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OQ-SRTK, a Python Toolkit for Seismic Site Response Analysis

Valerio Poggi, Graeme Weatherill, Garcia Julio, and Marco Pagani
GEM - Global Earthquake Model Foundation, Pavia, Italy

Ground shaking induced by destructive earthquakes is controlled at local scale by the effect of near surface geology. The presence of unfavourable soil conditions, such as loose low-velocity sediments and irregular bedrock geometries, can have a dramatic impact on the earthquake ground motion, producing large amplification and increased shaking duration. Furthermore, these phenomena are often localized in specific frequency bands, controlled by the characteristics of the site, with a chance of matching the resonance periods of buildings and civil structures. Evaluation of earthquake hazard at local scale, therefore, cannot be done without an accurate pre-emptive evaluation of the soil properties and the definition of the associate seismic response, either through analytical and numerical models or direct empirical observations. These are of major concern in local site-response and microzonation studies.

In parallel with the development of OpenQuake-engine software, the Global Earthquake Foundation (GEM) is presently developing various tools for the construction of PSHA input models including an open-source suite of tools for site characterisation and local seismic response analysis. The ultimate goal of these tools is to facilitate scientists and practitioners worldwide in the development of site-specific ground motion models for a variety of targets, such as earthquake hazard and risk analysis, urban design, post-disaster recovery planning and more. The OpenQuake Site Response Toolkits (oq-srtk) is written in Python and aims to collect a set of functionalities designed to:

• facilitate the creation and exploration of uniform databases of site conditions, including – but not limited to - elastic properties, geotechnical parameters, soil proxies and geometric/topographic information;
• estimate soil parameters from direct field measurement, earthquake recordings or by indirect classification methods;
• calculate site response through analytical/numerical, predictive (e.g. vs30 based) or empirical (spectral modelling, standard spectral ratios) amplification models;
• simulate site-specific ground motion fields.

The toolkit is currently under development and new functionalities are being added at any new release. The oq-srtk is designed to easily integrate with OpenQuake platform and other GEM tools, by using standardised I/O data formats and by sharing a uniform philosophy for testing, maintenance and data quality assurance.