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Micro-topography, rock surface modelling and minerology of notches in Mount Carmel

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Notches are defined as horizontal concaved indentations developed on slopes or cliffs in a basic "C" shape regardless of their location or formation process. Many studies have proclaimed that notches are associated with coastal processes where rocky shore faces are back carved, parallel to sea level by a combination of physical and biological abrasion, and by chemical and biological dissolution. The notches morphologies are various and depend on the lithology, climate, and environment history. These changes involve complex volumetric effects such as weathering and surface mineral dissolution. The main impetus for the present paper is to advance the modeling and the 3D complex pattern reconstruction of notch's cavity surface and detailed shapes and to assess the association between the morphological structures observed upon the notch parts and the fine scale mineralogical composition of the rock. The reconstruction of 3D surfaces using point clouds scanned data is a known problem in computer graphics. Several approaches are based on combinatorial structures, such as Delaunay triangulations, alpha shapes, or Voronoi diagrams. These schemes typically create a triangle mesh that interpolates all or most of the points. In the presence of noisy data, resulting surface is often jagged, and is therefore smoothed or refit to the points in subsequent processing. Fast Fourier Transform (FFT) is a common technique for solving dense, periodic Poisson systems. However, the FFT requires longer time and larger space, quickly becoming prohibitive for fine resolutions. The Poisson approach's key element is the observation that inward normal field of the boundary can be inferred as the gradient of a three dimensional solid indicator function. Thus, the generation of a watertight mesh can be obtained by: (1) transforming the oriented point samples into a continuous vector field referred to as the relationship between the gradient of the indicator function and an integral of surface normals. The computation of the indicator function is reduced to (2) finding a scalar function whose gradients best match the vector field. Point cloud input gives enough information for the approximation of the surface integral with discrete summation. A set of points used for the portioning of the whole scene into distinct patches and also for the surface integral scaled by the patch's area. (3) Extracting the appropriate iso-surface. The roughness spatial variation was calculated according to: 1) removal of the regional slope effect is a pre-step for the surface roughness indices calculation (regression surface is reduced from the original iso-surface model to produce residuals features, surface roughness, from which it possible to calculate the variogram of the residuals), 2) Semivariogram is used to determine the optimal window size for image texture analysis. Mineral composition and structure of the different patches and components define its solubility implying thus upon the micro-morphological differences. Spectral measurements taken in the field and in the lab will be constructed to spectral libraries representing the notch's visor, cavity and floor. The VIS-NIR, SWIR and MIR reflectance data measured by the different types of spectrometers will not be mixed for future evaluation of mineral identification. The constructed spectral libraries was analyzed and processed for the characterization of spectral features of samples. The spectral features were compared with various well characterized resampled mineral spectral libraries for identification of the forming minerals. The mineral composition is defined by spectroscopy and used to capture the areas corresponding to different patterns of micro roughness along the notch's surface. The suggested roughness and 3D surface reconstruction employ real data acquired by the Terrestrial Light and Range Detection (t-LiDAR) scanner. The project stresses an interdisciplinary approach to map the mineral variations along the notch's different components corresponding to the roughness surface changes.