User manual for Faster

21.04.2021

Introduction

Faster is a software program for controlling and generating input files to the wind turbine simulation program Openfast. In addition, it includes features to display the output in a user-controlled manner.

Basic features

The Faster software is a console application which is run by issuing faster<inputfile in a command window. The inputfile is generated by the user and will enable one or several openfast analyses to be run. If several openfast analyses are requested, they will be run in parallel.

The inputfile may be generated by any text editor and the syntax is in free format and is case insensitive. A comment line may be given with either of the characters in the first column:
%, $, #, !, * . For the examples as given herein the '*' will be used as comment sign.

Although the commands may be given in any order, it is recommended that commands are given in the same order as used in this manual.

In general, only 3 significant characters are needed for Faster to recognize the command, e.g. 'MAE' and 'MAESTRO' will both be recognized as maestro. Optional commands are given in paranthesis as (command), whereas required user input is given as <input>.

The commands may be given on several lines in which case a & at the end of the line serves as a continuation sign.

Even though Faster is rather flexible on regards to how the input is issued, i.e. case insensitive etc., it will under no circumstance tolerate than the tabulator is used, e.g. to include white spaces. Faster will read the tabulator as an unknown ascii-value and an error will be issued.

Command syntax

IDENTIFICATION <id> (EXPAND <number>) ('description')

The id is a user defined string of 4 characters that is used to identify the openfast analyses. The number that follows the EXPAND command is number of openfast analyses. Optionally a user defined description may be issued that should be enclosed in ampersand (not needed if there is no spaces).

Example of use:

```
Id HYW2 expand 8 'Test of applicability'
```

MAESTRO <program> <main_file>

This command is used to inform Faster about the main file that is used for the requested program. At current the only allowed parameters for <program> is openfast and turbsim. Note that if turbsim is to be run prior of an openfast analyses it is crucial that the maestro file for turbsim is given.

Example of use:

```
MAESTRO OPENFAST 5MW_OC3Spar_DLL_WTurb_WavesIrr.fst
```

and:

```
maestro turbsim ../5MW_Baseline/wind/90m_12mps_twr.inp
```

MASTER <file> SLAVES <file1> <file2> … <fileN>

The master file may include several slave files which will be updated for each run as required. The command may be issued several times.

Example of use:

```
  MASTER  5MW_OC3Spar_DLL_WTurb_WavesIrr.fst    &
          SLAVES   NRELOffshrBsline5MW_OC3Hywind_ElastoDyn.dat &
                   NRELOffshrBsline5MW_OC3Hywind_HydroDyn.dat
```

SLAVE (<program>) <file > SWAP <this> TO <that>

This command is used for swapping the string <this> to <that> in the slave file <file>. The parameter <program> is optional, but if given it must be either openfast or turbsim.

Example of use:

```
SLAVE openfast  5MW_OC3Spar_DLL_WTurb_WavesIrr.fst         &
      SWAP    NRELOffshrBsline5MW_OC3Hywind_MAP.dat    TO  &
              NRELOffshrBsline5MW_OC3Hywind_MoorDyn.dat
```

SLAVE (<program>) <file> &
<par1> <var1> <var2> … <varN> &
<par2> <var1> <var2> … <varN> ….

Command used to manipulate the different slave files. The parameters <par> must exist in the given slave file and the parameters will be updated with list given, one for each openfast analysis, i.e. the length of the list must correspond to the expand parameter as given in the IDENTIFICATION command. If the variables are constant for all the runs a shorthand way of issuing the command is to end the list with a plus sign.

Example of use:

```
SLAVE openfast NRELOffshrBsline5MW_OC3Hywind_HydroDyn.dat   &
   CurrMod   1  +         &
   CurrDIV   0.25  0.50  0.75  1.00  1.25  1.50  1.75  2.0
```

In the example CurrMod is constant and equal to 1 for all the openfast analyses. CurrDIV is varied a total number equal to the expand parameter. CurrMod could of course be issued as CurrMod 1 1 1 1 …, However if a parameter is constant for all the runs it will have some merits to apply the + option instead when it comes to displaying the results by the LIST command.

ANALYSIS <ON or OFF> (SIMUL <ON or OFF>)

In order to automatically run Openfast in the background then ANALYSIS ON must be issued. The optional SIMUL command should rarely be used and is implemented for convenience purposes for development of the software. By issuing ANALYSIS ON SIMUL OFF, then all the openfast files will be updated, but the simulation, i.e. openfast, will not be performed. This is a feature that might be helpful if a quality checks of the generated files is needed prior of running openfast. The default is ANALYSIS OFF, i.e. if the command is not issued, then no openfast analyses will be performed.

MOORING <mooring lines> SEG <segments>

Command used to issue number of mooring lines and number of segments of each line. If the command is issued, then the mooring line results will be read for later display of results. For the results to be read the ‘pt’ option needs to be set in the moordyn file. E.g.:

```
---------------------- LINE PROPERTIES -------------------------------------

3        NLines    - number of line objectsLine    LineType  UnstrLen  NumSegs
NodeAnch  NodeFair  Outputs  CtrlChan
(-)       (-)       (m)       (-)       (-)       (-)       (-)       (-)
1         main     893.0      20        1         4         pt        0
2         main     893.0      20        2         5         pt        0
3         main     893.0      20        3         6         pt        0
```

Example of use:

```
MOORING 3 SEG 20
```

LIST CHANNEL

The LIST CHANNEL command as a standalone command will list the available channels, i.e. their names and also the units for each channel.

LIST STATISTICS <channel_Id1> <channel_Id2> …

This command will list some statistics for the issued channels, i.e. minimum, maximum, mean and standard deviation for the time series.

LIST LOAD (ALL) 1 2 3 …

This command will load a list of Openfast run for the LIST CHANNEL command. The command LIST LOAD ALL will load all the available Openfast run.

LIST CHANNEL (FILE) (ALL) <channel_Id1> <channel_Id2> …

This will list the time series results for the issued channels and for the Openfast run that is loaded by the LIST LOAD command. If the option FILE is issued the results will be listed on separate files with file names corresponding to the identification of the analyses.

LIST MOORING

This will list the mooring line results. The command provides that number of lines and segments are known, i.e. the MOORING command is already issued.

CLEAN

This command will delete all the generated input files as well as their corresponding output files as generated from turbsim and openfast.

Full example

Faster input file:

```
**
** Faster input file
**
** Prepare openfast files and run the analyses.
**
**-------------------------------------------------------------------
** Assign ID and number of openfast analyses.
**-------------------------------------------------------------------
  id VARY expand 2
**
maestro openfast 5MW_OC3Mnpl_DLL_WTurb_WavesIrr.fst
maestro turbsim ../5MW_Baseline/wind/90m_12mps_twr.inp
**-------------------------------------------------------------------
** Assign Master along with the slaves.
** could be more than 1 slave file for each master.
**-------------------------------------------------------------------

 MASTER 5MW_OC3Mnpl_DLL_WTurb_WavesIrr.fst &
 SLAVES ../5MW_Baseline/NRELOffshrBsline5MW_InflowWind_12mps.dat

 MASTER ../5MW_Baseline/NRELOffshrBsline5MW_InflowWind_12mps.dat &
 SLAVES ../5MW_Baseline/Wind/90m_12mps_twr.inp

**-------------------------------------------------------------------
** Assign parameters to the slave files. Each parameter to be
** assigned n values where n is number of openfast analyses.
**-------------------------------------------------------------------
**
 SLAVE ../5MW_Baseline/wind/90m_12mps_twr.inp  &
 URef 3 5

 ANALYSIS ON
```

Notes:

- The id is VARY (note 4 characters) and 2 openfast analyses are requested. No identification is issued. It is however recommended that some user defined identification is issued, e.g. type of analyses, date of run, type of turbine, or whatever comes to mind.
- Maestro files for both openfast and turbsim is issued. The Faster program will check if a maestro for openfast is issued. However, this is not the case for turbsim. Thus, in order to run turbsim prior of openfast it is crucial that the maestro file for turbsim is issued.
- The master `5MW_OC3Mnpl_DLL_WTurb_WavesIrr.fst` have one slave `../5MW_Baseline/NRELOffshrBsline5MW_InflowWind_12mps.dat`. The command will generate files with names that includes the id, i.e. in this case VARY. For the example the file `5MW_OC3Mnpl_DLL_WTurb_WavesIrr_VARY_1.fst` will include a slave with name `../5MW_Baseline/NRELOffshrBsline5MW_InflowWind_12mps_VARY_1.dat`. These files will then be used by openfast for the first run.
- Another master is issued, i.e. `../5MW_Baseline/NRELOffshrBsline5MW_InflowWind_12mps.dat`. In this example this master is the file that was issued as a slave in the previous command. This is fully legal and makes it possible to create master/slave relations with arbitrary depth.
- The slave file `../5MW_Baseline/wind/90m_12mps_twr.inp` will be assigned 2 separate values for the parameter URef (3 and 5) that will be used for the 2 openfast analyses as requested.

In the example as given the LIST command is not issued. This could be included, however when the openfast analyses is finished, all the results as generated by Openfast will be stored on binary files for later access. In the example as given the files VARY_FAST.BIN, VARY_KEYS.BIN and VARY_USER.BIN will contain the results as produced by Openfast for all the analyses. Faster is simply run by issuing:
faster<input_file.inp>output_file.out
in a command window. The binary files must be accessible on the directory. Faster can of course be run by omitting the output file in which case the output will be written to the screen.

By running Faster by the simple input file:

```
id VARY
list stat Wind1VelX RotSpeed
```

the statistics for the channels Wind1VelX and RotSpeed will be produced.

Another example for the listing command would be:

```
id VARY
LIST LOAD 1 2
LIST channel Wind1VelX RotSpeed
```

that will list the time series results for Wind1VelX and RotSpeed for run 1 and 2.

Another quite straight forward example:

```
**
** Faster input file
**
**-------------------------------------------------------------------
** Assign ID and number of openfast analyses.
**-------------------------------------------------------------------
ID BMEL expand 7
**
MAESTRO OPENFAST 5MW_Land_DLL_WTurb.fst
**-------------------------------------------------------------------
** Assign Master along with the slaves.
** Could be more than 1 slave file for each master.
**-------------------------------------------------------------------
MASTER 5MW_Land_DLL_WTurb.fst &
   SLAVE  NRELOffshrBsline5MW_Onshore_ElastoDyn.dat
**
**-------------------------------------------------------------------
** Assign parameters to the slave files. Each parameter to be
** assigned n values where n is number of openfast analyses.
*-------------------------------------------------------------------
 SLAVE openfast NRELOffshrBsline5MW_Onshore_ElastoDyn.dat &
          BlPitch(1)  0 15 30 45 60 75 90  &
          BlPitch(2)  0 15 30 45 60 75 90  &
          BlPitch(3)  0 15 30 45 60 75 90
**
** A slave could also be it's own master, e.g.:
SLAVE openfast 5MW_Land_DLL_WTurb.fst &
CompAero   2 + &
CompInflow 1 +
**
** List channel results
LIST LOAD 1 2 3 4 5 6 7
LIST channel TTDspFA
**
** Perform openfast analysis (ON or OFF)
Analysis on simul on
***********************************
```

And then a quick and minimalistic example:

```
id SIMP expand 1 'my simple faster'
maestro openfast IEA-10.0-198-RWT.fst
anal on
list stat GenPwr
```

which will just run the Openfast file IEA-10.0-198-RWT.fst and then list statistics for the channel GenPwr.

If the command CLEAN is used, e.g. with an input file like:

```
id SIMP
clean
```

then all traces of the Openfast analyses as produced by Faster will be deleted, this also includes the output files from Openfast.

However, they may be recreated by issuing:

```
id SIMP
list load all
list chan file all
```

It should be noted that the *.sum and *.ech files generated by Openfast will be lost forever.

By issuing ANAL OFF along with the LISTING command in the same input file, then Faster will just skip everything and assume that results are already available and ready to be listed.