SECOND EUROPEAN CONFERENCE ON EARTHQUAKE ENGINEERING AND SEISMOLOGY, ISTANBUL AUG. 25-29, 2014

Turkish Earthquake Foundation - Earthquake Engineering Committee Prime Ministry, Disaster And Emergency Management Presidency

ISOLA SOFTWARE FOR MOMENT-TENSOR INVERSION: RECENT INNOVATIONS

Efthimios SOKOS[1] and Jiří ZAHRADNÍK[2]

We present a follow of the Sokos and Zahradník (2008) and Sokos and Zahradník (2013) papers in which the ISOLA software was described. The main innovation is the use of various methodologies that allow the assessment of solution quality. Furthermore a series of interesting enhancements have been implemented in the code; e.g., stations may be used in the moment tensor (MT) waveform inversion with a different frequency range, and the low-frequency range suitable for the MT inversion can be determined by analyzing the signal and noise spectra.

The solution quality is measured based on the signal-to-noise ratio (SNR), variance reduction (VR), condition number (CN), and two new indices, FMVAR and STVAR. FMVAR (the Focal-Mechanism VARiability) quantifies the stability of the focal mechanism in the space-time grid search within a prescribed correlation threshold. The variability is quantified using the Kagan angle (Kagan, 1991). STVAR (Space–Time VARiability) measures the stability of the source position and time in a grid search within the same correlation threshold.

The uncertainty analysis is also provided by means of a 6D theoretical error ellipsoid (Zahradník and Custódio, 2012). This analysis is data independent and a special tool to estimate the theoretical uncertainty of the strike, dip, rake and double-couple percentage for a given source-station configuration is provided with ISOLA code. This tool can also serve as a seismic network design tool to map the Kagan-angle variability in a focal region.

The fully automated jackknifing procedure has also been added in the code to assess the stability of the MT inversion under repeated removal of a single station or a single station component.

The calculation of the source-time function has been upgraded by implementing the Non-Negative Least Squares method (NNLS). A tool in which the NNLS method is used to jointly invert for 2-point models as a proxy of the finite-fault solution is also available in the code and has already been applied in the case of Van earthquake (Zahradník and Sokos, 2013). The main innovations of the software are illustrated by examples.

The software is available for download from http://seismo.geology.upatras.gr/isola/, it is running under all operating systems and has been extensively tested in routine use at various agencies.

REFERENCES

Kagan YY (1991) "3-D rotation of double-couple earthquake sources", *Geophysical Journal International,* 106(3):709–716, doi: 10.1111/j.1365-246X.1991.tb06343.x

Sokos E and Zahradník, J (2008) "ISOLA a Fortran code and a Matlab GUI to perform multiple-point source inversion of seismic data", *Computers & Geosciences*, 34(8):967-977, doi: 10.1016/j.cageo.2007.07.005

Sokos E and Zahradník, J (2013) "Evaluating Centroid-Moment-Tensor Uncertainty in the New Version of ISOLA Software", *Seismological Research Letters*, 84:656-665, doi:10.1785

[1] Dr, University of Patras, Patras (Greece), esokos@upatras.gr
[2] Dr, Charles University in Prague, Prague, jz@karel.troja.mff.cuni.cz

Zahradník J and Custódio, S (2012) "Moment tensor resolvability: application to southwest Iberia", *Bulletin of the Seismological Society of America*, 102:1235–1254.

Zahradník J and Sokos, E (2013) "The Mw 7.1 Van, Eastern Turkey, earthquake 2011: two-point source modelling by iterative deconvolution and non-negative least squares", *Geophysical Journal International*, 196: 522–538. doi:10.1093/gji/ggt386