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Offline-Performance of FinDer v.2 during the 2016/17 Central Italy Earthquake Sequence

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We demonstrate and analyze the performance of the Finite-Fault Rupture Detector (FinDer) v.2 algorithm (Böse et al., 2018) for the 2016/17 earthquake sequence in the Central Apennines, using a waveform playback of 13 normal fault earthquakes ($4.7 \leq Mw \leq 6.5$) recorded by the Italian Strong-Motion Networks (Rete Sismica Nazionale (RSN) and Rete Accelerometrica Nazionale (RAN)) operated by the Instituto Nazionale di Geofisica e Vulcanologia (INGV) and the Dipartimento della Protezione Civile (DPC), and accessed via the Engineering Strong Motion Database (ESM) website (http://esm.mi.ingv.it/). Based on the current spatial ground-motion pattern observed at the seismic stations at any given time, the FinDer algorithm determines a line-source model that is best suited to explain these motions. This is done by comparing the observed ground-motion amplitudes with theoretical templates modeled from empirical ground-motion prediction equations (GMPEs) assuming a magnitude-dependent line-source. To account for temporal changes in the observed amplitudes caused by the evolving fault rupture, all FinDer estimated line-source parameters (centroid, length, and strike) and uncertainty estimates are updated every second until peak shaking is reached. We compare the performance of FinDer for various ground-motion metrics used for template generation, including peak-ground acceleration and velocity amplitudes, with and without site corrections. Regardless of the chosen metric, for the three largest events, the 2016 Mw6.5 Norcia, Mw6.0 Amatrice, and Mw5.9 Visso earthquakes, we get stable line-source solutions within a few seconds from event origin, which are in good agreement with finite-fault models of Chiaraluce et al. (2017) and Tinti et al. (2016). For the smaller events, the FinDer estimated rupture strike tends to coincide within 15o or less with one of the nodal planes of the INGV-determined fault plane solutions, suggesting an important role of rupture directivity in the small earthquakes causing asymmetric ground-motion patterns. This work is carried out under WP28 of the SERA (Seismology and Earthquake Engineering Research Infrastructure Alliance for Europe) project, which aims to provide rapid seismic source information and shaking forecasts of potentially harmful earthquakes.