

PRESTo: a new stand-alone software tool for earthquake early warning

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PRESTo is the acronym of *PRobabilistic and Evolutionary early warning SysTem*, a new software platform based on which the Earthquake Early Warning System (EEWS) under development and testing in southern Italy is built. The core infrastructure of this EEWS is the high density, wide dynamic Irpinia Seismic Network (ISNet) deployed along the apenninic chain which is frequently strike by moderate to large magnitude damaging earthquakes. PRESTo is an integrated software tool that continuously processes the live streams of 3-component acceleration records from the seismic stations. As an energetic event is detected at a minimum number of two stations, the system promptly performs the first P-picking location. Peak ground displacement measurements (PD) in a narrow time windows after the observed P- and predicted S-signals are used to estimate the earthquake magnitude and predict a peak ground motion parameter at distant target sites.

As the radiated waves propagates through, alarm messages, containing the evolutionary estimates of the above parameters along with their uncertainties, can thus reach, through dedicated communication lines or the Internet, the vulnerable structures in the region, before the arrival of destructive waves, thus enabling the automatic activation of safety procedures.

The earthquake location algorithm adopts an evolutionary, real-time technique based on an equal differential time formulation, and a probabilistic approach for describing the hypocenter. The algorithm, at each time step, relies on both the information from triggered arrivals and not-yet-triggered stations.

The magnitude estimation is based on a Bayesian approach, and exploits an empirical relationship that correlates the final event magnitude with the logarithm of the peak ground

displacements, measured over just the first 2-4 seconds of signal following the detected P-wave arrivals and the theoretically estimated S-wave arrivals.

An empirical attenuation model at regional scale is used to predict the peak accelerations at target structures.

For earthquakes originating within the ISNet seismic network, a first alarm can be delivered within 4-6 seconds from the origin time and a stable, low error location and magnitude estimate is achieved within 10 seconds after the origin time.

PRESTo can easily be configured and tailored to different networks, by providing the seismic stations details, velocity model, coefficients of the regression laws, and by tuning the parameters controlling the data analyses algorithms and the alarms dissemination.

A simple integration with the underlying seismic network is granted by the widely available SeedLink communication protocol used for data acquisition.