

地之道GeoTaos临时台网数据处理流程

1. 数据整理及目录管理, 几点规则

GeoTaos 对文件目录及文件的命名有一定规范要求,先介绍最常用的规范及允许的变项。以下就一个小事例进行说明白。不同目录可以在不同盘里,也可以在网盘里。

1.11维速度模型文件

1.2 震相文件



目录: Phase_timezone+0800,任意,震相的时区也可以在震相文件名或者文件内部指定。优先级别为:文件内部 > 文件名 > 目录名

文件: CEDS_S 为震相文件格式标识符。地震数据共享中心的格式,目前都是这个。

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SC											

为了精定位,还得需要台站文件。

1.3 精定位数据文件

目录: Relocation_HypoDD,任意,精定位工作及定位结果目录。

dt.ct		2020/03/18 17:21	Paint Shop Pro イメージ	978 KB
event.dat		2020/03/18 17:21	DAT 7711	449 KB
event.sel		2020/03/18 17:21	SEL ファイル	372 KB
hypodd.ing		2020/03/18 17:22	INP ファイル	3 KB
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hypoDD_C	01.reloc	2020/03/18 17:22	RELOC ファイル	469 KB
hypoDD_C	02.reloc	2020/03/18 17:22	RELOC ファイル	10 KB
A hypoDD_C	03.reloc	2020/03/18 17:22	RELOC 7711	2 KB
HypoDD_G	eoTaos.log	2020/03/18 17:22	テキスト ドキュメント	34 KB
ph2dt.inp		2020/03/18 17:21	INP ファイル	1 KB
ph2dt.log		2020/03/18 17:21	テキスト ドキュメント	202 KB
phase.pha		2020/03/18 17:21	PHA 7711	1,707 KB
station.dat		2020/03/18 17:21	DAT 7711	1 KB
station.sel		2020/03/18 17:21	SEL ファイル	1 KB
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1.4 模板事件波形数据文件

目录: Templates

文件:最好通过 GeoTaos_Map 软件依据震相目录自动从连续记录提取。

ML.	^	名前	更新日時	種類	サイズ
Phase_timezone+0800		2014 03 09 19 51 00500.sacs	2020/03/18 19:16	SACS ファイル	191 KB
Relocation_HypoDD		2014_03_10_08_26_31400.sacs	2020/03/18 19:17	SACS ファイル	381 KB
Templates		2014_03_10_10_44_56100.sacs	2020/03/18 19:17	SACS ファイル	191 KB

1.5 连续波形数据文件(seed和sac):

连续波形数据文件可以是小时单位(1小时1个文件) seed文件或日单位seed文件,也可以是sac文件。 小时单位文件存放可以是月单位或日单位,日单位需要在目录名里包含"_byday_"指示符。推荐模式 是小时单位文件,月单位目录。seed文件时,固定台和流动台可以结合在一起,也可以分开。分开的情 况下,文件可以是台网单位,也可以是台站单位。台网单位的命名规则是:YYYYmmDD[hh].TW[.STA].seed, 其中TW表示台网编码,STA表示台站编码。

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> 🥃 Dianxi-2 (F:)	^	名前	更新日時	種類	サイズ
> 🥪 Dianxi-1 (l:)		2021050100.YN.seed	2021/05/07 11:16	SEED ファイル	84,292 KB
> _ Dianxi-1 (l:)		2021050101.YN.seed	2021/05/07 11:16	SEED ファイル	82,988 KB
		2021050102.YN.seed	2021/05/07 11:16	SEED ファイル	82,480 KB
 Dianxi-2 (F:) 		2021050103.YN.seed	2021/05/07 11:17	SEED ファイル	81,744 KB
 2021ctn_hour_fntz+0800 		2021050104.YN.seed	2021/05/07 11:17	SEED ファイル	81,868 KB
202105		2021050105.YN.seed	2021/05/07 11:17	SEED 7711	82,604 KB
Yangbi_detected_P		2021050106.YN.seed	2021/05/07 11:17	SEED ファイル	88,788 KB
Yangbi detected T		2021050107.YN.seed	2021/05/07 11:17	SEED ファイル	97,320 KB
> YangBi EO		2021050108.YN.seed	2021/05/07 11:17	SEED ファイル	103,188 KB
Vanabi EO 2		2021050109.YN.seed	2021/05/07 11:18	SEED ファイル	104,368 KB
		2021050110.YN.seed	2021/05/07 11:18	SEED ファイル	102,416 KB
Yangbi_HypoDD_P		2021050111.YN.seed	2021/05/07 11:18	SEED ファイル	102,576 KB
YangBi_MLP		2021050112.YN.seed	2021/05/07 11:18	SEED ファイル	101,792 KB
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月单位目录,小时单位台网单位 seed 文件实例

← → ~ ↑ 🔋 > USB ドライブ (F:) > Yi	aoYao > Ctn_hour_byday_fntz+0800 > 20140310	✓ U 2014031	0の検索	
✓	^ 名前 ^	更新日時	種類	サイズ
✓ ☐ Ctn_hour_byday_fntz+0800	2014031000.SC.SEED	2018/11/14 16:44	SEED ファイル	58.212 KB
20140310	2014031001.SC.SEED	2018/11/14 16:44	SEED ファイル	57,304 KB
20140311	2014031002.SC.SEED	2018/11/14 16:44	SEED ファイル	57,756 KB
ML	2014031003.SC.SEED	2018/11/14 16:44	SEED ファイル	56,900 KB
Phase_timezone+0800	2014031004.SC.SEED	2018/11/14 16:44	SEED ファイル	57,196 KB
Relocation HypoDD	2014031005.SC.SEED	2018/11/14 16:44	SEED ファイル	57,212 KB
Templates	2014031006.SC.SEED	2018/11/14 16:44	SEED ファイル	58,088 KB
		3010/11/14 46.44	CCCD 7921	67 444 VD

小时单位目录,小时单位台网单位 seed 文件实例

目录: Ctn_hour_byday_fntz+0800

Ctn:表示连续记录,可省略 hour:波形文件为小时记录。其它 day byday:波形文件是按年月日划分子目录。缺省表示不再划分子目录。 fntz+0800:波形文件名是按指定时区的年月日时命名。缺省表示按国际时命名。 注意: seed 文件内部一定是国际时!

文件:小时记录 yyyyMMddHH.SC.seed,日记录 yyyyMMdd.SC.EMS.seed。SC 为台网名,EMS 为台站 名。

如果为 SAC 文件,台站名后加分量名。

1.6 扫描结果:

目录: ML

存放扫描输出文件,可以任意指定。

输出文件包括目录,记录,及据选项而定的事件波形,相关系数等

2. 利用区域固定台震相数据进行地震事件(初选模板事件)精定位

启动GeoTaosMap

将震相文件拽入地之道。



载入区域台网震相文件

精定位非必须,具体方法参考有关精定位视频。精定为完成后,点击第20行的"Load Reloc.."载入定位结果,然后点击22行的"Apply relocation"更新震相事件的坐标。



载入精定位结果



载入精定位结果后



适用精定位结果后

2.1 模板事件波形抽取

 丛 23 行下拉菜单选择第 5 或第 6 号指令。5 号指令提取所有符合震级及时空范围的 事件波形。6 号指令(首选),只提取精定位后保留下来事件。

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24	Number	100.	-150.	Length(s),	SRmax(km
25					

- ② 24 指定最大震中距,R为正时,只抽取固定台有震相数据的台站。R为负值时,提取 震中距|R|以内的所有台站波形数据。
- ③ 点击 23 行的 Do 按钮,在弹出对话窗指定连续记录文件目录。



在提取出来的sacs文件的文件头里,已经注入了地震诸元数据及P(t1)波和S(t2)波到时数据,对应的kuser1和kuser2分别标注为"tp_opr"和"ts_opr"。

2.2 自动震相识别

由于临时台,没有震相到时数据,分两步实现震相识别和震相数据注入。 2.2.1 已经池田信息量准则AIC和自回归AR模型进行P和S震相的自动识别。 ① 启动GeoTaos,将提取出来的任意一个事件波形文件拖入窗口载入。



② 载入合适的1维速度模型,用于计算各震相理论走时。



③ 执行Event: Row6的1号命令,程序将自动对那些没有标注为"tp_opr"及"ts_opr"的通道进行自动震相识别处理。自动识别的震相数据标注为"tp_aic"及"ts_aic"的。P和S的振幅数据分别记入user3和 user4。

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④ 可以执行Event: Row6的11号命令将当前事件波形数据存档。

⑤ 执行Event: Row6的2号命令,对事件波形目录里所有事件进行震相不全和存档处理。

5		Srate=50	T_b=5.0	T_a=55.0	Sa
6	Do	2: Fill tp, ts by AIC ((auto run)	-	. (* fi
7	Other	t_zone= 0.0		Do	Tin

2.3 人工校验**处理**

自动识别有时不一定十分可靠,尤其是S波和初动方向和振幅,根据需要和目的可以对所有事件做一 遍人工校验处理。

- ① 启动GeoTaos,将任意一个事件波形文件拖入窗口载入。
- ② 人工校验在Wave3波形显示窗口进行,将光标十字中心移动到P波或S波(可选测S/N最大,最容易识别的通道)开始点,按下鼠标左键,这是光标将根据按下位置自动变为或,表示将提取相应震相的到时及振幅,如果光标不对,可按下《Ctr》或《Shift》键,强制为P或S提取模式。将光标十字中心移到第一个波峰或波谷,释放鼠标左键。程序将计算相应震相的初动走时,方向和振幅。



人工震相识别操作示意图

- ③ 依次处理其它需要处理的台站波形。
- ④ 执行Event: Row6的11号命令将修改数据存入sacs文件。

3. 二次双差定位精定位,生成模板事件波形文件库

用固定台和临时台震相数据进行二次双差定位

① 启动GeoTaos,将任意一个事件波形文件拖入窗口载入。



② 执行Event: Row6的0号命令,提取所有事件的PS震相数据,直接传输到震相层

③ 执行双差定位流程

18		Working Sheet	Open working s	25:
19		Seismic Frame	Show seismic fr	
20	Step-5	Load Reloc	Load relocated	
21	Do	0: Zs vs event[type=1]	Statistics of rel	
22	Step - 7	Apply relocation.	Replace hypoca	_

<Working Sheet> ->.... -> <Load Reloc..> -> <Apply relocation>.



④ 执行Event: Row6的0号命令,将定位数据注入事件波形



⑤ 执行Event: Row6的4号命令,生成扫描用模板事件波形文件库。

生成扫描用模板事件波形文件,将按4-5行设定的信噪比,震中距,采样率,时间窗进行切去。



4. 模板扫描与定位

采用Matching and location[*Zhang and Wen*, 2015]方法,在地之道GeoTaos平台下实现模板扫描与定位。 通过一些列算法优化,扫描程序只占用少量内存,可以同时开启与CPU核同等数量的线程作业,从而达 到快速扫描功能。图一为模板扫描的原理图。



Template-Matching



模板流程框图

4.1 模板扫描控制参数输入文件: MatchLoca.inp

```
* MatchLoca.inp - parameters for Matching filtering and location
path_templ= "F:/YangBi_TemplatesT/"
path_cont= "F:/2021ctn_hour_fntz+0800/202105/"
  path_out= "C:/Temp1/"
 1D_velmod= "F:/Vel_Yangbi_mean_Yao2018.vel"
                                                           //1D velocity model
 f_naming= "YYYYMMDDHH.seed" //rule
                                                     file
                                                                 naming
                                                                              "YYYYMMDD[HH].seed",
                                         of
"YYMMDD[HH].nt.sta.seed", "YYYY_MM_DD[_HH].sacs/"
scan start=2021 05 21 22
 scan end=2021 05 21 23
 num_temp1= 1200
                               //Maximum number of template eavents
                               //Flag of active channel[7], 1:EW, 2:NS, 4:UD
  chn flag= 7
    phase= 2
                               //Matching phase 1:P 2:S [2]
sampl rate= 50
                               //Re-sampling rate[0] 0: same to template
filter_fl= 1.0
                               //Lower cut frequency
 filter_fh= 10.0
                               //Higher cut frequency
                               //Do filtering for 1: continue, 2: template, 3:both
 filt flag= 3
  len_fft= 181000
                               //length running segment
  t before= 0.0
                               //time before pahse arrival [1]
   t after= 6.0
                               //time after pahse arrival [3]
                               //event mask time [6]
   t mask= 6.0
                               //threshold of correlation coieficient for detection [0.3]
     CCmi= 0.3 0.8 0.95
    SNRmi= 10
                               //threshold of signal to noise ratio for template phases [10]
Search R H= 2
                               //Horizontal searching distance in km [2]
Grid_num_H= 20
                               //Grid number of Horizontal searching [200]
Search R_V= 2
                               //Vertical searching distance in km [2]
Grid_num_V= 10
                               //Grid number of vertical searching [200]
                               //1: sac->sacs 2: detect event by STA/LTA, 3: Match and locate
 run flag= 3
 out_flag= 4, len=50, m>=0.0, CC>=0.75 //lst, 1 2 3 4 5:CCsum, 6:+CC., len, m, CC thresholds for
outputing sac file
time zone= 8
tz seed fn= 8
Mmi=O, Mmx=6, Hmi=O, Hmx=15
Pline 4
99 25
99 27
101 27
101\ 25
```

4.2 模板扫描

① 启动WaveMatch执行程序。

Waveform cross correlation			
Templates Path		- 200 <= Max. num. of e	vents
Out Path.		- Ousterization	
Do I: Check event SACs		Time shift (second) :	1 E-W V
Country days for the profile		Time window (tS*?) :	2.5 U-D 🖓
Create dLcc for Hypoul		Num. ref. station :	3
	Inp file	Time before P :	0.5
	Run	Time after P :	2.5
//////////////////////////////////////		Taper :	0
Matching and location		CC detect :	0.4
F:WraoYaoWMatchLoc.mp	Input file	IIR Filter (fL, fH) :	0 0
YYYY mm DD hh : TO	Run / Lunch	Test Run	Full Run
Auto lunch within day=1,31,+=1 Go]	CC Rep.Evt : 0.95	Clusterize
Matching and location		1	
0: Seed to SAC	• Do		1.15.2
Sampling rate : 50 Time zone : MM DD:	0101 1231		Auto dose 1
Bandpaas filte : 0 10 8			

② 点击Input file载入输入文件

F:¥YaoYao¥MatchLoc.inp				Input file
YYYY mm DD hh : 2014 03 01 00	то	2014 03 0	1 23	Run / Lunch
1				

③ 输入起始年月日时,点击Run/Lunch便自动开启一个线程对指定时段进行扫描。 可以陆续输入其它时段开启新的线程。

也可以点击Go对day=指定的月日范围与步长,针对开始年月自动开启若干个线程。

④ 扫描过程可以查看,指定输出目录里的内容。

③ USB ドライブ (F:)	^	名前	更新日時	種却	サイズ
BUFFALO		2014_03_09_19_51_00000.sacs	2020/03/19 8:44	SACS 7711	182 KB
System Volume Information		2014_03_10_02_38_22660_m008_CC046.sacs	2020/03/19 10:55	SACS 77414	182 KB
YaoYao		2014_03_10_03_50_55500_m091_CC100.sacs	2020/03/19 10:56	SACS 77474	182 KB
Ctn hour byday fntz+0800		2014_03_10_08_26_31000.sacs	2020/03/19 8:44	SACS 7711	363 KB
20140310		2014_03_10_10_44_56010.sacs	2020/03/19 8:44	SACS 7711	182 KB
20140310		2014_03_10_16_26_26400_m062_CC100.sacs	2020/03/19 11:08	SACS 7711	363 KB
20140311		2014_03_10_18_44_51080_m-31_CC100.sacs	2020/03/19 11:10	SACS 7711	182 KB
ML		ML_2014031000_2014031023.log	2020/03/19 11:15	テキスト ドキュメント	27 KB
Phase_timezone+0800		ML_detect.eqt	2020/03/19 11:10	EQT 7741V	2 KB
Relocation HynoDD 9 個の項目	*				

其中ML_detected.eqt为扫出目录,可以拽如GeoTaosMap显示。其它文件顾名思义。

4. 参考文献

Zhang, M., and L. Wen (2015), An effective method for small event detection: match and locate (M&L), *Geophysical Journal International*, 200(3), 1523-1537, doi:10.1093/gji/ggu466.