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Application of mathematical morphology to the enhancement of wavelet-detected fault lines on Mars

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The purpose of this work is the automatic recognition of tectonic lineaments on the surface of Mars. We use the MOLA MEGDR with a resolution of 128 px/deg. As shown in [1] wavelet edge analysis can be used to extract and enhance fault scarps in MOLA data. To eliminate noise and also to reduce the scarp lines to one pixel width, we have used mathematical morphology operators for binary images. Wavelet transform outputs were binarized using a hysteresis threshold. Each new binary image has undergone the following procedures: to eliminate holes that were present in the scarp lines we have performed a hole filling operation; to reduce the fault scarp lines to one pixel width a size twelve thinning was performed; this operation is applied to make objects narrower than twelve pixels end with one pixel widths and to allow the elimination of wider objects; next, to assure a good spatial continuity of the scarp lines, we have connected fault traces that were separated by one pixel; the thinning operation produces lines which have many little branches that can be eliminated by performing a spuring, but the spuring also suppresses fault extremities which implies the reduction of fault lengths. This problem is handled by adding the reconstructed branches to the pruned lines [2].

On the final data set it is possible to perform several measurements, for example fault strike, fault length, fracture density, etc. The described methodology is fully automated and reproducible which allows a quantitative comparison and characterization of tectonic lineament patterns between different regions or even between different planets.

References: [1] - Vaz, D., E. I. Alves, et al. (2005). Application of wavelet transforms to the automatic recognition of faults on MOLA data. Geophysical Research Abstracts. Vol. 7, 07092. [2] - Soille, P. (1999). Morphological Image Analysis - Principles and Applications. Berlin, Sringer-Verlag.