

# Slope-Independent Landscape Roughness Attribute Provided by Measurement of Local Contour Line Density

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## Abstract:

Various digital treatments have been proposed to describe the digital elevation model (DEM) surface roughness, depending on the geomorphologic purpose. Some of these treatments use the drainage network pattern directly or combine the former binary information with DEM data. Others take into account local characteristics of the DEM's surface, such as the deviation of the perpendicular issued from each pixel or the computation of the surface curvature. The aim of the present study is to propose new geomorphic algorithms based on contour line density to calculate the DEM surface roughness. The contour line density is calculated within a moving window of  $n \times n$  pixels, and the contour lines are extracted according to a given range of hypsometric intervals. The value of this total length inside the moving window reflects the local irregularities encountered in the studied zone. Meanwhile the slope-independent roughness parameter (SIRP) measures the total length of a limited number of contour lines inside a moving window, extracted according to the total hypsometric difference between the upper and lower altitudes encountered in the window. While the first calculation emphasizes the general features of the studied DEM in terms of its local surface roughness, the SIRP provides a roughness measurement independent of the slope. In the Sierra Norte de Puebla region (Central Mexico) where numerous landslides have occurred recently, slope instability is closely related with the smooth zones extracted by use of the SIRP attribute.

## Keywords:

DEM's surface roughness; Contour line density; Slope independent roughness parameter; Geomorphic features; Sierra Norte de Puebla