EGU22-3800, updated on 16 Aug 2022
https://doi.org/10.5194/egusphere-egu22-3800
EGU General Assembly 2022
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SSA2py: A seismic source imaging tool in Python based on the Source-Scanning Algorithm

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We introduce SSA2py, an open-source tool for the implementation of the Source-Scanning Algorithm (SSA) (Honn Kao and Shao-Ju Shan, 2007) in near-real time conditions. In general, Back-Projection methods due to their simplistic but at the same time effective approach provide the circumstances for fast analysis of the seismic rupture with relatively low computational cost and minimum initial assumptions. In accordance with that and by exploiting local strong motion data, SSA can be used for the detailed imaging of the high frequency seismic radiation after the occurrence of a major earthquake by stacking records based on the predicted arrival times for a specific seismic phase. Areas in a spatiotemporal grid system that produce high brightness values due to constructive stacking, usually point out the radiation of meaningful seismic energy at the examined frequency band. SSA2py is a command line tool, developed in Python high-level programming language and mainly designed to closely work with 'FDSN Compliant Web Services' for a real-time seismic event triggering and seismic waveform data provision. After the report of a significant seismic event SSA2py initially calculates the necessary travel time tables, using the optimal velocity model for the study area. The software is intended to offer several travel time calculation alternatives such as the fast marching or the finite difference method together with the possibility to use 1D or 3D velocity models (if it's applicable). In a subsequent step, it automatically obtains seismic waveform data and metadata from the user defined data sources (e.g. an FDSN web service) and applies a variety of signal assessment algorithms that examine data-clipping, signal to noise ratio, long period disturbances, station's performance based on power spectral density (PSD) of seismic noise etc. Selected data are carefully pre-processed, based on the user given configuration file and back-projected using SSA in an highly efficient way parallelized and adapted to run in GPU and CPU multiprocessing architectures. An extended configuration file is provided, allowing the user to manipulate in detail SSA settings, ranging from the style and the size of the grid system to the frequencies and the type of the used signals. Finally the software elucidates the method results by producing a series of plots and other important output info. The robustness of this new software will be presented in case studies from major earthquakes around the world (e.g. Japan, Greece). The program will be open source and freely available to the scientific community, oriented for computers with Linux OS and access to FDSN Web Services.

Honn Kao, Shao Ju Shan, Rapid identification of earthquake rupture plane using Source Scanning Algorithm, Geophysical Journal International, Volume 168, Issue 3, March 2007, Pages 1011–1020,

https://doi.org/10.1111/j.1365-246X.2006.03271.x

The research work was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the “First Call for H.F.R.I. Research Projects to support Faculty members and Researchers and the procurement of high-cost research equipment grant” (SIREN, Project Number: 910).