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## Deep learning approach for detecting low frequency events on DAS data at Vulcano Island, Italy

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Since September 2021, signs of unrest at Vulcano Island have been noticed after four years of quiescence, along with CO<sub>2</sub> degassing and the occurrence of long-period and very long-period events. With the intention of improving the monitoring activities, a submarine fiber optic telecommunications cable linking Vulcano Island to Sicily was interrogated from 15 January to 14 February 2022. Of particular interest has been the recording of 1488 events with wide range of waveforms made up of two main frequency bands (from 3 to 5 Hz and from 0.1 to 0.2 Hz).

With the aim of the automatic detection of seismic-volcanic events, different approaches were explored, particularly investigating whether the application of machine learning could provide the same performance as conventional techniques. Unlike many traditional algorithms, deep learning manages to guarantee a generalized approach by automatically and hierarchically extracting the relevant features from the raw data. Due to their spatio-temporal density, the data acquired by the DAS can be assimilated to a sequence of images; this property has been exploited by re-designing deep learning techniques for image processing, specifically employing Convolutional Neural Networks.

The results demonstrate that deep learning not only achieves good performance but that it even outperforms classical algorithms. Despite providing a generalized approach, Convolutional Neural Networks have been shown to be more effective than traditional techniques in exploiting the high spatial and temporal sampling of the acquired data.

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