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Application of subspace detector technique on acoustic signals recorded during eruptive activity: Mt. Etna lava fountains case of study

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The current eruptive period of Mount Etna, which began in January 2011, has produced numerous energetic episodes of lava fountaining, which have been recorded by the INGV permanent infrasound network with sensors located on and around the volcano. The source of these events was the New South-East Crater. Simultaneously, small levels of activity were noted in the Bocca Nuova and North-East Crater as well.
We will present an analysis of infrasound signals related to the Strombolian and lava fountaining activity during such eruptive episodes wherein we apply the method of subspace detector.
This method has promised to outperform standard STA/LTA and cross-correlation methods for real-time event detection in cases where similar events produced by a particular source can be expected.
The waveforms to be detected are organized in a matrix and, by means of the singular value decomposition, a set of basis vectors is built. The subspace detector operates by correlating linear combinations of the basis vectors against the windowed vector of continuous data to detect events that fall within the subspace spanned by the basis. Doing so, it can detect both identical events and events that exhibit small variations with respect to the reference templates. Hence, the subspace detector turns out to be powerful for the detection of explosive events occurring in a volcanic area. Indeed, during an eruption a single crater usually produces similar but not identical infrasonic events due to temporal variations in explosion dynamics, in vent geometry or in location (two or more vents inside a single crater).
In addition to detection performance, the method will be applied to determine whether the source exhibits a temporal evolution within or between fountaining events, or otherwise produces repeating, classifiable events occurring through the continuous explosive activity.