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Large seismic source imaging from old analogue seismograms

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In this work we present a procedure to recover the ground motions by a proper digital structure, from old seismograms in analogue physical support (paper or microfilm) to study the source rupture process, by application of modern finite source inversion tools.
Despite the quality that the analog data and the digitizing technologies available may have, recover the ground motions with the accurate metrics from old seismograms, is often an intricate procedure. Frequently the general parameters of the analogue instruments response that allow recover the shape of the ground motions (free periods and damping) are known, but the magnification that allow recover the metric of these motions is dubious. It is in these situations that the procedure applies.
The procedure is based on assign of the moment magnitude value to the integral of the apparent Source Time Function (STF), estimated by deconvolution of a synthetic elementary seismogram from the related observed seismogram, corrected with an instrument response affected by improper magnification. Two delicate issues in the process are 1) the calculus of the synthetic elementary seismograms that must consider later phases if applied to large earthquakes (the portions of signal should be 3 or 4 times larger than the rupture time) and 2) the deconvolution to calculate the apparent STF. In present version of the procedure was used the Direct Solution Method to compute the elementary seismograms and the deconvolution was processed in time domain by an iterative algorithm that allow constrains the STF to stay positive and time limited. The method was examined using synthetic data to test the accuracy and robustness.
Finally, a set of 17 real old analog seismograms from the Santa Maria (Azores) 1939 earthquake (Mw=7.1) was used in order to recover the waveforms in the required digital structure, from which by inversion allows compute the finite source rupture model (slip distribution).

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