STATIC AND QUASI-STATIC INVERSION OF FAULT SLIP DURING LABORATORY EARTHQUAKES

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Inferring from seismological data the spatio-temporal slip distribution during earthquakes remains a challenge due to the large size, non-uniqueness and ill-posedness of the problem; finite source inversion usually relies on simplifying assumptions. Moreover, without ground truth source data, the evaluation of the performance of source inversion is only possible by synthetic tests. To address these concerns and test the viability of the inversion methods used for natural earthquakes, laboratory earthquakes offer a valuable alternative. They enable us to work with simulated real data and provide a relatively well-constrained solution. Here, we employ a biaxial apparatus capable of reproducing shear rupture along a rectangular fault separating two PMMA blocks. Normal and shear stresses are initially increased up to the target normal stress using external pressure pumps, assuming a fixed shear to normal stress ratio of 0.3. Subsequently, the shear stress is increased until instabilities occur at a peak friction of 0.4. During the seismic rupture, we measure the acceleration at 20 receivers along the fault, integrate it twice into displacements. Then we use it to invert the slip history, which is compared to direct measurements using laser sensors placed through the fault. The predicted data is computed using Okada's formulation and the posterior PDF of the slip history is obtained using a Metropolis algorithm. The adoption of a probabilistic approach provided a range of solutions, is essential for assessing the uncertainty in our results and addressing the non-uniqueness issue. Ultimately, the obtained results will offer insights into inversion methods, presenting their strengths and limitations more realistically than when using artificially generated synthetic datasets.