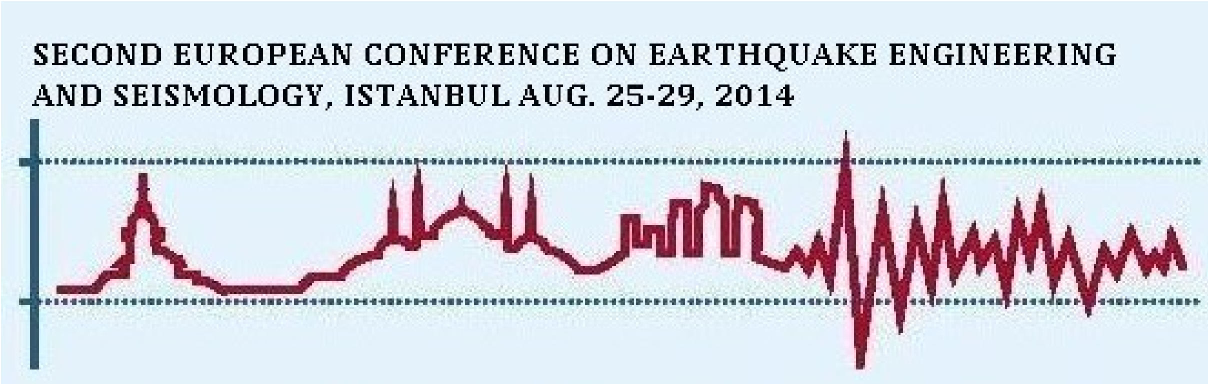

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SEIMICITY CLUSTERING USING SEISMIC SOURCE PARAMETERS

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The continuous increase in the number of available seismic stations, and the deployment of small-scale networks to monitor weak seismicity and microseismicity in specific areas, allowed the detection of weaker seismicity, dramatically increasing the size of seismic catalogues. The parallel improvement of source inversion methodologies facilitated the determination of focal mechanisms for smaller events, again providing large moment tensor catalogues. The current availability of massive seismicity and microseismicity catalogues, including complete or partial information on hypocenter location, origin time, magnitude, focal mechanisms, first onset polarities and waveform characteristics, provide a very important source of information to understand rupture processes and fault geometry at a very local scale. However, the interpretation of such large catalogues remains demanding. The development of classification techniques, able to recognise similarities among one or more seismcity patterns, is of extreme interest to automatically recognise the most significant seismicity features, their spatial distribution, and their evolution in time.

In this work I present a density based clustering algorithm (Cesca et al. 2013), which can be used to automatically classify seismic events and to analyse large seismic catalogues. The proposed method requires a definition of a metrics, which is used to quantify the similarity among two earthquakes, on the base of their parameters. The clustering concept can flexibly operate in the space of spatial locations, by considering the euclidean distance among epicenters or hypocenters (e.g. Maghsoudi et al. 2014), in the temporal space, by considering the inter-event times, or in the space of focal mechanisms and fault plane parameters. Other distance definitions may be chosen, whenever other source parameters are available. Once the metric is defined, the density based clustering searches for regions of the parameter space which are highly populated. Clusters are formed wherever the density conditions are met, and their edges correspond to regions of lower earthquakes density. This work includes applications to synthetic and real data, which discuss the performance of different metrics, and the expected results when the clustering of a seismic catalogue is performed upon spatial, temporal, focal mechanisms, or recorded waveforms. The application to real data from different regions, and including natural and induced seismicity, illustrates the potential of the clustering method for several purposes, such as the monitoring of spatial and temporal evolution of microseismicity, the reconstruction of fault system geometry, or the interpretation of repeated moment tensor features.

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