

Mechanism: Shear slip user guide



The program performs inversion of amplitudes of longitudinal (P) and transversal (S) seismic waves as 3-component vectors into the mechanism of the seismic source in the description of a double couple using a grid search across the full or a priori specified range of the fault-plane solution angles.

open in IS-EPOS
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REFERENCES

CATEGORY Source Parameter Estimation

KEYWORDS Seismic event mechanism, Shear slip along a fault, Inversion of P an/or S amplitudes, Grid search

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Introduction

The application Mechanism: Shear-Slip inverts amplitudes of P and/or S seismic phases complemented with the polarity signs, i.e. the particle motion vectors, into the traditional double-couple (DC) mechanism, i.e. the body-force couples equivalent to a shear slip along a planar fault in an isotropic medium (see, e.g., Aki, K., & Richards, P. G., 2002, *Quantitative seismology*, University Science Books). In the current implementation, it is joined with the application reading a seed file and picking the amplitude. If the seismograms processed represent velocity records, we need to pick the amplitude at each station in the peak-to-peak manner, i.e. from first peak of the phase to the second one, see Figure 1.

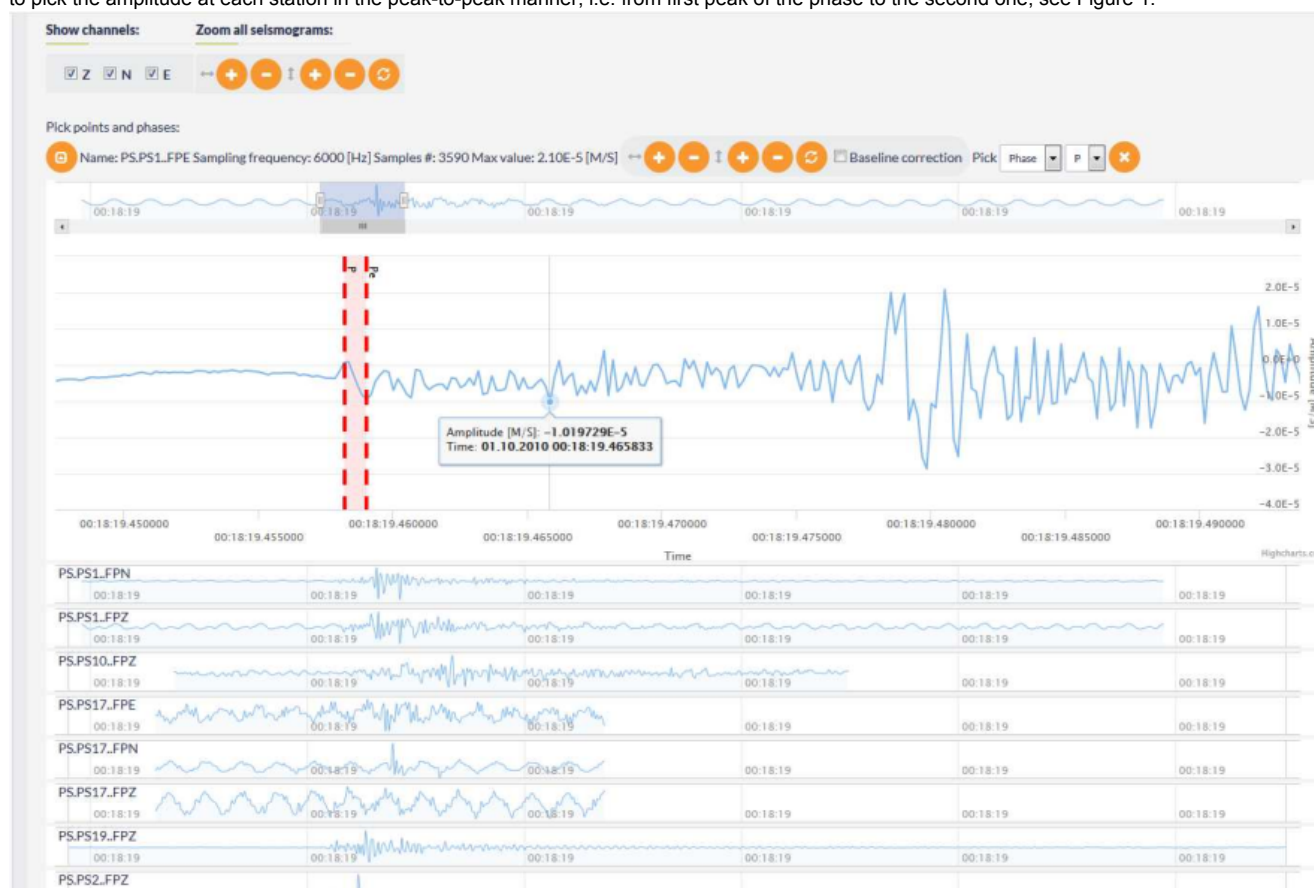


Figure1. Example of picking of the amplitude of the P-wave from a velocity record.

The more data available, the more is the inverse task constrained. Therefore, it is reasonable to pick amplitudes from all the components of 3-component records. If, however, some of the components are not of sufficient quality, it is possible to skip them.

The Shear-Slip source model is described by three angles – dip, strike and rake, and a magnitude. The application seeks for the parameters of the model by grid search with the step 2° . Definition ranges of the angles are the following:

- $dip < 0^\circ, +90^\circ$
- $strike < 0^\circ, +360^\circ$
- $rake < -180^\circ, +180^\circ$

Gridding of the magnitude of the mechanism – described usually as the moment – is different. Obviously, there is no definition range of this parameter. Therefore, for the sake of keeping the evaluation reasonably fast, we take advantage of using an estimate of the source moment obtained from an prior processing. Advantageously, it can be the norm of the moment tensor obtained by inverting the amplitudes in terms of the moment tensor source model first, e.g., by using the 'Mechanism: Full Moment Tensor' application. Then, the value of the moment norm estimate M_0 is put in the first box of the input table, see Fig.2. The application defines the interval for gridding of the moment $<0, 2 \cdot M_0>$ and proceeds here with the step $0.025 \cdot M_0$.

Step by Step

After the User adds the Application into his/her personal workspace, the window as shown in Figure 2 appears. The following files are necessary:

- *MiniSEED Waveform*
- *Network inventory*

Figure 2. Input window of the "Mechanism: Shear slip" application.

For more thorough instructions regarding uploading necessary files, loading picks from file and picking see [FOCI user guide](#).

Each source mechanism inversion needs the knowledge of the response of the medium, the Green's function. It is a characteristics of the material of the zone depending, in addition, of the configuration of the source and the recording stations. Positions of the stations are obtained from the seed file of the records, coordinates of the source – the hypocenter – must be filled into the table: the latitude, longitude and the depth (Figure 2). For complex structures the evaluation of the Green's function may be difficult. For the sake of simplicity, here we apply the simplest model of the rock mass, namely an isotropic homogeneous medium described by the P and S wave velocities and its density. Regardless its triviality, it may be a good approximation for local underground configurations. The corresponding values of the velocities and the density should be put into the input table (Figure 2). The scaling factor serves for an optional modification of the orders of the Green's function throughout the inversion, the value 1 means no modification of the evaluated Green's function entering the inversion.

The outputs of the application are presented in three sets:

- (1) The output values of the DC angles dip, strike and rake, are presented in Figure 3.

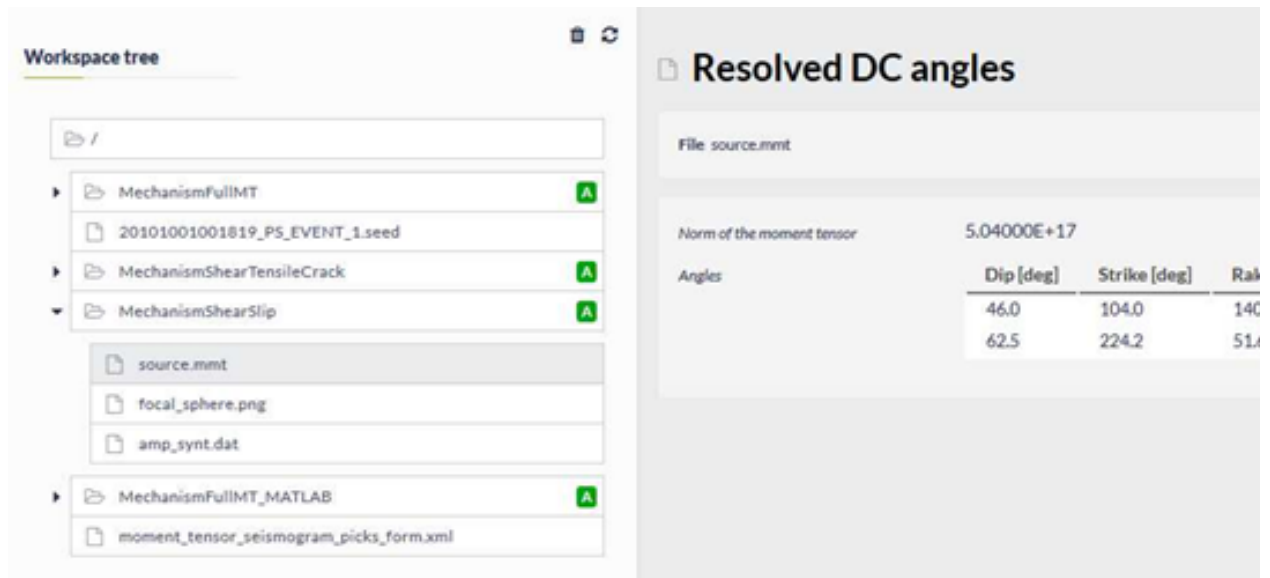


Fig.3 Resolved values of the angles dip, strike and rake, describing the orientation of the shear-slip mechanism (in the body-force equivalent the double-couple, DC).

(2) The plot of the mechanism in the traditional form of the display of zones of compression of the P-waves generated by the resolved mechanism ("beach ball"), Figure 4.

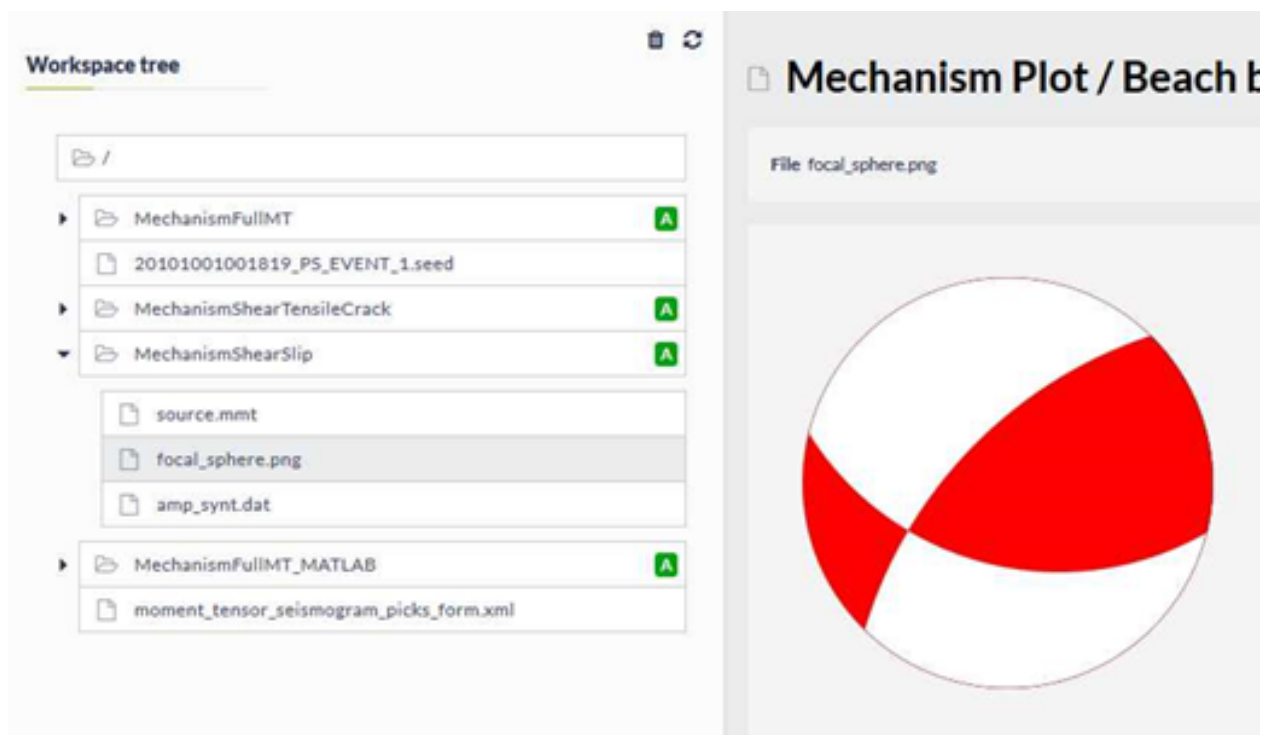


Figure 4. Plot of the mechanism in the traditional form of the "beach ball": polarities of the P-wave (compressions – red, dilatations – white) projected onto the lower focal hemisphere, equal-area projection.

(3) The match of the synthetic amplitudes generated for the resolved DC mechanism to the data at individual stations and components is presented in Figure 5.

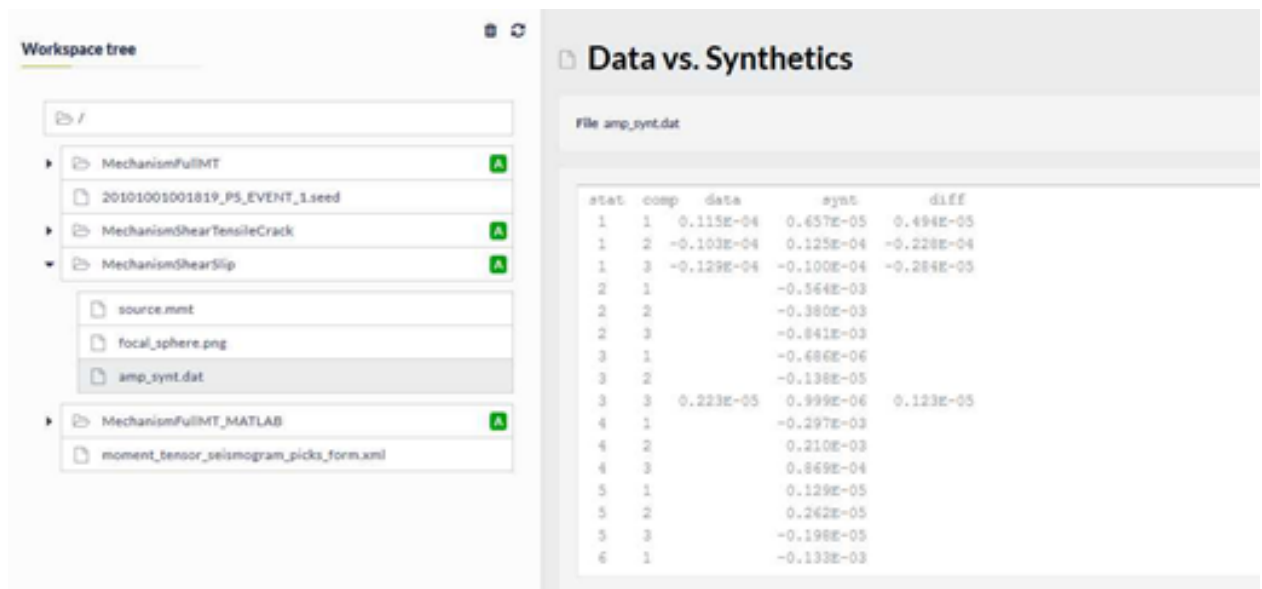


Figure 5. Comparison of synthetic amplitudes constructed for the resolved values of the DC mechanism and the input data.

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