

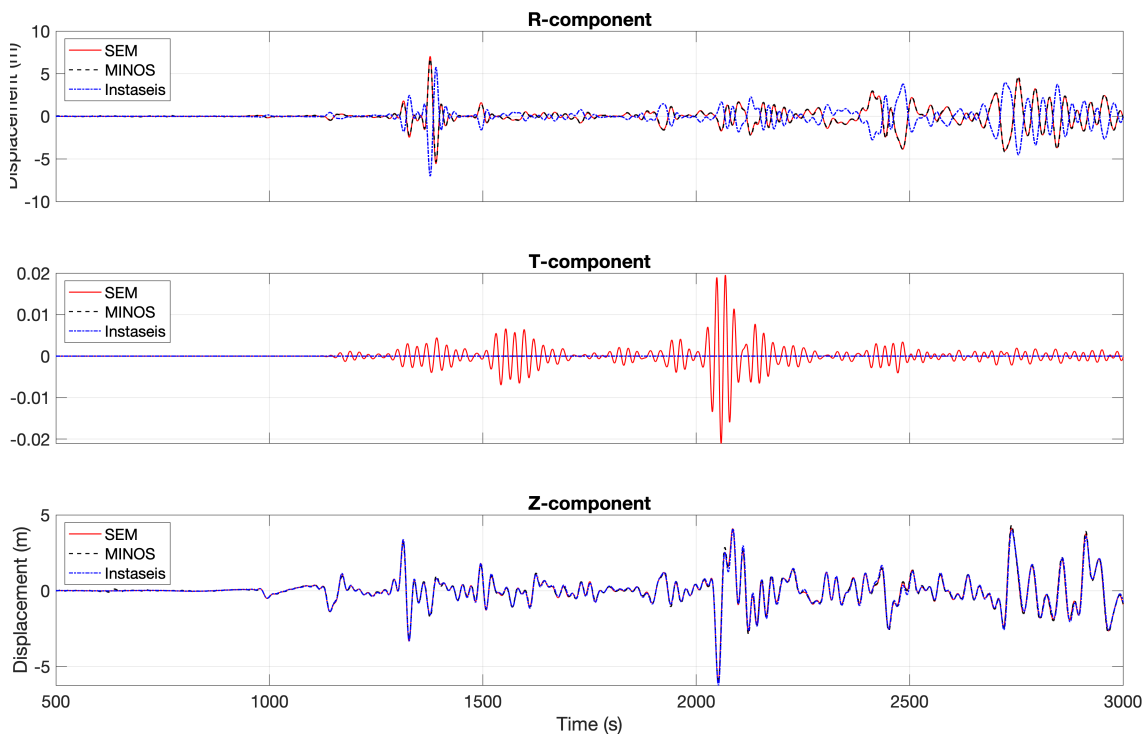
## Issue on R-component seismogram generated by a force source

To whom it may concern,

Recently I attempted to benchmark the Syngine seismograms with normal mode summation (MINOS) and SPECFEM3D. When using a force source, I noticed that only the R-component records are flipped. However, this sign-flipping issue did not appear when using a moment tensor source.

Below the file Syngine.log and the seismograms for a shallow **upward force** are attached. The seismograms are for station IU ANMO, whose epicentral distance is  $136.5^\circ$  in this case. For T-component, the SPECFEM3D non-zero but small amplitude signals should be related to the 'ghost modes' (from discussion with my advisor).

```
requesttype:          seismograms
model:                prem_i_2s
format:               saczip
components:          ZRT
units:                displacement
scale:               1
dt:                  0.2
kernelwidth:         12
origintime:           1900-01-01T00:00:00
sourcelatitude:       3.277957
sourcelongitude:      95.94
sourcedepthmeters:   10000
sourceforce:          1.0e21,0,0
locationcode:         SE
RECEIVER lat:32.713759, lon:-117.105, netcode:XX, stacode:109C, STATUS: OK
RECEIVER lat:42.447283, lon:74.494, netcode:XX, stacode:AAK, STATUS: OK
RECEIVER lat:40.042341, lon:-82.982, netcode:XX, stacode:ACSO, STATUS: OK
RECEIVER lat:42.573212, lon:-111.1, netcode:XX, stacode:AHID, STATUS: OK
RECEIVER lat:41.939605, lon:73.694, netcode:XX, stacode:AML, STATUS: OK
RECEIVER lat:34.765514, lon:-106.457, netcode:XX, stacode:ANMO, STATUS: OK
RECEIVER lat:39.679768, lon:32.794, netcode:XX, stacode:ANTO, STATUS: OK
RECEIVER lat:36.884073, lon:25.531, netcode:XX, stacode:APE, STATUS: OK
RECEIVER lat:42.162456, lon:13.405, netcode:XX, stacode:AQU, STATUS: OK
RECEIVER lat:56.252459, lon:58.562, netcode:XX, stacode:ARU, STATUS: OK
RECEIVER lat:34.946097, lon:-118.83, netcode:XX, stacode:ARV, STATUS: OK
```

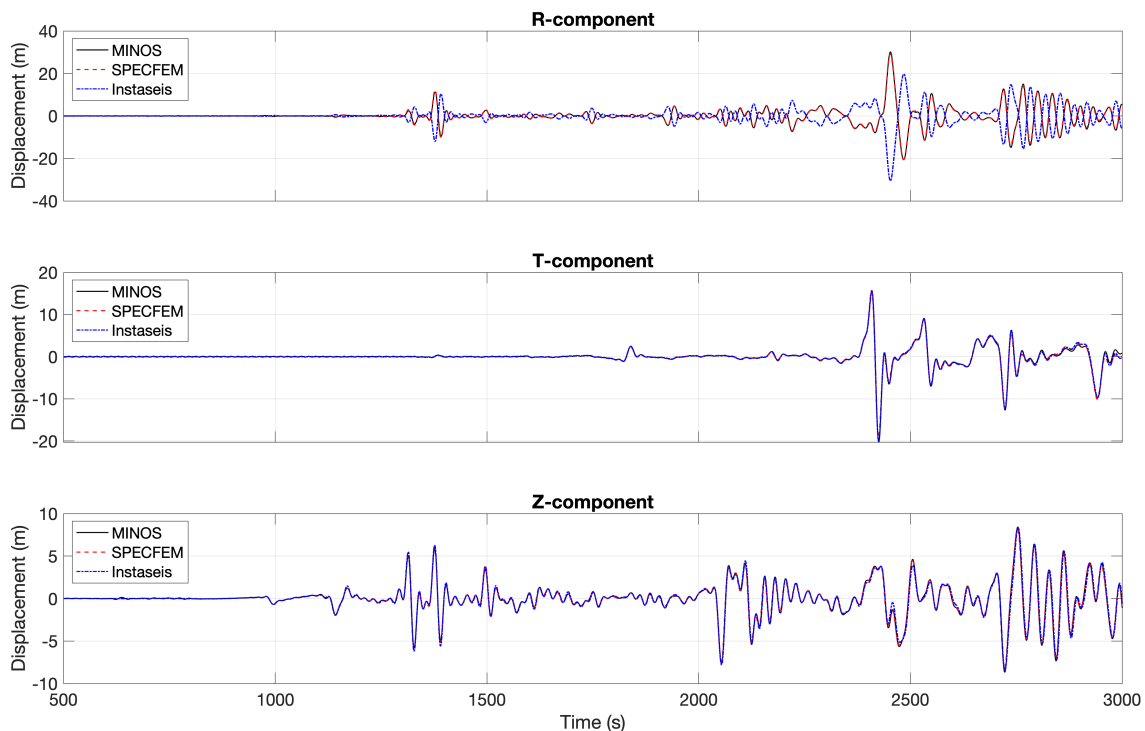


When the force is in the other two directions (ft or fp not zero), the R-component records are also flipped. Another example is for **a force with direction (fr, ft, fp)  $\propto$  (1,2,1)**, which also demonstrates the sign difference of R-component record. The seismograms are filtered by using command 'sac > bp c 0.005 0.05 n 8 p 2'. Here the order of the filter is a bit high. However, the order can be reduced if the cut-off frequency becomes lower.

```

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```



Nevertheless, this phenomenon did not show up for a moment tensor force, as mentioned previously. For the above figures, if the Syngine R-component records are flipped, the three traces can be matched well. This should not be a huge issue, but I would like to check if there would be a minor bug in the source codes only for the ForceSource solution.