A Novel Vision-Based Approach for the Classification of Volcanic Ash Granulometry

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The volcanic ash fall-out represents a serious hazard for air and road traffic. The forecasting models used to predict its time-space evolution require information about characteristic parameters such as the ash granulometry. Typically, such information is gained by spot direct observation of the ash at the ground or by using expensive instrumentation. A distributed Wireless Sensor Network (WSN) of low-cost monitoring stations would represent a suitable solution in performing a continuous and high spatial resolution monitoring.

In this paper, a novel low-cost vision-based methodology together with a dedicated image processing algorithm aimed at the estimation and classification of the ash granulometry is presented.

The first prototype developed to investigate the methodology consists of a light-controlled tank and a camera. The acquired images of the ash samples are transmitted to a PC and processed by a dedicated paradigm developed in LabVIEW™. A threshold algorithm has been developed to provide a classification of the detected ash. Optimal thresholds have been estimated by using the theory of Receiver-Operating-Characteristic (ROC) curves.

The methodology has been validated experimentally using real ash erupted by Mount Etna, with three different nominal granulometry, $\phi_1 = 0.5$ mm, $\phi_2 = 1$ mm, and $\phi_3 = 2$ mm.

The preliminary results demonstrated the viability of the proposed approach showing average accuracies in the estimation of the granulometry of 50 μm, suitable for the implementation of a low-cost distributed early warning solution.

The main novelties of this work reside in both the low-cost vision-based methodology and the proposed classification algorithm.