

# *Frequency-time analysis program Moment Tensor & Source Depth Inversion Program*

## *Tutorial*

Your first actions after 1-st login:

Enter \$HOME directory and execute script **/opt/fmt/bin/structdir**.

A structure of directories will be created in your \$HOME.

Directories VRANCEA90, TURKEY99, and COLIMA corresponds to the earthquakes which will be studied during the exercises.

### **I. Floating filtering of Vrancea earthquake records**

1.1. Enter directory \$HOME/VRANCEA90/FTAN

1.2. Execute command:

**ftan**

1.3. *New/Open* start window will appear.

Click on *New* tab


Brows:


/opt/fmt/exercise/VRANCEA90/Dbase/90150\_VRANCEA\_1040\_1.wfdisc




/opt/fmt/exercise/VRANCEA90/Dbase/90150\_VRANCEA\_1040.instrument


/opt/fmt/exercise/VRANCEA90/Dbase/90150\_VRANCEA\_1040.origin


Click on OK. Start window will disappear.


1.4. Click button  and assign following bandpass filtering parameters:  
short period zero = 80, short period corner = 90, long period corner = 220, long period zero = 200.



1.5. Click button  and assign following bounds for FTAN diagram:  
group velocity from 2 to 6, periods from 80 to 220.

1.6. Until you didn't select a station and a channel to be processed the light of semaphore button is red . Click on '+' near selected station, available channels will appear. Click on one of them. The semaphore light will change to yellow . The program is ready for processing of selected seismograms. Click on semaphore button. The semaphore light will change to green , and selected waveforms will be plotted.


1.7. To apply bandpass filtering click on the button .

1.8. Click on the button  to view FTAN maps for selected components and to make floating filtering (see p.p.35-43 of manual).

1.9. To save results click the button . The **Save Records Dialog** will appear. Click component toggle buttons required to be saved. Click OK button to save records.

1.10. Select next station-channel. Button  changes green color to yellow  and you can work with new selection.

1.11. After you finished the processing of all Vrancea records push the button  to save results.

The **Save Location As Dialog** will be invoked for selection of directory name. Click the 'Create New Folder' toolbar button  to create a new directory (mentioned further as **FLT**).

Recommended components to be saved and correspondent period ranges for floating filtering:

ANMO.LHT	100	190
ANMO.LHZ	100	190
CHTO.LHT	100	190
ERM.LHZ	100	190
HRV.LHZ	100	190
KIP.LHT	110	170
KIP.LHZ	100	170

## II. Moment Tensor & Source Depth Inversion for Vrancea earthquake.

2.1. Enter directory @HOME/VRANCEA90/MomTens.

2.2. Execute command **MomTens**. The main window of the program will appear.

2.3. Push button  to start a New Project.


Define Project Directory -  type Project Name (**Inversion** for example);


Filtered Wave Form Disc DB Name -  browse directory \$HOME/VRANCEA90/FTAN/FLT (if you saved the directory with results of floating filtering under name **FLT**), and click **table.wfdisc**.

Instrument, Site, Sensor DB Root Names - browse directory /opt/fmt/exercise/VRANCEA90/Dbase and click '90150\_VRANCEA\_1040.site'

Origin Info Event Db Name  - browse directory /opt/fmt/exercise/VRANCEA90/Dbase and click '90150\_VRANCEA\_1040.origin'


Note: Next time you can just use  to open Project Name **Inversion**, if you saved it.

2.4. To select records to be used for the inversion push button . In this example all the records are recommended to be used, so push button 'OK'.

2.5. Push button   
Structural models and related stations table:

Model	Station
CONT	CHTO
CONT	ERM
CONT	HRV
CONT	TOL
OCEAN	KIP
T_CON	ANMO

Click on the model 000, and after on the radio button 'Get Source Model from Model List'. Click 'OK'.

2.6. Push button .

We recommend following spectral bands to be used in the inversion (Spectral Range for every wave):


Record	Tmin	Tmax
ANMO.LHT	100	190
ANMO.LHZ	100	190
CHTO.LHT	100	190
ERM.LHZ	100	190
HRV.LHZ	100	190
KIP.LHT	110	170
KIP.LHZ	100	170

Parameters to be given in the right frame (Spectral rage):

Tmin=100, Tmax=190, Nw=12, N points FFT = 32768


Type in the text box at the bottom 120.

Push 'Get' button.

2.7. Push button .

Recomended grid characteristics:

- 0.0 - Initial Depth
- 5.0 - Depth Step
- 41 - Number of Depth Values
- 15.0 - Initial Dip
- 15.0 - Dip Step
- 6 - Number of Dip Values
- 0.0 - Initial Strike
- 15.0 - Strike Step
- 12 - Number of Strike Values
- 0.0 - Initial Slip
- 15.0 - Slip Step
- 12 - Number of Slip Values

2.8. Push the button  to perform the selection and rarefication of polarity data. Push the arrow in the combo box, choose the angle of polarity data smoothing (10 degrees), Push radio button 'bulletin plus supplementary'. Push radio button 'ak135 model', and confirm by pushing OK

2.9. Push the button  to start the inversion.

2.10. View of results:



Viewing all project lists and parameters.



Viewing the results.



View of the map of stations for selected records.

### III. Floating filtering of Turkey earthquake records

3.1. Enter directory \$HOME/TURKEY99/FTAN

3.2. Execute command:

**ftan**

3.3. *New/Open* start window will appear.

Click on *New* tab

Brows:

/opt/fmt/exercise/TURKEY99/Dbase/1999229\_TURKEY\_0001\_1.wfdisc  
/opt/fmt/exercise/TURKEY99/Dbase/1999229\_TURKEY\_0001.instrument  
/opt/fmt/exercise/TURKEY99/Dbase/1999229\_TURKEY\_0001.origin

Click on OK. Start window will disappear.

3.4. Click button  and assign following bandpass filtering parameters:

short period zero = 80, short period corner = 90, long period corner = 260, long period zero = 280.

3.5. Click button  and assign following bounds for FTAN diagram:

group velocity from 2 to 6, periods from 80 to 280.

Follow instructions 1.6 – 1.11.

Recommended components to be saved and correspondent period ranges for floating filtering:

Record	Tmin	Tmax
ALE.LHT	100.00	250.00
ATD.LHT	100.00	250.00
ATD.LHZ	120.00	160.00
BDFB.LHT	100.00	250.00
BDFB.LHZ	100.00	250.00
BGCA.LHT	100.00	220.00
BGCA.LHZ	100.00	220.00
COCO.LHT	110.00	170.00
COCO.LHZ	100.00	180.00
FFC.LHT	100.00	250.00
FFC.LHZ	100.00	250.00
HDC.LHT	100.00	140.00
HDC.LHZ	100.00	250.00
HYP.LHT	100.00	250.00

HYB.LHZ	100.00	250.00
KDAK.LHT	100.00	250.00
KDAK.LHZ	120.00	200.00
KIP.LHT	100.00	250.00
KIP.LHZ	100.00	250.00
KMI.LHT	100.00	250.00
KMI.LHZ	100.00	210.00
KOG.LHT	100.00	250.00
KOG.LHZ	120.00	160.00
NRIL.LHT	100.00	170.00
NRIL.LHZ	110.00	200.00
RPN.LHT	110.00	250.00
SHEL.LHT	110.00	200.00
SHEL.LHZ	100.00	250.00
TLY.LHZ	100.00	200.00
UNM.LHT	100.00	200.00
UNM.LHZ	100.00	250.00

#### IV. Moment Tensor & Source Depth Inversion for Turkey earthquake.

4.1. Enter directory @HOME/TURKEY99/MomTens.

4.2. Execute command **MomTens**. The main window of the program will appear.

4.3. Push button  to start a New Project.


Define Project Directory - type Project Name (**Inversion** for example);


Filtered Wave Form Disc DB Name - browse directory \$HOME/TURKEY99/FTAN/FLT (if you saved the directory with results of floating filtering under name **FLT**), and click **table.wfdisc**.


Instrument, Site, Sensor DB Root Names - browse directory /opt/fmt/exercise/TURKEY99/Dbase and click '1999229\_TURKEY\_0001.site'

Origin Info Event Db Name - browse directory /opt/fmt/exercise/TURKEY99/Dbase and click '1999229\_TURKEY\_0001.origin'

Note: Next time you can just use  to open Project Name **Inversion**, if you saved it.

4.4. To select records to be used for the inversion push button . In this example all the records are recommended to be used, so push button 'OK'.

4.5. Push button  Click on the button '3SMAC MODEL' – the structure models for all stations will be calculated. Click on the model 000, and after on the radio button 'Get Source Model from Model List'. Click 'OK'.

4.6. Push button .

We recommend following spectral bands to be used in the inversion (Spectral Range for every wave):


Record	Tmin	Tmax
ALE.LHT	100.00	250.00
ATD.LHT	100.00	250.00
ATD.LHZ	120.00	160.00
BDFB.LHT	100.00	250.00
BDFB.LHZ	100.00	250.00
BGCA.LHT	100.00	220.00
BGCA.LHZ	100.00	220.00
COCO.LHT	110.00	170.00
COCO.LHZ	100.00	180.00
FFC.LHT	100.00	250.00
FFC.LHZ	100.00	250.00
HDC.LHT	100.00	140.00
HDC.LHZ	100.00	250.00
HYB.LHT	100.00	250.00
HYB.LHZ	100.00	250.00
KDAK.LHT	100.00	250.00
KDAK.LHZ	120.00	200.00
KIP.LHT	100.00	250.00
KIP.LHZ	100.00	250.00
KML.LHT	100.00	250.00
KML.LHZ	100.00	210.00
KOG.LHT	100.00	250.00
KOG.LHZ	120.00	160.00
NRIL.LHT	100.00	170.00
NRIL.LHZ	110.00	200.00
RPN.LHT	110.00	250.00
SHEL.LHT	110.00	200.00
SHEL.LHZ	100.00	250.00
TLY.LHZ	100.00	200.00
UNM.LHT	100.00	200.00
UNM.LHZ	100.00	250.00

Parameters to be given in the right frame (Spectral rage):

Tmin=100, Tmax=250, Nw=12, N points FFT = 32768

Type in the text box at the bottom 150.


Push 'Get' button.

4.7. Push button .

Recomended grid characteristics:

- 0.0 - Initial Depth
- 5.0 - Depth Step
- 11 - Number of Depth Values

- 15.0 - Initial Dip
- 15.0 - Dip Step
- 6 - Number of Dip Values
- 0.0 - Initial Strike
- 15.0 - Strike Step
- 12 - Number of Strike Values
- 0.0 - Initial Slip
- 15.0 - Slip Step
- 12 - Number of Slip Values

4.8. Push the button  to perform the selection and rarefication of polarity data. Push the arrow in the combo box, choose the angle of polarity data smoothing (10 degrees), Push radio button 'bulletin plus supplementary'. Push radio button 'ak135 model', and confirm by pushing OK

4.9. Push the button  to start the inversion.

4.10. View of results:



Viewing all project lists and parameters.



Viewing the results.



View of the map of stations for selected records.

## V. Floating filtering of Colima earthquake records

5.1. Enter directory \$HOME/COLIMA/FTAN

5.2. Execute command:

**ftan**


5.3. *New/Open* start window will appear.


Click on *New* tab

Brows:

```
/opt/fmt/exercise/COLIMA /Dbase/COLIMA1.wfdisc
/opt/fmt/exercise/COLIMA /Dbase/COLIMA.instrument
/opt/fmt/exercise/COLIMA /Dbase/COLIMA.origin
```

Click on OK. Start window will disappear.

5.4. Click button  and assign following bandpass filtering parameters:  
short period zero = 80, short period corner = 90, long period corner = 260, long period zero = 280.

5.5. Click button  and assign following bounds for FTAN diagram:  
group velocity from 2 to 6, periods from 80 to 280.

Follow instructions 1.6 – 1.11.

Recommended components to be saved and correspondent period ranges for floating filtering:

Record	Tmin	Tmax
AAK.LHT	100.00	200.00
AAK.LHZ	100.00	250.00
CTAO.LHT	150.00	250.00
CTAO.LHZ	140.00	250.00
KONO.LHZ	110.00	250.00
LVC.LHZ	120.00	200.00
MTE.LHT	105.00	160.00
MTE.LHZ	105.00	250.00
NNA.LHT	100.00	200.00
PTCN.LHZ	100.00	200.00
RCBR.LHT	115.00	200.00
RCBR.LHZ	130.00	220.00
RPN.LHT	130.00	200.00
RPN.LHZ	110.00	200.00
SNAA.LHT	100.00	200.00
SNAA.LHZ	100.00	250.00
TAU.LHT	130.00	250.00
TAU.LHZ	130.00	250.00
WAKE.LHT	110.00	200.00
WAKE.LHZ	110.00	250.00
YAK.LHT	110.00	250.00
YAK.LHZ	115.00	250.00
YSS.LHT	110.00	200.00
YSS.LHZ	130.00	250.00

## VI. Moment Tensor & Source Depth Inversion for Turkey earthquake.

6.1. Enter directory @HOME/COLIMA/MomTens.

6.2. Execute command **MomTens**. The main window of the program will appear.

6.3. Push button  to start a New Project.

Define Project Directory - type Project Name (**Inversion** for example);


Filtered Wave Form Disc DB Name - browse directory \$HOME/COLIMA /FTAN/FLT (if you saved the directory with results of floating filtering under name **FLT**), and click **table.wfdisc**.


Instrument, Site, Sensor DB Root Names - browse directory /opt/fmt/exercise/COLIMA/Dbase and click 'COLIMA.site'

Origin Info Event Db Name - browse directory /opt/fmt/exercise/COLIMA /Dbase and click 'COLIMA.origin'


Note: Next time you can just use  to open Project Name **Inversion**, if you saved it.



6.4. To select records to be used for the inversion push button . In this example all the records are recommended to be used, so push button 'OK'.

6.5. Push button .

Click on the button '3SMAC MODEL' – the structure models for all stations will be calculated. Click on the model 000, and after on the radio button 'Get Source Model from Model List'. Click 'OK'.

6.6. Push button .

We recommend following spectral bands to be used in the inversion (Spectral Range for every wave):


Record	Tmin	Tmax
AAK.LHT	100.00	200.00
AAK.LHZ	100.00	250.00
CTAO.LHT	150.00	250.00
CTAO.LHZ	140.00	250.00
KONO.LHZ	110.00	250.00
LVC.LHZ	120.00	200.00
MTE.LHT	105.00	160.00
MTE.LHZ	105.00	250.00
NNA.LHT	100.00	200.00
PTCN.LHZ	100.00	200.00
RCBR.LHT	115.00	200.00
RCBR.LHZ	130.00	220.00
RPN.LHT	130.00	200.00
RPN.LHZ	110.00	200.00
SNAA.LHT	100.00	200.00
SNAA.LHZ	100.00	250.00
TAU.LHT	130.00	250.00
TAU.LHZ	130.00	250.00
WAKE.LHT	110.00	200.00
WAKE.LHZ	110.00	250.00
YAK.LHT	110.00	250.00
YAK.LHZ	115.00	250.00
YSS.LHT	110.00	200.00
YSS.LHZ	130.00	250.00

Parameters to be given in the right frame (Spectral rage):

Tmin=100, Tmax=250, Nw=18, N points FFT = 32768


Type in the text box at the bottom 150.

Push 'Get' button.

6.7. Push button .

Recommended grid characteristics:

- 0.0 - Initial Depth
- 5.0 - Depth Step
- 11 - Number of Depth Values
- 15.0 - Initial Dip
- 15.0 - Dip Step
- 6 - Number of Dip Values
- 0.0 - Initial Strike
- 15.0 - Strike Step
- 12 - Number of Strike Values
- 0.0 - Initial Slip
- 15.0 - Slip Step
- 12 - Number of Slip Values

6.8. Push the button  to perform the selection and rarefication of polarity data. Push the arrow in the combo box, choose the angle of polarity data smoothing (10 degrees), Push radio button 'bulletin'. Push radio button 'manually', and print in edit box at the bottom '7.2'- the value of P-wave velocity in the source location. Confirm by pushing OK.

6.9. Push the button  to start the inversion.

6.10. View of results:



Viewing all project lists and parameters.



Viewing the results.



View of the map of stations for selected records.