

FOCI user guide

 This application makes use of the P-wave first arrivals from the waveforms recorded by the seismic stations and resolves seismic moment tensors using various decomposition schemes. Three moment tensors are calculated: unconstrained (full) moment tensor solution, deviatoric moment tensor solution (no volumetric change in the source), and double-couple moment tensor solution (no volumetric change in the source, no linear dipole). In addition to the moment tensor components various source parameters are calculated as well (fault plane solutions, P/T/B axes orientation, scalar seismic moment etc).

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REFERENCES [Document Repository](#)

CATEGORY Source Parameter Estimation

KEYWORDS Source parameters, Source mechanism, Moment tensor

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Kwiatek, G., Martínez-Garzón, P. and M. Bohnhoff (2016). HybridMT: A MATLAB/Shell Environment Package for Seismic Moment Tensor Inversion and Refinement. *Seismological Research Letters* 87 (4), DOI: 10.1785/S0220150251.

Step by Step

After the User adds the Application into his/her personal workspace, the window as shown in Figure 1 appears. The following files are necessary in order to perform the moment tensor inversion:

- *MiniSEED Waveform*
- *Network inventory*
- *Ray Tracing Angles*

FOCI

ACTIONS

File FOCI

Description This application makes use the P-wave first arrivals from the waveforms re... [EXPAND](#)

INPUTS

Miniseed Waveform ⓘ

Required 1 file

SELECT FILES

Network inventory ⓘ

Required 1 file

SELECT FILES

Ray Tracing Angles ⓘ

Required 1 file

SELECT FILES

LOAD PICKS FROM FILE

Event coordinates

Latitude

Longitude

Depth

LOAD VALUE FROM FILE

Density [kg/m³]

2,700

Output file name

Result

Output solution types

☒ All

☒ F - Full Solution

☒ T - Trace-null Solution

☒ D - Double Couple Solution

Advanced options ⓘ

⚠ Missing or invalid input files: Miniseed Waveform, Network Inventory, Ray Tracing Angles

CLEAR

SAVE

RUN

✖

☐ Enable autorun

Status: New ⓘ

Figure 1. Inputs for the "FOCI" application.

The User can upload files which are already available in his/her personal workspace (green filed in Figure 2) after clicking "SELECT FILES" (red filed in Figure 2). However, if User is not in possession of such files, he/she can obtain them from "Data Search" (green filed in Figure 3).

The screenshot shows the FOCI application interface. The 'INPUTS' section on the left includes fields for 'Miniseed Waveform', 'Network inventory', and 'Ray Tracing Angles', each with a 'SELECT FILES' button. Below these are fields for 'Event coordinates', 'Density [kg/m³]', 'Output file name', and 'Output solution types'. A 'LOAD PICKS FROM FILE' button is also present. A red box highlights the 'SELECT FILES' button for 'Miniseed Waveform'. A 'Select files' dialog box is open, showing a file list with 'FOCI' and 'SONG_TRANH_signal000010.mseed'. The 'OK' button is highlighted. At the bottom, there are 'CLEAR', 'SAVE', 'RUN', and 'Enable autorun' buttons. A status bar at the bottom indicates 'Status: New'.

Figure 2. Input data uploading files for the application.

The screenshot shows the FOCI application interface. The 'INPUTS' section on the left includes fields for 'Miniseed Waveform', 'Network inventory', and 'Ray Tracing Angles', each with a 'SELECT FILES' button. Below these are fields for 'Event coordinates', 'Density [kg/m³]', 'Output file name', and 'Output solution types'. A 'LOAD PICKS FROM FILE' button is also present. A red box highlights the 'SELECT FILES' button for 'Ray Tracing Angles'. An 'Application input information' dialog box is open, displaying text about the required input file type and providing links to 'Upload the file' and 'Go to Data Search to download it from the eNode Data Center'.

Figure 3. Application input information.

Once all these files are uploaded the waveforms are shown in the screen and are available for elaboration. As depicted in Figure 4, only the vertical channels are shown by default, since the methodology applied in this application uses only P-waves. Nevertheless, the User can make all the channels appear on the window, by ticking the 'N' and 'E' components, below the 'Show channels' (field 1).



Figure 4. Description of waveform processing

Waveform Processing

The options provided by the waveform viewer are described in Figure 4. When clicking on one waveform, a detailed waveform window extends.

1. The user selects the component(s) that he/she wishes to be displayed in the screen. East-West, North-South, Vertical.
2. Horizontal zooming in-out.
3. Vertical zooming in-out.
4. Undo all zooming.
5. Select between phase (start and end point) picking and single point picking.
6. Only P-wave is enabled in this Application. (In other Applications, selection between P-wave and S-wave picking are possible, see "Waveform viewer guide" in "Visualization" chapter).
7. Undo picking.
8. Horizontal zooming tool. The User may alternatively zoom in-out the waveform by clicking on this small vertical bar and move the mouse left-right. The User may also click and drag the selected (shaded) part of the waveform left and right.
9. Collapse the details of the waveform.
10. Move the selected (zoomed) part of the waveform left-right.

Picking Phase

The User has to pick a starting and an ending point from the Vertical component of a station (**Z channel - see Figure 4). Then, he/she has to repeat this picking for the other stations.

NOTE: Although it is not necessary to pick P-wave arrivals in all of the waveforms to run the application, a minimum of 8 picks is required for the application to proceed to the calculations (stated also at the bottom of Figure 5). The number of the seismograms and P-wave phases picked, are updated, each time the User selects makes a new picking. The User may also load picks from XML file (red filed in Figure 4) rather than processing the waveforms manually.



Picked seismograms: 2 . Required at least: 8

Picked phases: P: 2

Figure 5. Demonstration of waveform picking

Parameters selected for the waveform inversion:

- *Event Coordinates:* The hypocentral coordinate of the event can be taken from the catalog ('LOAD VALUE FROM FILE' tab, Figure 5), however the User has here the chance to modify the given values, or retry the process with different e.g. depths.
- *Density [kg/m³]:* The density of the medium is requested by the User.
- *Output file name:* The User may select the name of the files that are going to be saved after the inversion process ('Result' by default).
- *Output solution types:* All options are described next to the boxes. **At least one item has to be selected.**
- *Advanced Options:* The User may type command-line arguments.

Event coordinates	Latitude	Longitude	Depth	LOAD VALUE FROM FILE
Density [kg/m ³]	2,700			
Output file name	Result			
Output solution types	☒ All ☒ F - Full Solution ☒ T - Trace-null Solution ☒ D - Double Couple Solution			
Advanced options ⓘ				

Figure 6. Additional input parameters selection

When the picking and the parameter selection is over, the User shall click on 'RUN' to initiate the application).

The results obtained after the process terminates include the values of the parameters and also focal mechanism types, as requested in the previous step (Figure 6). An example is shown in Figure 7. The scheme of the focal mechanisms (.png files) can be demonstrated and downloaded by the User. Tables with numerical values (.asc files) can also be displayed on the screen.

Status: Finished ⓘ

OUTPUTS

Result files:

[Result-dc.asc](#)

[Result-full.asc](#)

[Result-full.png](#)

[Result-full.mat](#)

[Result-dc.mat](#)

[Result-dc.png](#)

[Result-deviatoric.png](#)

[Result-deviatoric.mat](#)

[Result-deviatoric.asc](#)

Figure 7. Outputs of the application

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