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An Ensemble System of Classifiers for Computer-Aided Volcano Monitoring

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Abstract : Continuous evaluation of the status of potentially hazardous volcanos plays a key role for civil protection purposes. The importance of monitoring volcanic activity, especially for energetic paroxysms that usually come with tephra emissions, is crucial not only for exposures to the local population but also for airline traffic. Presently, real-time surveillance of most volcanoes worldwide is essentially delegated to one or more human experts in volcanology, who interpret data coming from different kind of monitoring networks. Unfavorably, the high nonlinearity of the complex and coupled volcanic dynamics leads to a large variety of different volcanic behaviors. Moreover, continuously measured parameters (e.g. seismic, deformation, infrasonic and geochemical signals) are often not able to fully explain the ongoing phenomenon, thus making the fast volcano state assessment a very puzzling task for the personnel on duty at the control rooms. With the aim of aiding the personnel on duty in volcano surveillance, here we introduce a system based on an ensemble of data-driven classifiers to infer automatically the ongoing volcano status from all the available different kind of measurements. The system consists of a heterogeneous set of independent classifiers, each one built with its own data and algorithm. Each classifier gives an output about the volcanic status. The ensemble technique allows weighting the single classifier output to combine all the classifications into a single status that maximizes the performance. We tested the model on the Mt. Etna (Italy) case study by considering a long record of multivariate data from 2011 to 2015 and cross-validated it. Results indicate that the proposed model is effective and of great power for decision-making purposes.

Keywords : Bayesian networks, expert system, mount Etna, volcano monitoring
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