Geophysical Research Abstracts
Vol. 21, EGU2019-1321, 2019
EGU General Assembly 2019

A new kinematic finite-fault inversion method based on neuro-fuzzy model estimation

Navid Kheirdast (1,2), Anooshiravan Ansari (1), and Susana Custodio (2)

(1) International Institute of Earthquake Engineering and Seismology, Earthquake Seismology, Tehran, Iran, Islamic Republic Of (khairdast@gmail.com) , (2) Instituto Dom Luiz, Faculdade de Ciências da Universidade de Lisboa, Portugal

Finite-fault inversions aim at imaging the spatiotemporal evolution of slip on the fault during an earthquake. Given the high number of model parameters commonly employed in finite-fault inversions on one hand, and the limited datasets recorded at the Earth's surface on the other hand, these problems are often underdetermined, and one can find multiple models that fit the data equally well. In this presentation, we propose a new formulation to find the evolution of slip on the fault that uses a neuro-fuzzy computational strategy to build up the model space. The new formulation has the advantage of decreasing the number of model parameters, retaining only the critical features of the model required to fit the observations. Neuro-Fuzzy systems are mathematical universal approximators, which means that they can model any continuous function or system, provided that enough base functions, or "fuzzy rules", are used. In this framework, the kinematic source model is represented as an expansion using a set of base functions, which are – both themselves and their weights – inferred by fuzzy logic. The base functions are found by a "learning procedure", which is the standard method for finding the parameters of a neural network in deep learning algorithms. This new methodology is applied to synthetic data of SIV inv1 benchmark problem (http://equake-rc.info/SIV/sivtools/list_benchmarks/) in order to find the model parameters that minimize the cost function, in this case, the misfit between data and synthetics. The proposed method can decrease the number of model parameters by $\sim$10 times with respect to the number of parameters used in classical finite-fault inversions (e.g. (Olson and Apsel 1982)). A synthetic test shows that the retrieved (output) model reproduces well the true (input) model. The performance of this new methodology will be compared with the results of other methods (Mai, et al. 2016) highlighting the advantages and disadvantages of the proposed method.