating display (*EOS,* v. 73, no. 43, p. 364) or as relief when presented as a stereo pair, despite the 6 meter maximum size of the displacements and the 10 meter pixel size of the SPOT imagery. Quantification of the displacements is made through subpixel image matching by correlation analysis, applied at each point on a fine grid. Resolution of the displacement measurements is limited to about 1/20 pixel by systematic factors (e.g. one-byte quantization), but further by the characteristics of the terrain (e.g. radiometric variability related to the distinctiveness of terrain patterns, such as topographic shading), A consequence of the later limitation is that imageodesy works best in areas of rugged, eroded bedrock. The method is thus complementary with radar interferometry, which is more precise, but generally works best in low-relief terrains with small displacement gradients. Advantageously, imageodesy measures both geographic dimensions, rather than interferometry 's one-dimensional differences in slant range.

Results along fault breaks resulting from the Landers earthquake show displacement vectors consistent with field measurements, other field observations, and tectonic geomorphology. Final results should reveal details of the tectonic strain field that would not otherwise be detected.