

CAPJOINT: A SOFTWARE PACKAGE for SOURCE
PARAMETER INVERSION of MODERATE EARTHQUAKES

USER'S GUIDE

By

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Code available from server at

<http://home.ustc.edu.cn/~vincentc/CAPjoint>

Requirement

In order to run the code CAPjoint, you must have the following software installed and environment variable added to the system path.

1. Seismic Analysis Code (SAC)
<http://www.iris.edu/dms/nodes/dmc/software/>
2. Tau-P
<http://www.seis.sc.edu/taup/>
3. CRUST2.0
<http://igppweb.ucsd.edu/~gabi/crust2.html>
4. Frequency-Wavenumber synthetic seismogram (FK)
<http://www.eas.slu.edu/People/LZhu/downloads/fk3.1.tar>
5. Numerical Recipes (NR)
<http://www.nr.com/>
6. Generic Mapping Tools (GMT)
<http://gmt.soest.hawaii.edu/projects/gmt>
7. PSSAC2
https://geodynamics.org/svn/cig/seismo/3D/ADJOINT_TOMO/measure_adj/UTIL/pssac2/
8. Ghostscript and Gsview
<http://www.cs.wisc.edu/~ghost/>

Installation

1. Make sure the Numerical Recipes (NR) is installed and the default path for the NR is `~/bin/NR`. Change the path in `cap_main/subhir/Makefile` if necessary.
2. Compile the CAPjoint code by do the Makefile.
3. Compile the tel3 code in the folder tel3/.
4. Be aware that the default output path for the executable file is in `~/bin/`; please add it to the system path if necessary.

Run the Code

1. If you do not have a crustal/upper mantle velocity model, make sure that CRUST2.0 is installed to generate velocity model automatically. Please check `vmodel_tel` and `vmodel_loc` for the detailed format of the model file (defined in `LeadCAP.cmd`).
2. Specify the input parameters in `LeadCAP.cmd` (see detailed information in the script annotations).

3. For IRIS WILBER format seed files, extract the SAC files by “sh LeadDATA.cmd *.seed”. Otherwise, you will need to manually de-instrument and rotate the SAC files to the great arc, then cut the window length and multiply 100 to fit the measurement of the forward modeling codes.
4. Run “sh LeadCAP.cmd”.

```
[cww@localhost CAPjoint]$ ls
2014-03-10_MW6.8_N_California.seed  cmds          LeadData.cmd
cap_plt_3.pl                        LeadCAP.cmd
[cww@localhost CAPjoint]$ sh LeadData.cmd 2014-03-10_MW6.8_N_C
alifornia.seed
```

```
[cww@localhost CAPjoint]$ sh LeadCAP.cmd
```

Joint Inversion Implementation

```
# Now specify weighting parameters:
# teleseismic Vs. Local; teleseismic P Vs. SH; switch of P/SH
# P/SH switch: P only: -1 ; SH only: 1 ; P & SH: 0 (default)
w_TEL_LOC=50;          w_P_SH=1;          s_P_SH=0;
```

1. Modify the weighting parameters in the LeadCAP.cmd
2. The total misfit of each datasets—local and teleseismic, as well as the average misfit (the total misfit divided by number of stations)—will be printed on the screen after the inversion is done (see figure below). For beginner users, we recommend choosing the weighting parameters to equalize the average misfit of each dataset, which requires making the misfit of the two datasets as equal as possible.
3. For example, in this case, we advise using 1/4 (i.e., 0.25) for the tel/loc weighting parameter to balance the local and teleseismic datasets.
4. A weighting parameter for teleseismic *P* and *SH* waves is also provided. Usage is similar to that described above.

```

rms:          total      tel      loc      P      SH
n:            25        10       15       5       5
rms_average:  3.307160   6.022500  1.496933  4.485000  7.560000

      rms_loc  n_tel
scalar: ----- * ----- = 0.248557
      rms_tel  n_loc

      rms_SH  n_P
scalar: ----- * ----- = 1.685619
      rms_P   n_SH

```