‘ms_picker’: an automated Sta/Lta picker

Introduction

‘ms_picker’ uses a Sta/Lta algorithm to automatically make picks from miniseed waveform data. The program processes a single, possibly multiplexed, miniseed file using parameters specified in a separate input file. Calculated phase arrival times are output to file. If the miniseed file is multiplexed, an individual output file is created for each station. The program processes one component per station; if a station contains multiple components the user should specify which component to process. If a station only contains one component, this component is processed by default and any user-specified component choice is ignored. The parameters that control filtering and the picking algorithm may be specified for each station, generically using a wildcard or a mixture of the two. The program assumes the miniseed records are contiguous i.e. there are no gaps in the data.

Installation

The installation package contains the source code, a Makefile, required miniseed headers and a static 32-bit linux version of the miniseed I/O library, ‘libmseed.a’. All source files unpack into the same directory. A C/C++ compiler (e.g. from the GNU compiler collection) is required to build the program. The program is built by typing ‘make’. The program executable is created in the same directory as the source files.

The Makefile specifies the “-m32” flag to ensure binary files generated are compatible with the supplied miniseed library. This flag can be removed if not required. If the target system already has *libmseed* installed, update the settings of the “LIBS” and “INCLUDES” variables in the Makefile with the appropriate path(s) to the existing installation.

Execution

The program requires a miniseed file and a parameter file as mandatory command line input. Two other optional arguments may be also be specified. Each argument is specified via a single character switch:

Switch	Argument	Required?	Notes
-p	Parameter filename	mandatory	Records in this file contain parameters controlling filtering and picking algorithm for a station. A wildcard (‘*’) can be used in place of the station name to refer to all stations.
-m	Miniseed filename	mandatory	Waveform data (may be multiplexed).
-c	Component code	optional	Specifies which component to process. Allowed values are ‘z’, ‘n’ & ‘e’ (without the apostrophes).
-d	Output directory	optional	Output files will be written into this directory. The directory must exist prior to execution.

The “usage” message for the program is:

```
ms_picker -p <parameter_file> -m <miniseed_file> [-c z|n|e] [-d <output_dir>]
```

Parameter File

The parameter file consists of individual records, one per line. Comment lines can be included in the file, these are designated with a ‘#’ as the first character of the line. The 7 parameter values in a record are separated by spaces, and their meanings are:

<station> <trigger level> <sta (s)> <lta (s)> <dead time (s)> <high pass (Hz)> <low pass (Hz)>

e.g.

```
ABC 10.0 1.0 30.0 30.0 1.0 12.0
DEF 8.0  1.0 35.0 30.0 1.0 10.0
*   11.0 1.0 30.0 30.0 1.5 10.5
```

A <station> name should exactly match a station name specified in the miniseed file header. The wildcard '*' station name will match all stations, but preference is given if an exact match of the name is found. Therefore stations 'ABC' and 'DEF' (from the example above) will use the parameter values explicitly stated, whereas any other station name will use the values defined by station '*'.

Output files

Output files are written to the current working directory or into the directory specified by the '-d' command line option. Files are named using the following convention:

```
<station>_<component code>.picks
```

where <station> is the name specified in the miniseed file header and the <component code> is an integer with value 0, 1 or 2. '0' refers to the vertical component, '1' to North and '2' to East.
An output file contains one phase arrival time record per line. The elements within a record are separated by spaces, and the record is interpreted using the following definition:

<station> <time (s)>* <year> <month> <day> <hour> <minute> <second>

*time in seconds from 00:00:00 UTC, January 1, 1970

The automatic picker processes one miniseed file per execution. We have assumed a series of miniseed files may be processed consecutively by the program (for instance, by looping over a list of input files within a shell script). Therefore the output files are opened for writing in "append" mode, and picks for a particular station and component code will be appended to an existing file for the same station and component code. If no such previous file exists, a new file will be created.

The following paper describes the methodology and citing this would be appropriate:

S.E.J. Nippress, A. Rietbrock & A.E. Heath, "Optimized automatic pickers: Application to the ANCORP dataset", *In Review*, *Geophys. J. Int.*, 2009.