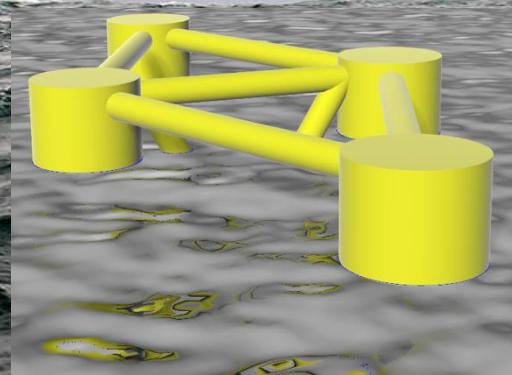




UMERC 2024 – OpenFAST Workshop  
*Installation and Running*

August 7, 2024



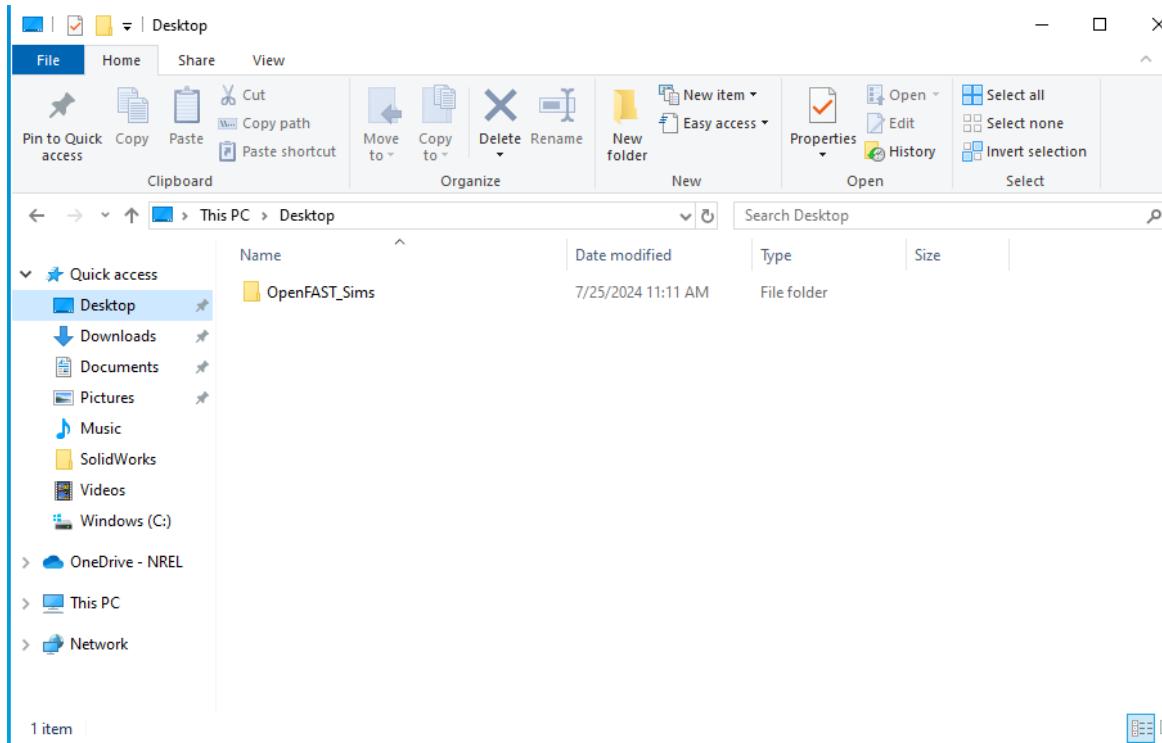
# Installation

Instructions at: <https://openfast.readthedocs.io/en/main/source/install/index.html>

- Options for precompiled binaries:
  - Conda installation
  - Homebrew installation
  - Download releases on Github (Windows only)
- Compile from source - <https://github.com/OpenFAST>

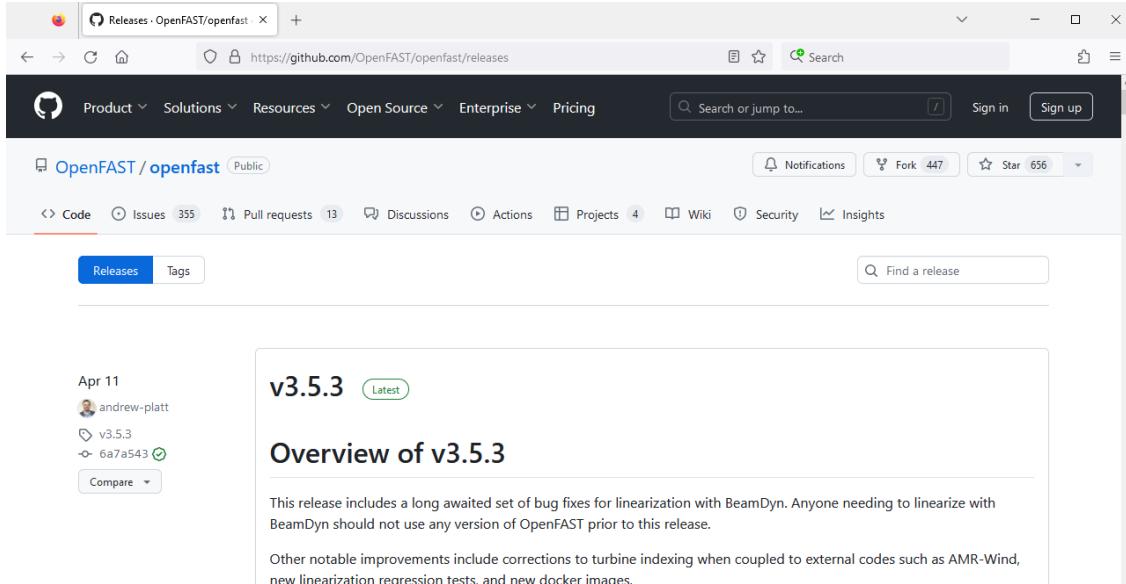
# Windows

1. Create a new folder for your OpenFAST simulations. I've created a folder on the desktop called "OpenFAST\_Sims", but you may want to create the folder in a different location.



# Windows

2. Go to the OpenFAST releases GitHub page: <https://github.com/OpenFAST/openfast/releases>. The latest release will be shown at the top of the page.



# Windows

3. Scroll down to the “Assets” header. Note that each version has its own set of Assets, so make sure to select the most recent version, unless you intentionally want to use an older release.

The screenshot shows a Microsoft Edge browser window displaying the 'Precompiled Windows Binaries' section of the OpenFAST GitHub releases page. The URL in the address bar is <https://github.com/OpenFAST/openfast/releases>. The page content includes:

- A heading "Precompiled Windows Binaries".
- A note about the build environment: "The binary files in this release were built with the Visual Studio solution files distributed with OpenFAST (not using cmake), using:
  - Intel Fortran compiler 2021 (Update 2, [\\_oneAPI\\_2021.2.0.243](#)) with Microsoft Visual Studio Community 2019
  - Microsoft Visual C++ 2019 (C), for build in Matlab
  - MATLAB Version: 9.9.0.1857802 (R2020b) Update 7
  - Executables with `_OpenMP` or `_OMP` in the name are built with OpenMP libraries and linked with dynamic libraries.
    - You will need [this Intel Fortran redistributable package](#) installed to use these executables if you do not already have Intel Fortran OneAPI 2021 installed. See the installation instructions [here](#).
    - You may also need [a redistributable library for Visual Studio](#) installed. See instructions [here](#).
- A note below: "The other OpenFAST executables DO NOT require these redistributable libraries to be installed. Instead, they were built with static libraries."
- A "Contributors" section showing profile icons for several contributors.
- A "Assets" section with a table listing 24 files:

File	Size	Last Modified
<a href="#">AeroDyn_Driver_x64.exe</a>	33.9 MB	Apr 12
<a href="#">AeroDyn_Driver_x64_OpenMP.exe</a>	33.7 MB	Apr 12
<a href="#">AeroDyn_Inflow_c_binding_x64.dll</a>	34 MB	Apr 12
<a href="#">AeroDyn_Inflow_c_binding_x64_OpenMP.dll</a>	33.8 MB	Apr 12
<a href="#">BeamDyn_Driver_x64.exe</a>	26.8 MB	Apr 12
<a href="#">Discon.dll</a>	570 KB	Apr 12
<a href="#">Discon_ITIBarge.dll</a>	571 KB	Apr 12
<a href="#">Discon_OC3Hywind.dll</a>	570 KB	Apr 12
...	...	...

# Windows

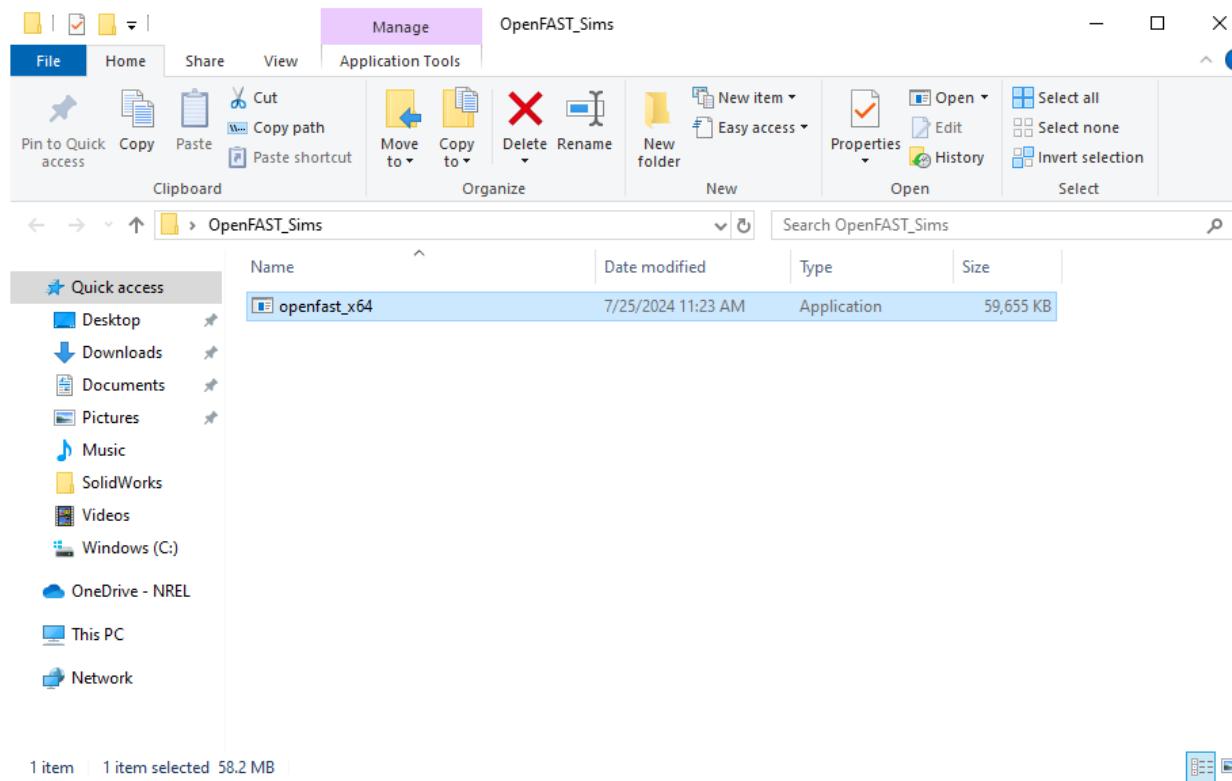
4. There is a list of executables corresponding to the different ways you can run OpenFAST or the individual modules. Here, we will install only the main OpenFAST program (`openfast_x64.exe`).

Assets <span style="font-size: small;">24</span>		
	<a href="#">AeroDyn_Driver_x64.exe</a>	33.9 MB
	<a href="#">AeroDyn_Driver_x64_OpenMP.exe</a>	33.7 MB
	<a href="#">AeroDyn_Inflow_c_binding_x64.dll</a>	34 MB
	<a href="#">AeroDyn_Inflow_c_binding_x64_OpenMP.dll</a>	33.8 MB
	<a href="#">BeamDyn_Driver_x64.exe</a>	26.8 MB
	<a href="#">Discon.dll</a>	570 KB
	<a href="#">Discon_ITIBarge.dll</a>	571 KB
	<a href="#">Discon_OC3Hywind.dll</a>	570 KB
	<a href="#">Discon_SC.dll</a>	570 KB
	<a href="#">FAST.Farm_x64.exe</a>	68.9 MB
	<a href="#">FAST.Farm_x64_OpenMP.exe</a>	67.9 MB
	<a href="#">FAST_SFunc.mexw64</a>	128 KB
	<a href="#">HydroDynDriver_x64.exe</a>	30 MB
	<a href="#">HydroDyn_c_binding_x64.dll</a>	30 MB
	<a href="#">InflowWind_c_binding_x64.dll</a>	26 MB
	<a href="#">InflowWind_driver_x64.exe</a>	26.1 MB
	<a href="#">InflowWind_driver_x64_OpenMP.exe</a>	26.1 MB
	<a href="#">MoorDynDriver_x64.exe</a>	26.7 MB
	<a href="#">MoorDyn_c_binding_x64.dll</a>	26.6 MB
	<a href="#">OpenFAST-Simulink_x64.dll</a>	60.1 MB
	<a href="#">openfast_x64.exe</a>	58.3 MB
	<a href="#">TurbSim_x64.exe</a>	25.3 MB
	<a href="#">Source code (zip)</a>	Apr 11
	<a href="#">Source code (tar.gz)</a>	Apr 11

1 5 people reacted 0 Join discussion

# Windows

5. Click on “openfast\_x64.exe” and find the downloaded file (most likely in your Downloads folder). Move this file to the folder you created to host your OpenFAST simulations.



6. This is all that is required to install OpenFAST on Windows.

1. OpenFAST can be installed through conda, which requires an Anaconda installation. If Anaconda is already installed on your system, you can skip to step 3. There are several different ways to install Anaconda. One option is directly through the Anaconda website (<https://www.anaconda.com/download>). You can hit “skip registration” if you prefer not to provide your email address.

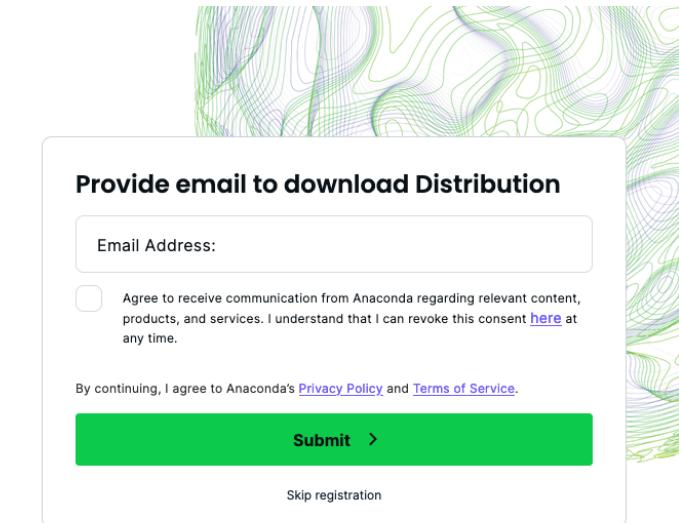
## Distribution

### Free Download\*

Register to get everything you need to get started on your workstation including Cloud Notebooks, Navigator, AI Assistant, Learning and more.

- Easily search and install thousands of data science, machine learning, and AI packages
- Manage packages and environments from a desktop application or work from the command line
- Deploy across hardware and software platforms
- Distribution installation on Windows, MacOS, or Linux

\*Use of Anaconda's Offerings at an organization of more than 200 employees requires a Business or Enterprise license. See [Pricing](#)



Provide email to download Distribution

Email Address:

Agree to receive communication from Anaconda regarding relevant content, products, and services. I understand that I can revoke this consent [here](#) at any time.

By continuing, I agree to Anaconda's [Privacy Policy](#) and [Terms of Service](#).

**Submit >**

Skip registration

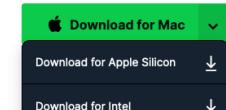
# Mac

1b. Then, choose the “Mac” download and select either “Download for Apple Silicon” or “Download for Intel”, depending on your processor. Instructions for determining your processor type can be found here: <https://support.xtool.com/article/643>.

## Download Now

For installation assistance, refer to [Troubleshooting](#).

Download Distribution by choosing the proper installer for your machine.



### Anaconda installers



#### Windows

##### Python 3.12

64-Bit Graphical Installer (912.3M)



#### Mac

##### Python 3.12

64-Bit (Apple silicon) Graphical Installer (704.7M)

64-Bit (Apple silicon) Command Line Installer (707.3M)

64-Bit (Intel chip) Graphical Installer (734.7M)



#### Linux

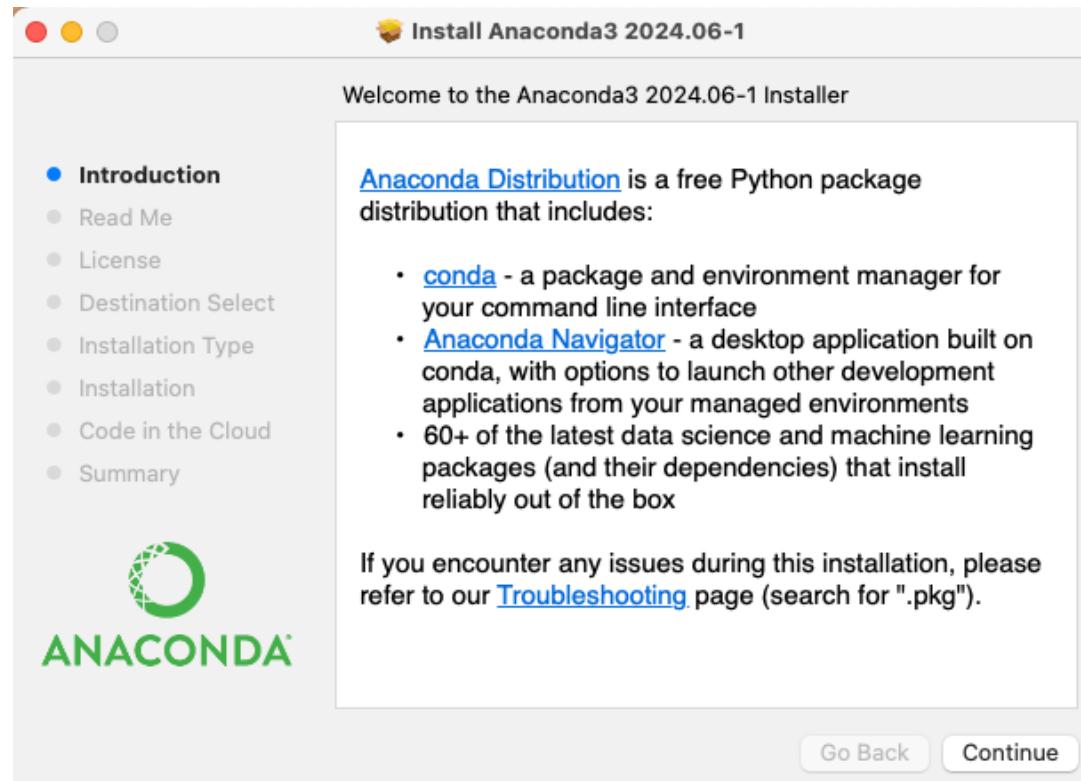
##### Python 3.12

64-Bit (x86) Installer (1007.9M)

64-Bit (AWS Graviton2 / ARM64) Installer (800.6M)

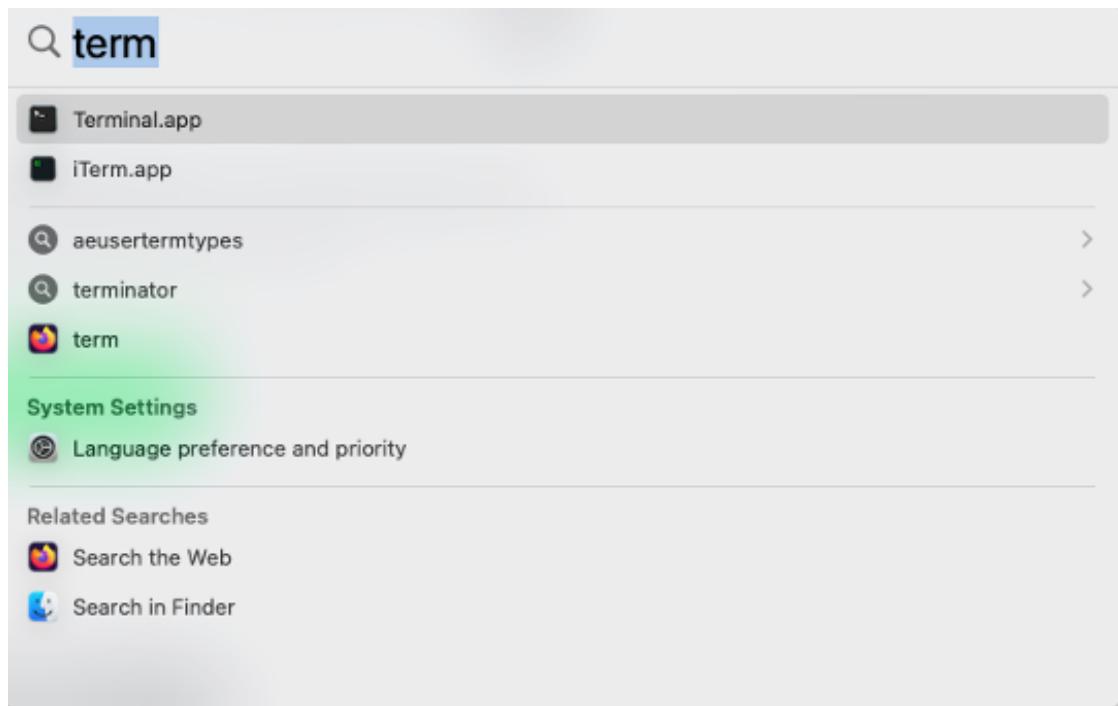
64-bit (Linux on IBM Z & LinuxONE) Installer (425.8M)

1c. Find the installer download in your Downloads folder, and double click on it. Follow the prompts to install Anaconda. Selecting the default install options when relevant should be sufficient.



\* Another option to install Anaconda is through the Homebrew package manager. Detailed instructions for this method will not be covered in this video but can be found here:  
<https://medium.com/ayuth/install-anaconda-on-macos-with-homebrew-c94437d63a37>.

2. Now test that your Anaconda installation is successful. Open a terminal by searching for and opening “Terminal.app” (the default Mac terminal), or your preferred terminal if others are installed.



A screenshot of a Terminal window. The title bar shows "hross — hross@hross-38546s ~ zsh 80x24". The window displays the following text:  
Last login: Tue Jul 23 09:26:32 on ttys002  
NOTICE TO USERS:  
~ > [REDACTED]

2b. Type `conda list` into the terminal. This command displays a list of packages installed in your active environment and their versions and will only execute if your Anaconda installation is successful.



A screenshot of a Mac OS X terminal window. The title bar shows the user's name and session information: "hross — hross@hross-38546s — ~ — zsh — 80x24". The terminal window contains the output of the `conda list` command, which lists various Python packages and their details:

```
[~ > conda list
# packages in environment at /opt/homebrew/Caskroom/miniforge/base:
#
# Name          Version      Build  Channel
archspec        0.2.2       pyhd8ed1ab_0  conda-forge
boltons         23.1.1      pyhd8ed1ab_0  conda-forge
brotli-python   1.1.0       py310h1253130_1  conda-forge
bzip2           1.0.8       h93a5062_5   conda-forge
c-ares          1.24.0      h93a5062_0   conda-forge
ca-certificates 2023.11.17 hf0a4a13_0   conda-forge
certifi          2023.11.17 pyhd8ed1ab_0  conda-forge
cffi             1.16.0      py310hdcd7c05_0  conda-forge
charset-normalizer 3.3.2      pyhd8ed1ab_0  conda-forge
colorama         0.4.6       pyhd8ed1ab_0  conda-forge
conda            23.11.0      py310hbe9552e_1  conda-forge
conda-libmamba-solver 23.12.0      pyhd8ed1ab_0  conda-forge
conda-package-handling 2.2.0      pyh38be061_0   conda-forge
conda-package-streaming 0.9.0      pyhd8ed1ab_0  conda-forge
```

### 3. Now, create a new conda environment for OpenFAST:

```
conda create -n openfast_env
```



```
hross — hross@hross-38546s — ~ — zsh — 106x42
[~ > conda create -n openfast_env

Channels:
  - conda-forge
Platform: osx-arm64
Collecting package metadata (repodata.json): done
Solving environment: done

==> WARNING: A newer version of conda exists. <==
      current version: 23.11.0
      latest version: 24.5.0

Please update conda by running
$ conda update -n base -c conda-forge conda

## Package Plan ##
environment location: /opt/homebrew/Caskroom/miniforge/base/envs/openfast_env

Proceed ([y]/n)? y

Preparing transaction: done
Verifying transaction: done
Executing transaction: done
#
# To activate this environment, use
#
#     $ conda activate openfast_env
#
# To deactivate an active environment, use
#
#     $ conda deactivate
~ >
```

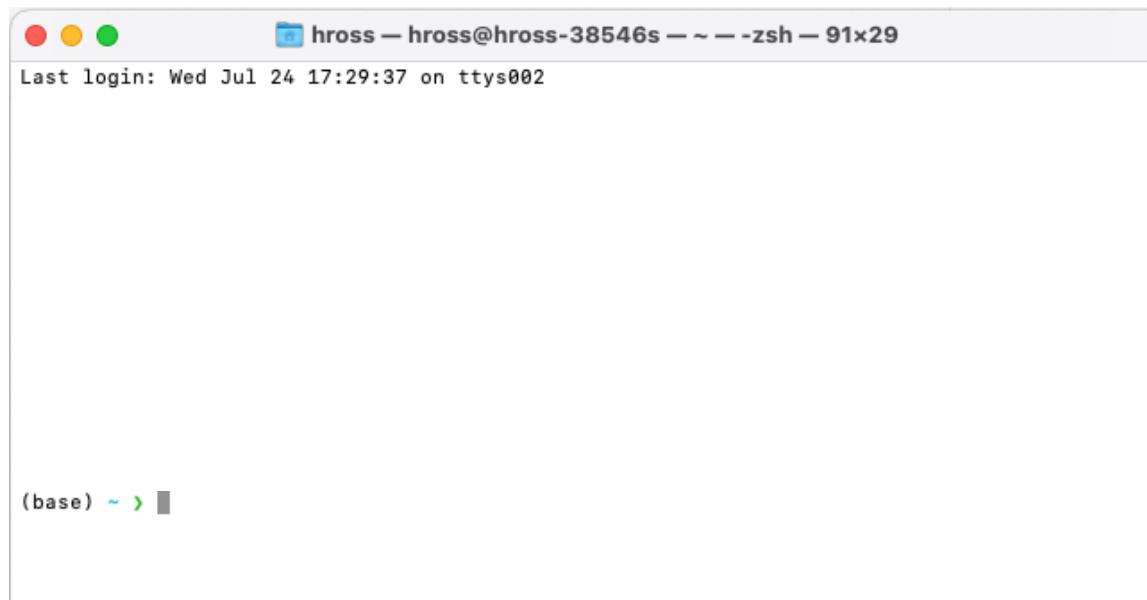
## 3b. Run conda init zsh



```
[~ > conda init zsh
no change    /opt/homebrew/Caskroom/miniforge/base/condabin/conda
no change    /opt/homebrew/Caskroom/miniforge/base/bin/conda
no change    /opt/homebrew/Caskroom/miniforge/base/bin/conda-env
no change    /opt/homebrew/Caskroom/miniforge/base/bin/activate
no change    /opt/homebrew/Caskroom/miniforge/base/bin/deactivate
no change    /opt/homebrew/Caskroom/miniforge/base/etc/profile.d/conda.sh
no change    /opt/homebrew/Caskroom/miniforge/base/etc/fish/conf.d/conda.fish
no change    /opt/homebrew/Caskroom/miniforge/base/shell/condabin/Conda.psm1
no change    /opt/homebrew/Caskroom/miniforge/base/shell/condabin/conda-hook.ps1
no change    /opt/homebrew/Caskroom/miniforge/base/lib/python3.10/site-packages/xontrib/conda.xsh
no change    /opt/homebrew/Caskroom/miniforge/base/etc/profile.d/conda.csh
no change    /Users/hross/.zshrc
No action taken.
~ > ]
```

\* Note that zsh may need to be replaced by your shell name, which should be displayed at the top of your terminal.

## 4. Close and reopen your terminal



5. Activate the environment: `conda activate openfast_env`



A screenshot of a terminal window on a Mac OS X desktop. The window title bar reads "hross — hross@hross-38546s — ~ — zsh — 91x29". Below the title bar, the status bar shows "Last login: Wed Jul 24 17:29:37 on ttys002". The main terminal area displays the command: `(base) ~ > conda activate openfast_env`. The output shows the environment being activated: `(openfast_env) ~ >`. The terminal has its characteristic blue header and gray body, with red, yellow, and green window control buttons at the top left.

6. Install OpenFAST: `conda install -c conda-forge openfast`. This will install the most recent version of OpenFAST.

```
hross — hross@hross-38546s — — -zsh — 91x29
[(openfast_env) ~ > conda install -c conda-forge openfast
Channels:
- conda-forge
Platform: osx-arm64
Collecting package metadata (repodata.json): done
Solving environment: done

==> WARNING: A newer version of conda exists. <==
    current version: 23.11.0
    latest version: 24.5.0

Please update conda by running

$ conda update -n base -c conda-forge conda

## Package Plan ##

environment location: /opt/homebrew/Caskroom/miniforge/base/envs/openfast_env
added / updated specs:
- openfast
```

7. Test that OpenFAST was installed correctly: `which openfast`. This will display the installation location.

```
hross — hross@hross-38546s — ~ — zsh — 91x29

The following packages will be downloaded:


| package       | build      |                    |
|---------------|------------|--------------------|
| libcxx-18.1.8 | h167917d_0 | 1.2 MB conda-forge |
|               | Total:     | 1.2 MB             |



The following NEW packages will be INSTALLED:

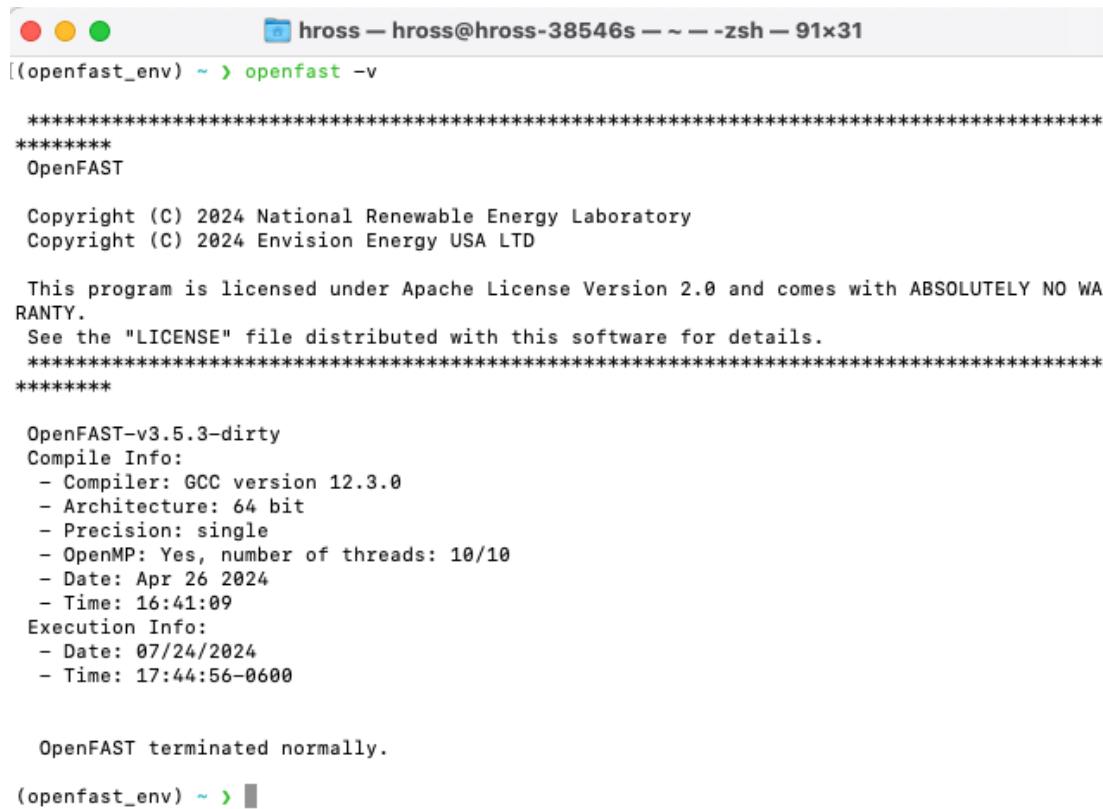
  libcxx      conda-forge/osx-arm64::libcxx-18.1.8-h167917d_0
  libgfortran  conda-forge/osx-arm64::libgfortran-5.0.0-13_2_0_hd922786_3
  libgfortran5 conda-forge/osx-arm64::libgfortran5-13.2.0-hf226fd6_3
  llvm-openmp   conda-forge/osx-arm64::llvm-openmp-18.1.8-hde57baf_0
  openfast     conda-forge/osx-arm64::openfast-3.5.3-hbd8d116_0

Proceed ([y]/n)? y

Downloading and Extracting Packages:

Preparing transaction: done
Verifying transaction: done
Executing transaction: done
[(openfast_env) ~ > which openfast
/opt/homebrew/Caskroom/miniforge/base/envs/openfast_env/bin/openfast
(openfast_env) ~ >
```

7b. You can also run `openfast -v`, which will display version information. Successful running of these commands indicates that OpenFAST was installed.



```
hross — hross@hross-38546s — ~ — zsh — 91x31
(openfast_env) ~ > openfast -v

*****
***** OpenFAST
***** Copyright (C) 2024 National Renewable Energy Laboratory
***** Copyright (C) 2024 Envision Energy USA LTD
***** This program is licensed under Apache License Version 2.0 and comes with ABSOLUTELY NO WAR
***** RANTY.
***** See the "LICENSE" file distributed with this software for details.
***** *****
***** OpenFAST-v3.5.3-dirty
***** Compile Info:
*****   - Compiler: GCC version 12.3.0
*****   - Architecture: 64 bit
*****   - Precision: single
*****   - OpenMP: Yes, number of threads: 10/10
*****   - Date: Apr 26 2024
*****   - Time: 16:41:09
***** Execution Info:
*****   - Date: 07/24/2024
*****   - Time: 17:44:56-0600

***** OpenFAST terminated normally.

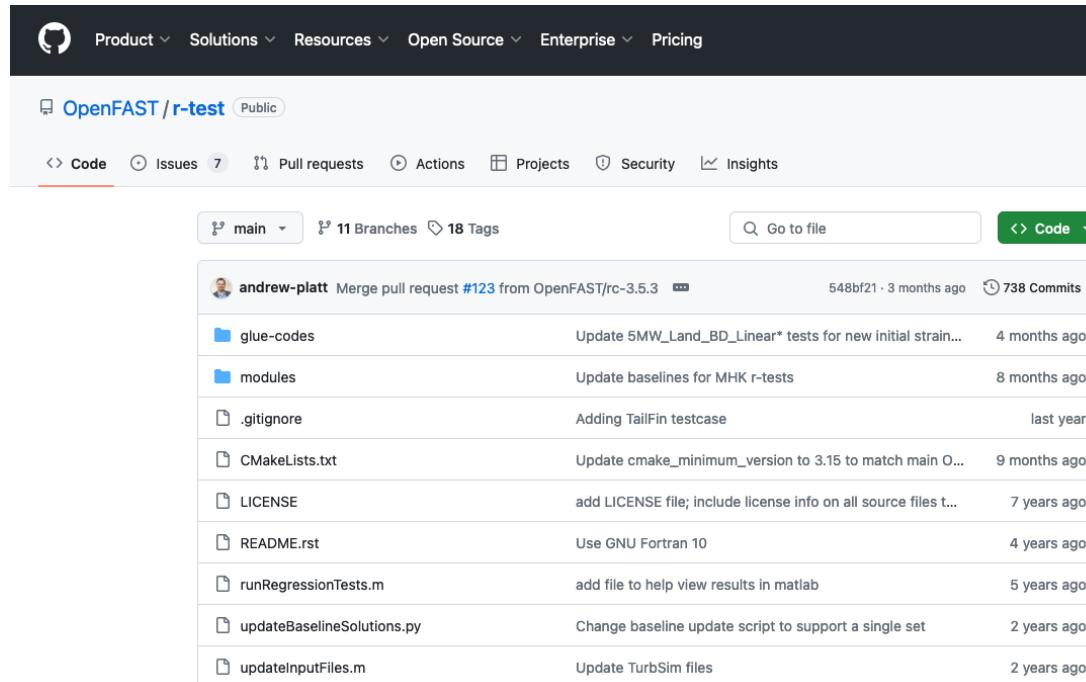
(openfast_env) ~ >
```

8. After working with OpenFAST, you can simply close the terminal.

Note that this method will also install module drivers, if available. These allow you to run individual modules (i.e., AeroDyn, HydroDyn) on their own.

# Running OpenFAST

1. OpenFAST uses regression test to ensure that developers do not unintentionally change the code when adding new features. These tests are mostly used by developers, but they can also serve as example cases. We will use them here to make sure OpenFAST was installed correctly and to demonstrate running the code. Regression tests are hosted on the OpenFAST GitHub page: <https://github.com/OpenFAST/r-test/tree/main>.



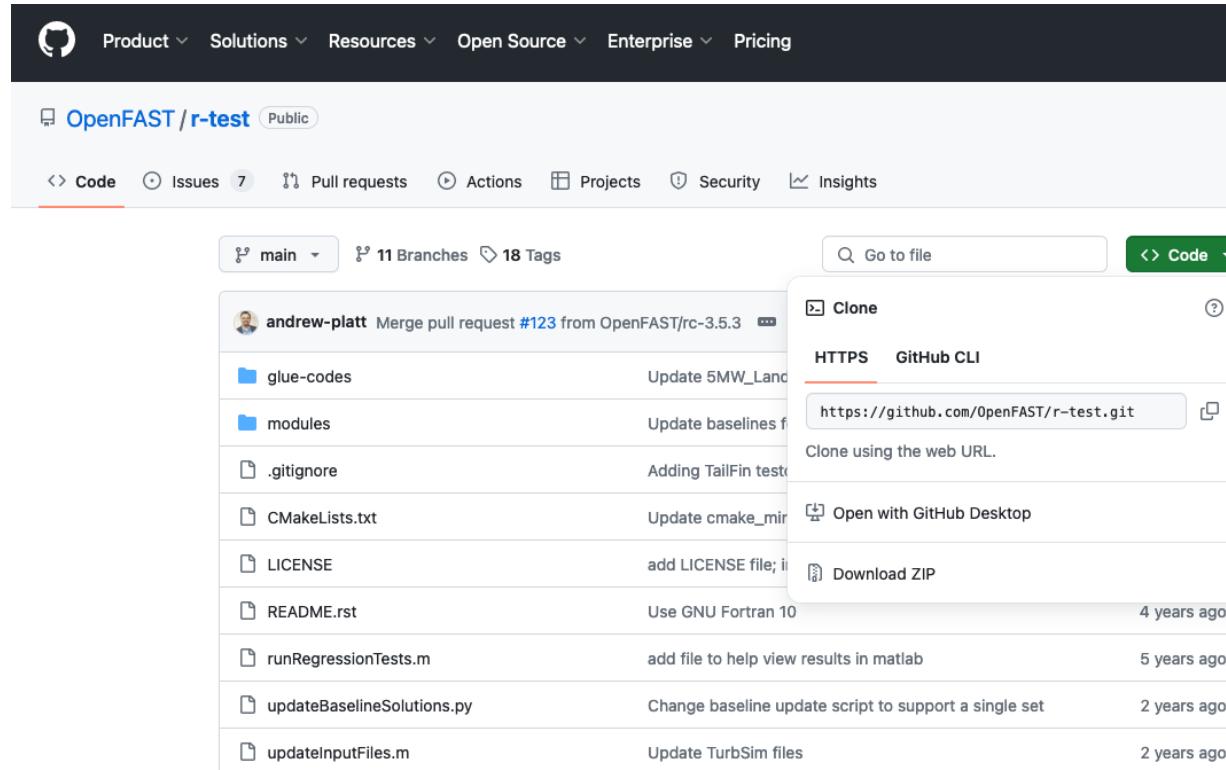
The screenshot shows the GitHub repository 'OpenFAST / r-test' with the 'Code' tab selected. The repository has 11 branches and 18 tags. The commit history is displayed below:

Commit	Message	Date
andrew-platt Merge pull request #123 from OpenFAST/rc-3.5.3	548bf21 · 3 months ago	738 Commits
glue-codes	Update 5MW_Land_BD_Linear* tests for new initial strain...	4 months ago
modules	Update baselines for MHK r-tests	8 months ago
.gitignore	Adding TailFin testcase	last year
CMakeLists.txt	Update cmake_minimum_version to 3.15 to match main O...	9 months ago
LICENSE	add LICENSE file; include license info on all source files t...	7 years ago
README.rst	Use GNU Fortran 10	4 years ago
runRegressionTests.m	add file to help view results in matlab	5 years ago
updateBaselineSolutions.py	Change baseline update script to support a single set	2 years ago
updateInputFiles.m	Update TurbSim files	2 years ago

MHK directory for this demo here:  
[https://github.com/hkross/OpenFAST\\_UMERC\\_Demo](https://github.com/hkross/OpenFAST_UMERC_Demo)

# Running OpenFAST

2. We will be using files from this repository, so we need to download the files to our local machine. This is done by clicking on the green “<> Code” button in the upper right corner of the screen and selecting “Download ZIP”.



This will download a zip folder of all the files in this repository.

# Running OpenFAST

1. Find the zip file, which will most likely be in your downloads folder, and extract it.
2. We will now copy specific files to the location where you will be running simulations. For Windows users, this should be the folder where the openfast\_x64.exe file is located. Mac and Linux users can create a new folder in a preferred location. My folder is named “OpenFAST\_Sims”.
3. We will be working with MHK\_RM1\_Floating

Ideal_Beam_Fixed_Free_Linear	Consolidate baselines
Ideal_Beam_Free_Free_Linear	Consolidate baselines
MHK_RM1_Fixed	Update baselines for MHK r-tests
<b>MHK_RM1_Floating</b>	Update baselines for MHK r-tests
SWRT	Update for MHK buoyancy (#957) (#71)
SWRT_YFree_VS_EDC01	Merge remote tracking branch upstream/dev into feature
SWRT_YFree_VS_EDG01	Merge remote tracking branch upstream/dev into feature
SWRT_YFree_VS_WTurb	Merge remote tracking branch upstream/dev into feature

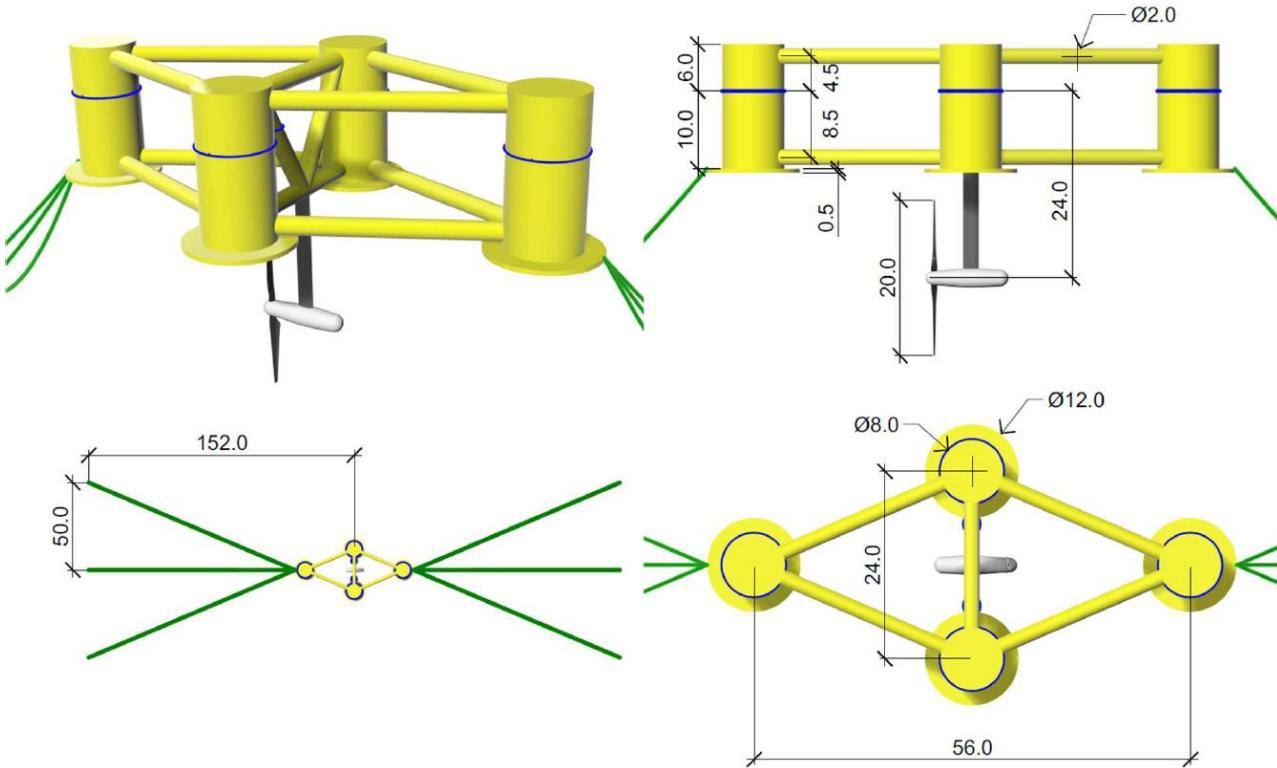
# Floating RM1 Quad

## RM1 Turbine

- 500 kW reference turbine designed by national labs in 2011
- 2-bladed
- Variable speed – variable pitch
- 20 m rotor diameter
- 1.9 m/s rated speed
- Specifications include:
  - Blade structural + aerodynamic properties
  - Nacelle and hub
  - Drivetrain
  - Operating profile

## Floating Quad Platform

- Robust test platform designed by NREL in 2023
- Similar elements to typical FOWT semisubmersible
  - Large diameter columns
  - Heave plates
  - Catenary mooring system
- Fairied tower



	Platform Structure	Platform Structure + Ballast	Platform Structure + Ballast + Tower & RNA
Mass [kg]	1.050e6	2.525e6	2.588e6
COG [m]	[0.0, 0.0, -5.63]	[0.0, 0.0, -6.09]	[-0.02, 0.0, -6.52]
Ixx [kg-m <sup>2</sup> ]	8.866e7	1.952e8	2.155e8
Iyy [kg-m <sup>2</sup> ]	3.408e8	9.194e8	9.403e8
Izz [kg-m <sup>2</sup> ]	3.691e8	1.054e9	1.054e9

[https://github.com/OpenFAST/r-test/tree/dev/glue-codes/openfast/MHK\\_RM1\\_Floating](https://github.com/OpenFAST/r-test/tree/dev/glue-codes/openfast/MHK_RM1_Floating)

# Running OpenFAST

- ElastoDyn Structural dynamics
- BeamDyn
- AeroDyn Turbine hydrodynamics
- InflowWind Current inflow
- SeaState Wave and current field
- ServoDyn
- HydroDyn Platform hydrodynamics
- SubDyn
- MoorDyn Dynamic mooring
- MAP++
- FEAMooring
- OrcaFlexInterface
- IceFloe
- IceDyn

- Steady, 1.9 m/s current
- Power law shear
- No control
- Fixed rotational speed
- Blade, tower, and drivetrain DOFs

# Running OpenFAST

- In a terminal, navigate to the folder containing the relevant OpenFAST executable for your system and the simulation input files
  - For Mac users, run OpenFAST using the following command for the example  
➤ ./openfast\_Mac “Onshore/ MHK\_RM1\_Floating.fst”
  - For Windows users, run OpenFAST using the following command for the example  
➤ openfast\_Windows.exe Onshore\ MHK\_RM1\_Floating.fst
  - For Linux users, run OpenFAST using the following command for the example  
➤ ./openfast\_Linux Onshore/MHK\_RM1\_Floating.fst

\* Just need full relative path of executable and input files

# Running OpenFAST – Input Files

Key input files to look at:

- Primary glue-code input:
  - [`MHK\_RM1\_Floating.fst`](#)
- AeroDyn
  - [`MHK\_RM1\_Floating\_AeroDyn15.dat`](#)
- ElastoDyn
  - [`MHK\_RM1\_Floating\_ElastoDyn.dat`](#)
- HydroDyn
  - [`MHK\_RM1\_Floating\_HydroDyn.dat`](#)

# Running OpenFAST – View Outputs

## Summary files

- OpenFAST (MHK\_RM1\_Floating.sum)
- ElastoDyn (MHK\_RM1\_Floating.sum)
- AeroDyn (MHK\_RM1\_Floating.sum)

## Output file

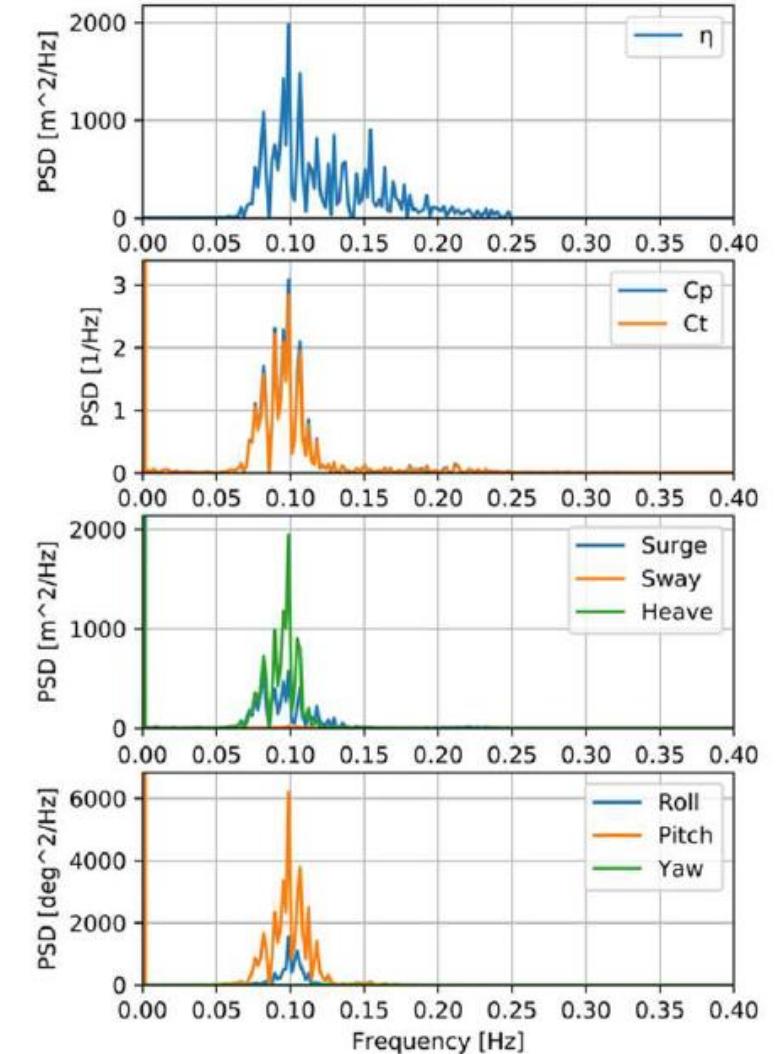
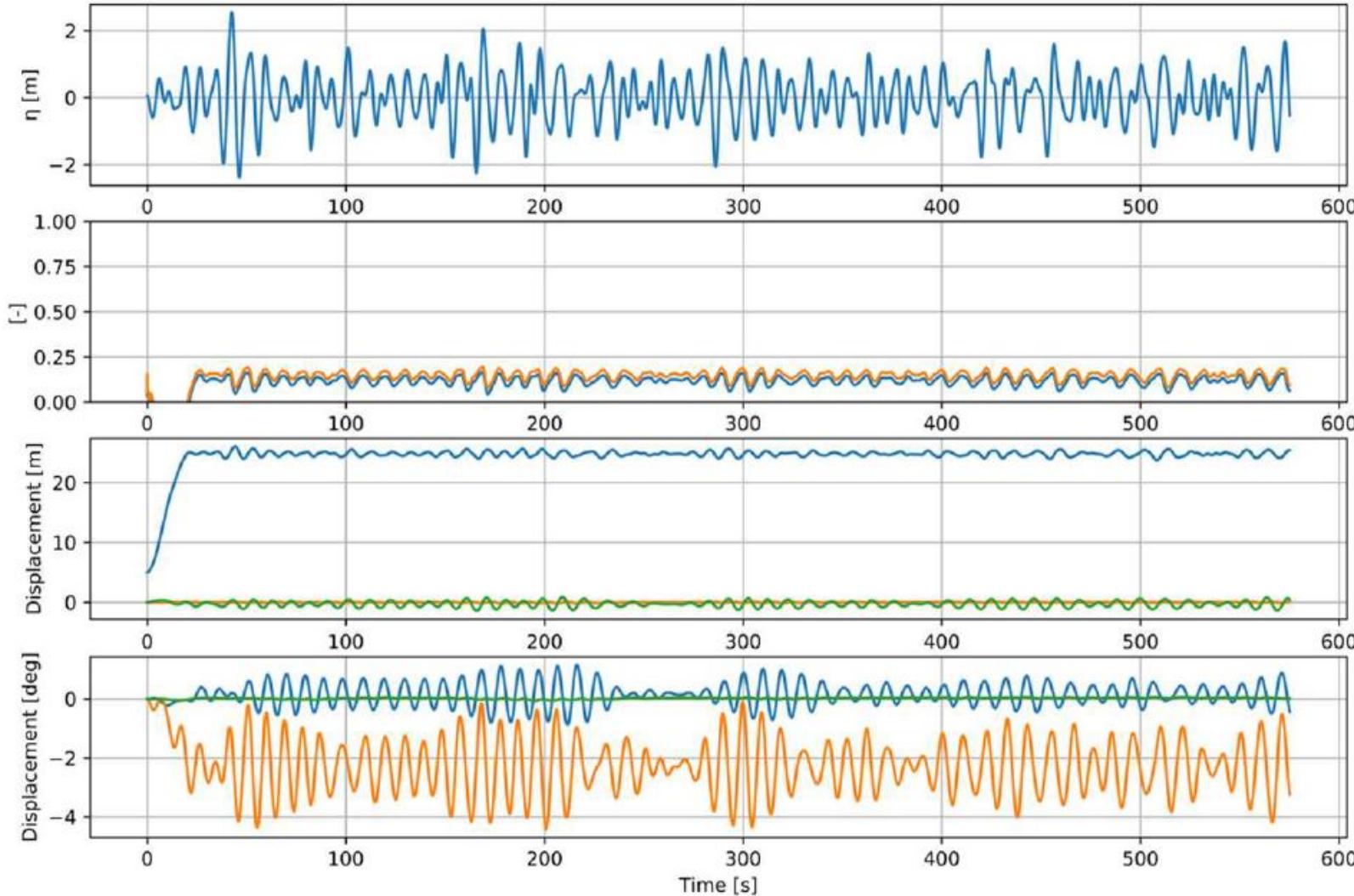
- MHK\_RM1\_Floating.out

Full list of possible outputs:

<https://github.com/OpenFAST/openfast/tree/main/docs/OtherSupporting/OutListParameters.xlsx>

Predictions were generated on 16-Jan-2022 at 20:07:40 using OpenFAST, compiled as a 64-bit application using double precision at commit v3.0.0 linked with NWTc Subroutine Library; ElastoDyn; InflowWind; AeroDyn																	
Description from the FAST input file: MECC OpenFAST Webinar: NREL 5.0 MW Baseline Wind Turbine (Onshore)																	
Time (s)	Wind1VelX (m/s)	Wind1VelY (m/s)	Wind1VelZ (m)	OoPDefl1 (deg)	IPDefl1 (deg)	TwstDefl1 (deg)	BldPitch1 (deg)	Azimuth (deg)	RotSpeed (rpm)	GenSpeed (kN-m)	TTDspFA (kN)	TTDspSS (kN)	TTDspTwst (kN-m)	Spn2MLxb1 (kN-m)	Spn2MLyb1 (kN-m)	RootFxb1 (kN)	RootFyb1 (kN)
0.0000	8.000E+00	-0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.000E+00	8.730E+02	0.000E+00	-0.000E+00	0.000E+00	3.179E+00	-8.463E+00	
0.0125	8.000E+00	-0.000E+00	0.000E+00	4.536E-03	-7.934E-05	0.000E+00	0.000E+00	6.752E-01	9.005E+00	8.730E+02	-6.648E-06	-9.360E-08	0.000E+00	2.637E+00	-1.772E+01		
0.0250	8.000E+00	-0.000E+00	0.000E+00	1.753E-02	-2.317E-04	0.000E+00	0.000E+00	1.351E+00	9.018E+00	8.730E+02	-2.619E-05	-1.031E-06	0.000E+00	-4.740E+00	-1.089E+01		
0.0375	8.000E+00	-0.000E+00	0.000E+00	3.791E-02	-3.428E-04	0.000E+00	0.000E+00	2.027E+00	9.014E+00	8.730E+02	-5.740E-05	-3.834E-06	0.000E+00	-1.259E+01	-1.121E+00		
0.0500	8.000E+00	-0.000E+00	0.000E+00	6.530E-02	-5.111E-04	0.000E+00	0.000E+00	2.703E+00	9.018E+00	8.730E+02	-9.823E-05	-9.546E-06	0.000E+00	-2.322E+01	1.254E+01		
0.0625	8.000E+00	-0.000E+00	0.000E+00	9.902E-02	-8.166E-04	0.000E+00	0.000E+00	3.379E+00	9.020E+00	8.730E+02	-1.460E-04	-1.920E-05	0.000E+00	-3.524E+01	2.920E+01		
0.0750	8.000E+00	-0.000E+00	0.000E+00	1.385E-01	-1.409E-03	0.000E+00	0.000E+00	4.056E+00	9.021E+00	8.730E+02	-1.973E-04	-3.379E-05	0.000E+00	-4.819E+01	4.890E+01		
0.0875	8.000E+00	-0.000E+00	0.000E+00	1.833E-01	-2.459E-03	0.000E+00	0.000E+00	4.732E+00	9.020E+00	8.730E+02	-2.481E-04	-5.421E-05	0.000E+00	-6.136E+01	7.130E+01		
0.1000	8.000E+00	-0.000E+00	0.000E+00	2.329E-01	-4.153E-03	0.000E+00	0.000E+00	5.409E+00	9.018E+00	8.730E+02	-2.940E-04	-8.127E-05	0.000E+00	-7.405E+01	9.622E+01		
0.1125	8.000E+00	-0.000E+00	0.000E+00	2.869E-01	-6.672E-03	0.000E+00	0.000E+00	6.085E+00	9.014E+00	8.730E+02	-3.300E-04	-1.156E-04	0.000E+00	-8.555E+01	1.235E+02		
0.1250	8.000E+00	-0.000E+00	0.000E+00	3.448E-01	-1.018E-02	0.000E+00	0.000E+00	6.761E+00	9.010E+00	8.730E+02	-3.508E-04	-1.577E-04	0.000E+00	-9.529E+01	1.529E+02		
0.1375	8.000E+00	-0.000E+00	0.000E+00	4.063E-01	-1.481E-02	0.000E+00	0.000E+00	7.436E+00	9.004E+00	8.730E+02	-3.510E-04	-2.078E-04	0.000E+00	-1.028E+02	1.843E+02		
0.1500	8.000E+00	-0.000E+00	0.000E+00	4.711E-01	-2.066E-02	0.000E+00	0.000E+00	8.112E+00	8.999E+00	8.730E+02	-3.249E-04	-2.660E-04	0.000E+00	-1.083E+02	2.174E+02		
0.1625	8.000E+00	-0.000E+00	0.000E+00	5.388E-01	-2.777E-02	0.000E+00	0.000E+00	8.786E+00	8.994E+00	8.730E+02	-2.670E-04	-3.322E-04	0.000E+00	-1.102E+02	2.520E+02		
0.1750	8.000E+00	-0.000E+00	0.000E+00	6.086E-01	-3.611E-02	0.000E+00	0.000E+00	9.461E+00	8.989E+00	8.730E+02	-1.719E-04	-4.059E-04	0.000E+00	-1.085E+02	3.070E+02		
0.1875	8.000E+00	-0.000E+00	0.000E+00	6.799E-01	-4.561E-02	0.000E+00	0.000E+00	1.013E+01	8.985E+00	8.730E+02	-3.381E-05	-4.866E-04	0.000E+00	-1.063E+02	3.219E+02		
0.2000	8.000E+00	-0.000E+00	0.000E+00	7.532E-01	-5.617E-02	0.000E+00	0.000E+00	1.081E+01	8.983E+00	8.730E+02	-1.537E-04	-5.737E-04	0.000E+00	-1.006E+02	3.656E+02		
0.2125	8.000E+00	-0.000E+00	0.000E+00	8.280E-01	-6.764E-02	0.000E+00	0.000E+00	1.148E+01	8.983E+00	8.730E+02	-3.964E-04	-6.664E-04	0.000E+00	-9.368E+01	4.036E+02		
0.2250	8.000E+00	-0.000E+00	0.000E+00	9.044E-01	-7.987E-02	0.000E+00	0.000E+00	1.216E+01	8.984E+00	8.730E+02	-6.999E-04	-7.639E-04	0.000E+00	-8.589E+01	4.420E+02		
0.2375	8.000E+00	-0.000E+00	0.000E+00	9.823E-01	-9.269E-02	0.000E+00	0.000E+00	1.283E+01	8.986E+00	8.730E+02	-1.069E-03	-8.651E-04	0.000E+00	-7.733E+01	4.803E+02		
0.2500	8.000E+00	-0.000E+00	0.000E+00	1.061E+00	-1.059E-01	0.000E+00	0.000E+00	1.350E+01	8.990E+00	8.730E+02	-1.510E-03	-9.692E-04	0.000E+00	-6.742E+01	5.224E+02		

# Running OpenFAST – View Outputs

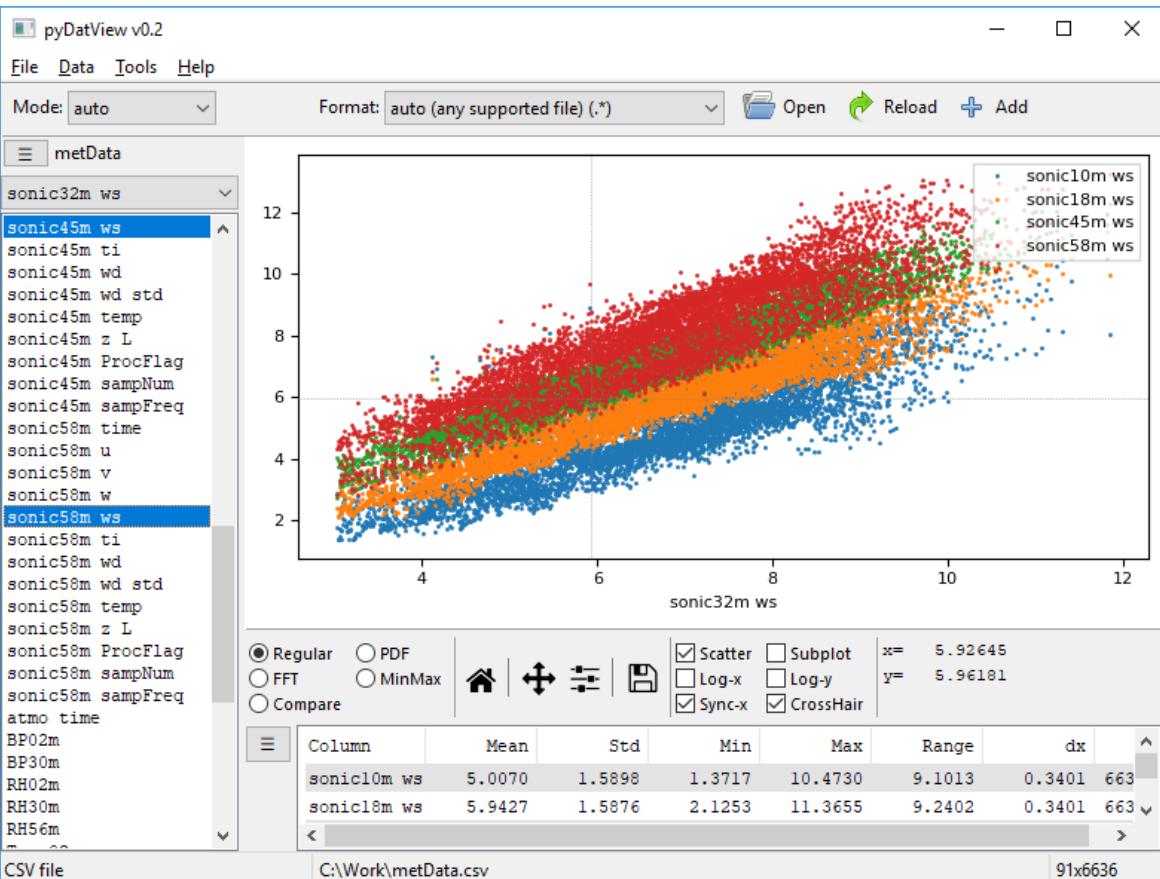


# Running OpenFAST – View Outputs

<https://github.com/ebranlard/pyDatView>

## pyDatView

A crossplatform GUI to display tabulated data from files or python pandas dataframes. It's compatible Windows, Linux and MacOS, with python 3. Some of its features are: multiples plots, FFT plots, probability plots, export of figures... The file formats supported, are: CSV files and other formats present in the [weio](#) library. Additional file formats can easily be added.



# Running OpenFAST – View Outputs

## QuickStart

### Install pyDatView

For Windows users, an installer executable is available [here](#) (look for the latest pyDatView\*.exe)

Linux users can use the command lines below, but first they'll need to install the package python-wxgtk\* (e.g. `python-gtk3.0`) from their distribution:

```
git clone https://github.com/ebranland/pyDatView
cd pyDatView
python -m pip install --user -r requirements.txt
make                                # will run python pyDatView.py
echo "alias pydat='make -C `pwd`'" >> ~/.bashrc
```

MacOS users can use a `brew`, `anaconda` or `virtualenv` version of python and pip, but the final version of python that calls the script needs to have access to the screen (for instance using `pythonw`) (see [details for MacOS](#)). We recommend using conda, in the base environment, for which the following commands should work:

```
conda install -c conda-forge wxpython      # install wxpython
git clone https://github.com/ebranland/pyDatView -b dev
cd pyDatView
python -m pip install --user -r requirements.txt
make                                # will run ./pythonmac pyDatView.py
# OR try
#pythonw pyDatView.py      # NOTE: using pythonw not python
echo "alias pydat='make -C `pwd`'" >> ~/.bashrc  # add an alias for quicklaunch
```

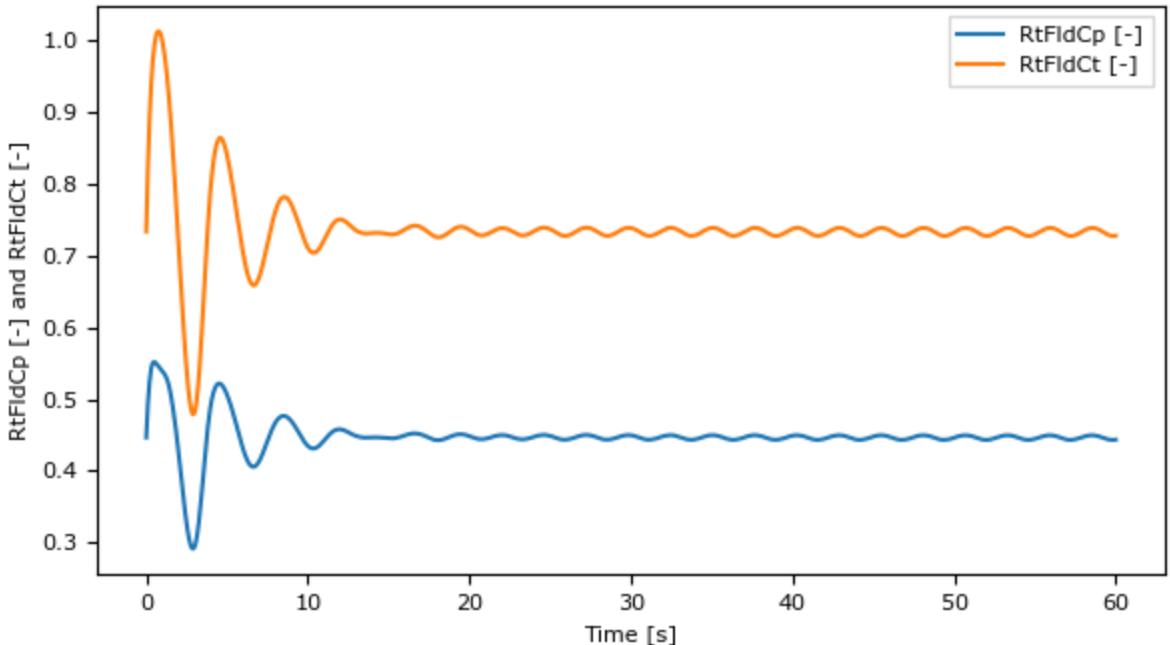
If this fails using the Mac terminal, try the zsh terminal from [VSCode](#) or [iterm2](#). More information about the download, requirements and installation is provided [further down this page](#)

# Running OpenFAST – Input Files

Changes for demonstration:

## Run # 1

1. ElastoDyn
  - a) Turn off all blade DOF's
  - b) Turn off all tower DOF's
  - c) Turn off all platform DOF's
2. Glue-code (.fst)
  - a) Increase dt – 0.025 s
  - b) Increase tmax – 60.0 s
  - c) Set CompMooring to 0
  - d) Dt\_Out – 0.05 s
3. Aerodyn
  - a) Add outputs: "RtFldCp" and "RtFldCt"

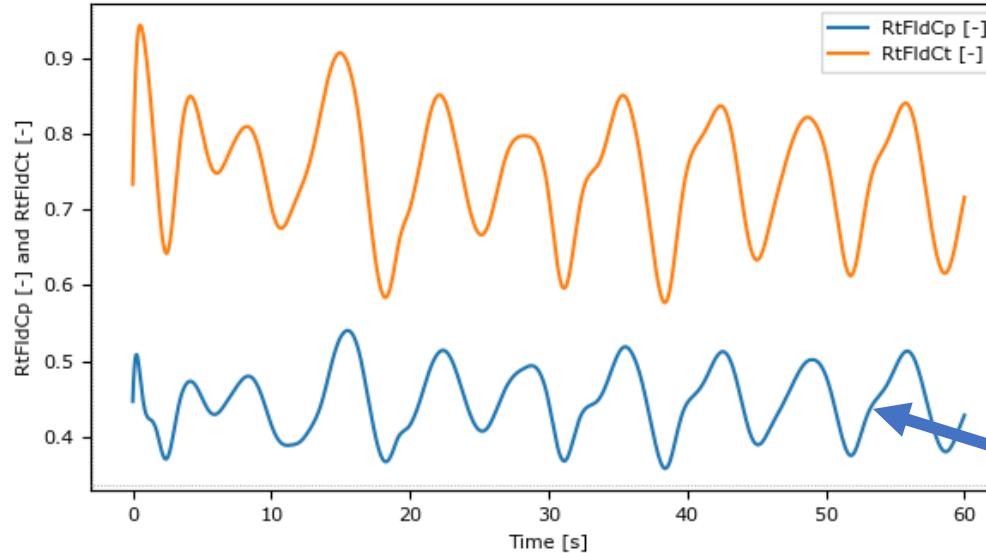


# Running OpenFAST – Input Files

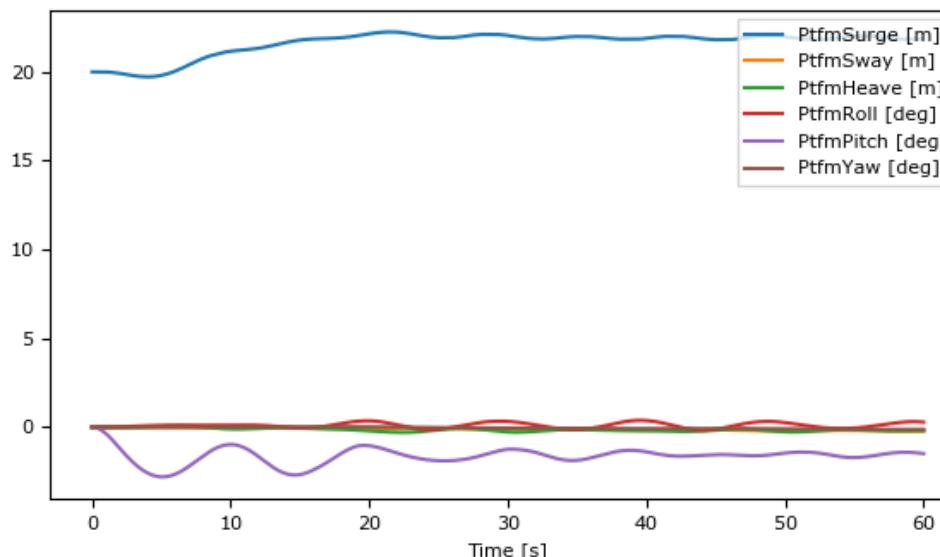
Changes for demonstration:

## Run # 2

1. ElastoDyn
  - a) Turn on all platform DOF's
2. Glue-code (.fst)
  - a) Set CompMooring to 3



Oscillation with  
surge frequency





# Thank You

[www.nrel.gov](http://www.nrel.gov)

NREL/CP-5700-87249  
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Photo from iStock-627281636



# OpenFAST Input File Format

```
----- OpenFAST EXAMPLE INPUT FILE -----
Floating MHK turbine, based on the RM1 tidal current rotor
----- SIMULATION CONTROL -----
False          Echo           - Echo input data to <RootName>.ech (flag)
"FATAL"        AbortLevel    - Error level when simulation should abort (string) {"WARNING", "SEVERE", "FATAL"}
                         6      - Total run time (s)
                         0.003 - Recommended module time step (s)
                         2      - Interpolation order for input/output time history (-) {1=linear, 2=quadratic}
                         5      - Number of correction iterations (-) {0=explicit calculation, i.e., no corrections}
                         99999 - Time between calls to get Jacobians (s)
                         100000 - Scaling factor used in Jacobians (-)
```

- **Description**
  - Brief description, including options/units
- **Keyword**
  - Variable name/identifier
- **Value**
  - Numerical, logical, flag, or string

# OpenFAST Driver Input File

```
----- OpenFAST EXAMPLE INPUT FILE -----
Floating MHK turbine, based on the RM1 tidal current rotor
----- SIMULATION CONTROL -----
False      Echo          - Echo input data to <RootName>.ech (flag)
"FATAL"    AbortLevel   - Error level when simulation should abort (string) {"WARNING", "SEVERE", "FATAL"}
6          Tmax         - Total run time (s)
0.003     DT            - Recommended module time step (s)
2          InterpOrder  - Interpolation order for input/output time history (-) {1=linear, 2=quadratic}
5          NumCrcn      - Number of correction iterations (-) {0=explicit calculation, i.e., no corrections}
99999     DT_UJac      - Time between calls to get Jacobians (s)
1000000   UJacSclFact - Scaling factor used in Jacobians (-)
----- FEATURE SWITCHES AND FLAGS -----
1          CompElast     - Compute structural dynamics (switch) {1=ElastoDyn; 2=ElastoDyn + BeamDyn for blades}
1          CompInflow    - Compute inflow wind velocities (switch) {0=still air; 1=InflowWind; 2=external from OpenFOAM}
2          CompAero      - Compute aerodynamic loads (switch) {0=None; 1=AeroDyn v14; 2=AeroDyn v15}
0          CompServo    - Compute control and electrical-drive dynamics (switch) {0=None; 1=ServoDyn}
1          CompSeaSt    - Compute sea state dynamics (switch) {0=None; 1=SeaDyn}
1          CompHydro    - Compute hydrodynamic loads (switch) {0=None; 1=HydroDyn}
0          CompSub      - Compute substructure dynamics (switch) {0=None; 1=SubDyn}
3          CompMooring  - Compute mooring dynamics (switch) {0=None; 1=MooringDyn}
0          CompIce      - Compute ice dynamics (switch) {0=None; 1=IceDyn}
2          MHK           - MHK turbine (switch) {0=None; 1=MHK}
----- ENVIRONMENTAL CONDITIONS -----
9.80665  Gravity      - Gravitational acceleration (m/s^2)
1.225    AirDens      - Air density (kg/m^3)
1025     WtrDens      - Water density (kg/m^3)
1.06E-06  KinVisc     - Kinematic viscosity of working fluid (m^2/s)
1500     SpdSound     - Speed of sound in working fluid (m/s)
101325   Patm         - Atmospheric pressure (Pa) [used only for an MHK turbine cavitation check]
2500     Pvap          - Vapour pressure of working fluid (Pa) [used only for an MHK turbine cavitation check]
50       WtrDpth      - Water depth (m)
0        MSL2SWL      - Offset between still-water level and mean sea level (m) [positive upward]
```

• **TMax** should allow convergence  
• **DT** should resolve structural frequencies  
(≤ 1/10 of the highest frequency DOF)

# OpenFAST Driver Input File

```
----- OpenFAST EXAMPLE INPUT FILE -----
Floating MHK turbine, based on the RM1 tidal current rotor
----- SIMULATION CONTROL -----
False      Echo          - Echo input data to <RootName>.ech (flag)
"FATAL"    AbortLevel   - Error level when simulation should abort (string) {"WARNING", "SEVERE", "FATAL"}
       6   Tmax          - Total run time (s)
0.003     DT            - Recommended module time step (s)
       2   InterpOrder   - Interpolation order for input/output time history (-) {1=linear, 2=quadratic}
       5   NumCrctn     - Number of correction iterations (-) {0=explicit calculation, i.e., no corrections}
99999     DT_UJac      - Time between calls to get Jacobians (s)
1000000   UJacSclFact - Scaling factor used in Jacobians (-)
----- FEATURE SWITCHES AND FLAGS -----
1   CompElast      - Compu
1   CompInflow     - Compu
2   CompAero        - Compu
0   CompServo      - Compu
1   CompSeaSt      - Compu
1   CompHydro      - Compu
0   CompSub         - Compu
3   CompMooring    - Compu
0   CompIce         - Compu
2   MHK             - MHK t
• CompElast=1: ElastoDyn without BeamDyn
• CompInflow=1: Inflow set by InflowWind
• CompAero=2: Aerodynamics computed by AeroDyn15
• CompSeaSt=1: Full grid wave field with SeaState
• CompHydro=1: Hydrodynamic platform forces
• CompMooring=3: Dynamic mooring with MoorDyn
• MHK=2: Floating marine turbine
----- ENVIRONMENTAL -----
9.80665  Gravity      - Gravi
1.225    AirDens      - Air density (kg/m^3)
1025     WtrDens      - Water density (kg/m^3)
1.06E-06  KinVisc      - Kinematic viscosity of working fluid (m^2/s)
1500     SpdSound     - Speed of sound in working fluid (m/s)
101325   Patm          - Atmospheric pressure (Pa) [used only for an MHK turbine cavitation check]
2500     Pvap          - Vapour pressure of working fluid (Pa) [used only for an MHK turbine cavitation check]
50      WtrDpth       - Water depth (m)
0       MSL2SWL        - Offset between still-water level and mean sea level (m) [positive upward]
```

# OpenFAST Driver Input File

```
-- FEATURE SWITCHES AND FLAGS --
1 CompElast      - Compute structural dynamics (switch) {1=ElastoDyn; 2=ElastoDyn + BeamDyn for blades}
1 CompInflow     - Compute inflow wind velocities (switch) {0=still air; 1=InflowWind; 2=external from OpenFOAM}
2 CompAero       - Compute aerodynamic loads (switch) {0=None; 1=AeroDyn v14; 2=AeroDyn v15}
0 CompServo      - Compute control and electrical-drive dynamics (switch) {0=None; 1=ServoDyn}
1 CompSeaSt      - Compute sea state information (switch) {0=None; 1=SeaState}
1 CompHydro      - Compute hydrodynamic loads (switch) {0=None; 1=HydroDyn}
0 CompSub        - Compute sub-structural dynamics (switch) {0=None; 1=SubDyn; 2=External Platform MCKF}
3 CompMooring    - Compute mooring system (switch) {0=None; 1=MAP++; 2=FEAMooring; 3=MoorDyn; 4=OrcaFlex}
0 CompIce         - Compute ice loads (switch) {0=None; 1=IceFlo; 2=IceDyn}
2 MHK            - MHK turbine type (switch) {0=Not an MHK turbine; 1=Fixed MHK turbine; 2=Floating MHK turbine}

-- ENVIRONMENTAL CONDITIONS --
9.80665 Gravity      - Gravitational acceleration (m/s^2)
1.225 AirDens      - Air density (kg/m^3)
1025 WtrDens      - Water density (kg/m^3)
1.06E-06 KinVisc     - Kinematic viscosity of working fluid (m^2/s)
1500 SpdSound      - Speed of sound (m/s)
101325 Patm        - Atmospheric pressure (Pa)
2500 Pvap          - Vapour pressure (Pa)
50 WtrDpth        - Water depth (m)
0 MSL2SWL         - Offset between MSL and SWL (m)

-- INPUT FILES --
"MHK_RM1_Floating_ElastoDyn.dat" EDFile      - Name of file containing ElastoDyn input parameters (quoted string)
"unused"      BDBldFile(1)   - Name of file containing BeamDyn input parameters for blade 1 (quoted string)
"unused"      BDBldFile(2)   - Name of file containing BeamDyn input parameters for blade 2 (quoted string)
"unused"      BDBldFile(3)   - Name of file containing BeamDyn input parameters for blade 3 (quoted string)
"MHK_RM1_Floating_InflowWind.dat" InflowFile   - Name of file containing inflow wind input parameters (quoted string)
"MHK_RM1_Floating_AeroDyn15.dat" AeroFile     - Name of file containing aerodynamic input parameters (quoted string)
"unused"      ServoFile     - Name of file containing control and electrical-drive input parameters (quoted string)
"SeaState.dat" SeaStFile    - Name of file containing sea state input parameters (quoted string)
"MHK_RM1_Floating_HydroDyn.dat" HydroFile     - Name of file containing hydrodynamic input parameters (quoted string)
"unused"      SubFile       - Name of file containing sub-structural input parameters (quoted string)
"MHK_RM1_Floating_MoorDyn.dat" MooringFile   - Name of file containing mooring system input parameters (quoted string)
"unused"      IceFile       - Name of file containing ice input parameters (quoted string)
```

- Specify module primary input files
  - Path relative to folder containing .fst file
- Unused modules not specified

# OpenFAST Driver Input File

OUTPUT		
True	SumPrint	- Print summary data to "<RootName>.sum" (flag)
5	SttsTime	- Amount of time between screen status messages (s)
99999	ChkptTime	- Amount of time between creating checkpoint files for potential restart (s)
0.03	DT_Out	- Time step for tabular output (s) (or "default")
0	ITstart	- Time to begin tabular output (s)
3	OutFileFmt	- Format for tabular (time-marching) output file (switch) {1: text file [<RootName>.out], 2: binary file}
True	TabDelim	- Use tab delimiters in text tabular output file? (flag) {uses spaces if false}
"ES10.3E2"	OutFmt	- Format used for text tabular output, excluding the time channel. Resulting field should be 10 characters
LINEARIZATION		
False	Linearize	- Linearize system (flag) [linearize=False] (false)
False	CalcSteady	- Calculate steady state (flag) [calcSteady=True] (-)
1	TrimCase	- Control trim case (flag) [true]
0.01	TrimTol	- Tolerance for trim (rad)
0.01	TrimGain	- Propagation gain (flag) [propagationGain=0.01]
0	Twr_Kdmp	- Damping for trim (flag) [twrKdmp=0]
0	Bld_Kdmp	- Damping for blade trim (flag) [bldKdmp=0]
0	NLinTimes	- Number of linearization times (flag) [nlTimes=0]
0	LinTimes	- List of times for linearization output (flag) [linTimes=[0]]
0	LinInputs	- Inputs for linearization (flag) [linInputs=[0]]
0	LinOutputs	- Outputs for linearization (flag) [linOutputs=[0]]
False	LinOutJac	- Include full Jacobian in linearization output (flag) [linOutJac=false] (false)
False	LinOutMod	- Write module-level linearization output files in addition to output for full system? (flag) [unused if linearize=False] (false)
VISUALIZATION		
0	WrVTK	- VTK visualization data output: (switch) {0=none; 1=initialization data only; 2=animation; 3=mode shape}
1	VTK_type	- Type of VTK visualization data: (switch) {1=surfaces; 2=basic meshes (lines/points); 3=all meshes (debris)}
False	VTK_fields	- Write mesh fields to VTK data files? (flag) {true/false} [unused if WrVTK=0]
0	VTK_fps	- Frame rate for VTK output (frames per second){will use closest integer multiple of DT} [used only if WrVTK>0]

- Summary file prints inputs as read by the code
  - Useful for debugging inputs
- **SttsTime** should balance screen updates with time required to write to screen
- **DT\_Out** can downsample calculated values when writing to file

# OpenFAST Driver Input File

```
--> OUTPUT <--  
True   SumPrint      - Print summary data to "<RootName>.sum" (flag)  
      | 5 SttsTime       - Amount of time between screen status messages (s)  
      | 99999 ChkptTime    - Amount of time between creating checkpoint files for potential restart (s)  
      | 0.03 DT_Out        - Time step for tabular output (s) (or "default")  
      | 0 TStart          - Time to begin tabular output (s)  
      | 3 OutFileFmt      - Format for tabular (time-marching) output file (switch) {1: text file [<RootName>.out], 2: binary file  
True   TabDelim       - Use tab delimiters in text tabular output file? (flag) {uses spaces if false}  
"ES10.3E2" OutFmt      - Format used for text tabular output, excluding the time channel. Resulting field should be 10 characters  
--> LINEARIZATION <--  
False  Linearize      - Linearization analysis (flag)  
False  CalcSteady     - Calculate a steady-state periodic operating point before linearization? [unused if Linearize=False] (flag)  
      | 1 TrimCase        - Controller parameter to be trimmed {1:yaw; 2:torque; 3:pitch} [used only if CalcSteady=True] (-)  
      | 0.01 TrimTol       - Tolerance for the rotational speed convergence [used only if CalcSteady=True] (-)  
      | 0.01 TrimGain      - Proportion of trim to be applied to the controller  
      | 0 Twr_Kdmp         - Damping for trim calculation  
      | 0 Bld_Kdmp         - Damping for trim calculation  
      | 0 NLinTimes        - Number of linearization iterations  
      | 0 LinTimes         - List of linearization points  
      | 0 LinInputs         - Inputs for linearization  
      | 0 LinOutputs        - Outputs for linearization  
      | 0 LinOutJac         - Include Jacobian matrix in output  
False  LinOutMod       - Write module-level linearization output files in addition to output for full system? (flag) [unused if Linearize=False]  
--> VISUALIZATION <--  
      | 0 WrVTK            - VTK visualization data output: (switch) {0=none; 1=initialization data only; 2=animation; 3=mode shape  
      | 1 VTK_type          - Type of VTK visualization data: (switch) {1=surfaces; 2=basic meshes (lines/points); 3=all meshes (debug)}  
False  VTK_fields       - Write mesh fields to VTK data files? (flag) {true/false} [unused if WrVTK=0]  
      | 0 VTK_fps           - Frame rate for VTK output (frames per second){will use closest integer multiple of DT} [used only if WrVTK=1]
```

- **Linearization=True** enables linearization of the full coupled solution
  - Linearized equations can be output for use in other models

# OpenFAST Driver Input File

```
--> OUTPUT <--  
True   SumPrint      - Print summary data to "<RootName>.sum" (flag)  
      | 5 SttsTime       - Amount of time between screen status messages (s)  
      | 99999 ChkptTime    - Amount of time between creating checkpoint files for potential restart (s)  
      | 0.03 DT_Out        - Time step for tabular output (s) (or "default")  
      | 0 TStart          - Time to begin tabular output (s)  
      | 3 OutFileFmt      - Format for tabular (time-marching) output file (switch) {1: text file [<RootName>.out], 2: binary file}  
True   TabDelim       - Use tab delimiters in text tabular output file? (flag) {uses spaces if false}  
"ES10.3E2" OutFmt      - Format used for text tabular output, excluding the time channel. Resulting field should be 10 characters  
----- LINEARIZATION -----  
False  Linearize      - Linearization analysis (flag)  
False  CalcSteady     - Calculate a steady-state periodic operating point before linearization? [unused if Linearize=False] (flag)  
      | 1 TrimCase        - Controller parameter to be trimmed {1:yaw; 2:torque; 3:pitch} [used only if CalcSteady=True] (-)  
      | 0.01 TrimTol       - Tolerance for the rotational speed convergence [used only if CalcSteady=True] (-)  
      | 0.01 TrimGain      - Proportional gain for the rotational speed error (>0) [used only if CalcSteady=True] (rad/(rad/s)) for  
      | 0 Twr_Kdmp         - Damping factor for the tower [used only if CalcSteady=True] (N/(m/s))  
      | 0 Bld_Kdmp         - Damping factor for the blades [used only if CalcSteady=True] (N/(m/s))  
      | 0 NLinTimes        - Number of times to linearize (-) [>=1] [unused if Linearize=False]  
      | 0 LinTimes          - List of times at which to linearize (s) [1 to NLinTimes] [used only when Linearize=True and CalcSteady=True]  
      | 0 LinInputs         - Inputs included in linearization (switch) {0=none; 1=standard; 2=all module inputs (debug)} [unused if  
      | 0 LinOutputs        - Outputs included in linearization (switch) {0=none; 1=standard; 2=all module outputs (debug)} [used only if  
False  LinOutJac       - Include Jacobian matrix in linearization output files? (flag) [unused if WrVTK=0]  
False  LinOutMod       - Write module-level linearization output files in addition to output for full system? (flag) [unused if WrVTK=0]  
----- VISUALIZATION -----  
      | 0 WrVTK           - VTK visualization data output: (switch) {0=none; 1=initialization data only; 2=animation; 3=mode shape}  
      | 1 VTK_type         - Type of VTK visualization data: (switch) {1=surfaces; 2=basic meshes (lines/points); 3=all meshes (debug)}  
False  VTK_fields       - Write mesh fields to VTK data files? (flag) {true/false} [unused if WrVTK=0]  
      | 0 VTK_fps          - Frame rate for VTK output (frames per second){will use closest integer multiple of DT} [used only if WrVTK=1]
```

## • Visualization using VTK (Visualization ToolKit)

# ElastoDyn Primary Input File

```
-- ELASTODYN for OpenFAST I  
Floating MHK turbine structural  
----- SIMULATIO  
False | Echo - Echo  
| | | 3 Method - Inte  
"default" DT - Inte  
----- DEGREES OF FREEDOM -----
```

- Blade and tower bending DOFs enabled
- Platform 6 DOFs enabled
- Generator and yaw DOFs disabled
  - Fixed RPM specified
- Teeter and platform DOFs not applicable

True	FlapDOF1	- First flapwise blade mode DOF (flag)
True	FlapDOF2	- Second flapwise blade mode DOF (flag)
True	EdgeDOF	- First edgewise blade mode DOF (flag)
False	TeetDOF	- Rotor-teeter DOF (flag) [unused for 3 blades]
True	DrTrDOF	- Drivetrain rotational-flexibility DOF (flag)
False	GenDOF	- Generator DOF (flag)
False	YawDOF	- Yaw DOF (flag)
True	TwFADOF1	- First fore-aft tower bending-mode DOF (flag)
True	TwFADOF2	- Second fore-aft tower bending-mode DOF (flag)
True	TwSSDODF1	- First side-to-side tower bending-mode DOF (flag)
True	TwSSDODF2	- Second side-to-side tower bending-mode DOF (flag)
True	PtfmSgDOF	- Platform horizontal surge translation DOF (flag)
True	PtfmSwDOF	- Platform horizontal sway translation DOF (flag)
True	PtfmHvDOF	- Platform vertical heave translation DOF (flag)
True	PtfmRDOF	- Platform roll tilt rotation DOF (flag)
True	PtfmPDOF	- Platform pitch tilt rotation DOF (flag)
True	PtfmYDOF	- Platform yaw rotation DOF (flag)

# ElastoDyn Primary Input File

```
----- INITIAL CONDITIONS -----
0 OoPDefl - Initial out-of-plane blade-tip displacement (meters)
0 IPDefl - Initial in-plane blade-tip deflection (meters)
0 BlPitch(1) - Blade 1 initial pitch (degrees)
0 BlPitch(2) - Blade 2 initial pitch (degrees)
0 BlPitch(3) - Blade 3 initial pitch (degrees) [unused for 2 blades]
0 TeetDefl - Initial or fixed teeter angle (degrees) [unused for 3 blades]
0 Azimuth - Initial azimuth angle for blade 1 (degrees)
11.5 RotSpeed - Initial or fixed rotor speed (rpm)
0 NacYaw - Initial or fixed nacelle-yaw angle (degrees)
0 TTDspFA - Initial fore-aft tower-top displacement (meters)
0 TTDspSS - Initial side-to-side tower-top displacement (meters)
20 PtfrmSurge - Initial or fixed horizontal surge translational displacement of platform (meters)
0 PtfrmSway - Initial or fixed horizontal sway translational displacement of platform (meters)
0 PtfrmHeave - Initial or fixed vertical heave translational displacement of platform (meters)
0 PtfrmRoll - Initial or fixed roll tilt rotational displacement of platform (degrees)
0 PtfrmPitch - Initial or fixed pitch tilt rotational displacement of platform (degrees)
0 PtfrmYaw - Initial or fixed yaw rotational displacement of platform (degrees)
```

- Specify initial angles, displacements, and motions
- Fixed rotor speed of rated 11.5 rpm
- Initial surge based on rated thrust

# ElastoDyn Primary Input File

----- TURBINE CONFIGURATION -----		
2	NumBl	- Number of blades (-)
10	TipRad	- The distance from the rotor apex to the blade tip (meters)
1	HubRad	- The distance from the rotor apex to the blade root (meters)
0	PreCone(1)	- Blade 1 cone angle (degrees)
0	PreCone(2)	- Blade 2 cone angle (degrees)
0	PreCone(3)	- Blade 3 cone angle (degrees) [unused for 2 blades]
0.2222	HubCM	- Distance from rotor apex to hub mass [positive downwind] (meters)
0	UndSling	- Undersling length [distance from teeter pin to the rotor apex] (meters) [unused for 3 blades]
0	Delta3	- Delta-3 angle for teetering rotors (degrees) [unused for 3 blades]
0	AzimB1Up	- Azimuth value to use for I/O when blade 1 points up (degrees)
-4.91	OverHang	- Distance from yaw axis to rotor apex [3 blades] or teeter pin [2 blades] (meters)
0	ShftGagL	- Distance from rotor apex [3 blades] or teeter pin [2 blades] to shaft strain gages [positive for upwind]
0	ShftTilt	- Rotor shaft tilt angle (degrees)
0.43	NacCMxn	- Downwind distance from the tower-top to the nacelle CM (meters)
0	NacCMyn	- Lateral distance from the tower-top to the nacelle CM (meters)
-1.2	NacCMzn	- Vertical distance from the tower-top to the nacelle CM (meters)
0	NcIMUxn	- Downwind distance from the tower-top to the nacelle IMU (meters)
0	NcIMUyn	- Lateral distance from the tower-top to the nacelle IMU (meters)
-1.2	NcIMUzn	- Vertical distance from the tower-top to the nacelle IMU (meters)
-1.2	Twr2Shft	- Vertical distance from the tower-top to the rotor shaft (meters)
-24	TowerHt	- Height of tower relative to ground level [onshore], MSL [offshore wind or floating MHK], or seabed [fixed]
-9	TowerBsHt	- Height of tower base relative to ground level [onshore], MSL [offshore wind or floating MHK], or seabed [fixed]
0	PtfmCMxxt	- Downwind distance from the ground level [onshore], MSL [offshore wind or floating MHK], or seabed [fixed]
0	PtfmCMyrt	- Lateral distance from the ground level [onshore], MSL [offshore wind or floating MHK], or seabed [fixed]
-6.09	PtfmCMztt	- Vertical distance from the ground level [onshore], MSL [offshore wind or floating MHK], or seabed [fixed]
0	PtfmRefzt	- Vertical distance from the ground level [onshore], MSL [offshore wind or floating MHK], or seabed [fixed]

- Specify turbine geometry
- Platform COG

# ElastoDyn Primary Input File

```
----- MASS AND INERTIA -----
 0 TipMass(1) - Tip-brake mass, blade 1 (kg)
 0 TipMass(2) - Tip-brake mass, blade 2 (kg)
 0 TipMass(3) - Tip-brake mass, blade 3 (kg) [unused for 2 blades]
140 HubMass - Hub mass (kg)
79.6 HubIner - Hub inertia about rotor axis [3 blades] or teeter axis [2 blades] (kg m^2)
139.5 GenIner - Generator inertia about HSS (kg m^2)
40100 NacMass - Nacelle mass (kg)
244643 NacYIner - Nacelle inertia about yaw axis (kg m^2)
 0 YawBrMass - Yaw bearing mass (kg)
2525214 PtfmMass - Platform mass (kg)
195242474 PtfmRIner - Platform inertia for roll tilt rotation about the platform CM (kg m^2)
919435755 PtfmPIner - Platform inertia for pitch tilt rotation about the platform CM (kg m^2)
1053535885 PtfmYIner - Platform inertia for yaw rotation about the platform CM (kg m^2)
```

- Specify turbine mass and inertia
- Specify platform mass and inertia

# ElastoDyn Primary Input File

- Specify blade structural input files
  - **BldFile(3)** ignored for 2-bladed rotor

```
-- BLADE --
  8 BldNodes    - Number of blade nodes (per blade) used for analysis (-)
"MHK_RM1_ElastoDyn_Blade.dat"   BldFile(1)  - Name of file containing properties for blade 1 (quoted string)
"MHK_RM1_ElastoDyn_Blade.dat"   BldFile(2)  - Name of file containing properties for blade 2 (quoted string)
"unused"          BldFile(3)  - Name of file containing properties for blade 3 (quoted string) [unused for 2 blades]
```

# ElastoDyn Primary Input File

```
-- BLADE --
  8 BldNodes    - Number of blade nodes (per blade) used for analysis (-)
"MHK_RM1_ElastoDyn_Blade.dat"    BldFile(1)  - Name of file containing properties for blade 1 (quoted string)
"MHK_RM1_ElastoDyn_Blade.dat"    BldFile(2)  - Name of file containing properties for blade 2 (quoted string)
"unused"      BldFile(3)  - Name of file containing properties for blade 3 (quoted string) [unused for 2 blades]
-- ROTOR-TEETER --
  0 TeetMod
  0 TeetDmpP
  0 TeetDmp
  0 TeetCDmp
  0 TeetSStP
  0 TeetHStP
  0 TeetSSSp
  0 TeetHSSp
-- DRIVETRAIN --
  92 GBoxEff
  53 GBRatio
 600000 DTTorSpr
 100000 DTTorDmp

```

The code snippet shows the primary input file for ElastoDyn. It includes sections for BLADE, ROTOR-TEETER, and DRIVETRAIN. The ROTOR-TEETER section is highlighted with a blue box. The first eight lines of the ROTOR-TEETER section are also highlighted with a blue box.

- Specifications for teetering rotors

# ElastoDyn Primary Input File

```
-- BLADE --
  8 BldNodes - Number of blade nodes (per blade) used for analysis (-)
"MHK_RM1_ElastoDyn_Blade.dat" BldFile(1) - Name of file containing properties for blade 1 (quoted string)
"MHK_RM1_ElastoDyn_Blade.dat" BldFile(2) - Name of file containing properties for blade 2 (quoted string)
"unused" BldFile(3) - Name of file containing properties for blade 3 (quoted string) [unused for 2 blades]
-- ROTOR-TEETER --
  0 TeetMod - Rotor-teeter spring/damper model {0: none, 1: standard, 2: user-defined from routine UserTeet} (switch) [u]
  0 TeetDmpP - Rotor-teeter damper position (degrees) [used only for 2 blades and when TeetMod=1]
  0 TeetDmp - Rotor-teeter damping constant (N-m/(rad/s)) [used only for 2 blades and when TeetMod=1]
  0 TeetCDmp - Rotor-teeter rate-independent Coulomb-damping moment (N-m) [used only for 2 blades and when TeetMod=1]
  0 TeetSStP - Rotor-teeter soft-stop position (degrees) [used only for 2 blades and when TeetMod=1]
  0 TeetHStP - Rotor-teeter hard-stop position (degrees) [used only for 2 blades and when TeetMod=1]
  0 TeetSSSp - Rotor-teeter soft-stop linear-spring constant (N-m/rad) [used only for 2 blades and when TeetMod=1]
  0 TeetHSSp - Rotor-teeter hard-stop linear-spring constant (N-m/rad) [used only for 2 blades and when TeetMod=1]
-- DRIVETRAIN --
  92 GBoxEff - Gearbox efficiency (%)
  53 GBRatio - Gearbox ratio (-)
  600000 DTTorSpr - Drivetrain torsional spring (N-m/rad)
  100000 DTTorDmp - Drivetrain torsional damper (N-m/(rad/s))
```

- Gearbox and drivetrain specifications, including drivetrain rotational flexibility

# ElastoDyn Primary Input File

```
-- FURLING --
False      Furling    - Read in additional model properties for furling turbine (flag) [must currently be FALSE)
"unused"   FurlFile   - Name of file containing furling properties (quoted string) [unused when Furling=False]

-- TOWER --
2          TwrNodes  - Number of tower nodes used for analysis (-)
"MHK_RM1_Floating_ElastoDyn_Tower.dat" TwrFile   - Name of file containing tower properties (quoted string)

-- OUTPUT --
True       SumPrint  - Print summary data to "<RootName>.sum" (flag)
1          OutFile   - Switch to determine where output will be placed: {1: in module output file only; 2: in glue code
True       TabDelim  - Use tab delimiters in text tabular output file? (flag) (currently unused)
"ES10.3E2" OutFmt    - Format used for tabular output (10 characters. (quoted string)
0          TStart    - Time to begin
1          DecFact   - Decimation factor for tabular output {1: output every time step} (-) (currently unused)
0          NTwGages  - Number of tower nodes that have strain gages for output [0 to 9] (-)
0          TwrGagNd  - List of tower nodes that have strain gages [1 to TwrNodes] (-) [unused if NTwGages=0]
0          NBlGages  - Number of blade nodes that have strain gages for output [0 to 9] (-)
0          BldGagNd  - List of blade nodes that have strain gages [1 to BldNodes] (-) [unused if NBlGages=0]
OutList   OutList   - The next line(s) contains a list of output parameters. See OutListParameters.xlsx for a listing

"PtfmSurge"
"PtfmSway"
"PtfmHeave"
"PtfmRoll"
"PtfmPitch"
"PtfmYaw"
"TwrTpTDxi"
"TwrTpTDyi"
"TwrTpTDzzi"
"OoPDefl1"
END of OutList section (the word "END" must appear in the first 3 columns of the last OutList line)
```

- Furling properties (currently unused)

# ElastoDyn Primary Input File

```
-- FURLING --
False      Furling    - Read in additional model properties for furling turbine (flag) [must currently be FALSE)
"unused"   FurlFile   - Name of file containing furling properties (quoted string) [unused when Furling=False]
-- TOWER --
  2 TwrNodes  - Number of tower nodes used for analysis (-)
"MHK_RM1_Floating_ElastoDyn_Tower.dat" TwrFile   - Name of file containing tower properties (quoted string)
-- OUTPUT --
True       SumPrint  - Print summary data to "<RootName>.sum" (flag)
  1 OutFile   - Switch to determine where output will be placed: {1: in module output file only; 2: in glue code
True       TabDelim  - Use tab delimiters in text tabular output file? (flag) (currently unused)
"ES10.3E2"  OutFmt   - Format used for text tabular output (except time). Resulting field should be 10 characters. (qu
  0 TStart    - Time to begin tabular output (s) (currently unused)
  1 DecFact   - Decimation factor (currently unused)
  0 NTwGages  - Number of tower
  0 TwrGagNd  - List of tower nodes that have strain gages [1 to TwrNodes] (-) [unused if NTwGages=0]
  0 NBlGages  - Number of blade nodes that have strain gages for output [0 to 9] (-)
  0 BldGagNd  - List of blade nodes that have strain gages [1 to BldNodes] (-) [unused if NBlGages=0]
  OutList   - The next line(s) contains a list of output parameters. See OutListParameters.xlsx for a listing
"PtfmSurge"
"PtfmSway"
"PtfmHeave"
"PtfmRoll"
"PtfmPitch"
"PtfmYaw"
"TwTpTDxi"
"TwTpTDyi"
"TwTpTDz"
"OoPDefl1"
END of OutList section (the word "END" must appear in the first 3 columns of the last OutList line)
```

- Specify tower structural input file

# ElastoDyn Primary Input File

```
-- FURLING --
False      Furling    - Read in additional model properties for furling turbine (flag) [must currently be FALSE)
"unused"   FurlFile   - Name of file containing furling properties (quoted string) [unused when Furling=False]
-- TOWER --
| | | 2 TwrNodes   - Number of tower nodes used for analysis (-)
|MHK_RM1_Floating_ElastoDyn_Tower.dat" TwrFile   - Name of file containing tower properties (quoted string)
-- OUTPUT --
True       SumPrint  - Print summary data to "<RootName>.sum" (flag)
| | | 1 OutFile   - Switch to output file only; 2: in glue code
True       TabDelim - Use tab separator instead of space
"ES10.3E2" OutFmt   - Format used for output file
| | | 0 TStart    - Time to start output
| | | 1 DecFact  - Decimation factor for tabular output {1: output every time step} (-) (currently unused)
| | | 0 NTwGages - Number of tower nodes that have strain gages for output [0 to 9] (-)
| | | 0 TwrGagNd - List of tower nodes that have strain gages [1 to TwrNodes] (-) [unused if NTwGages=0]
| | | 0 NBlGages - Number of blade nodes that have strain gages for output [0 to 9] (-)
| | | 0 BldGagNd - List of blade nodes that have strain gages [1 to BldNodes] (-) [unused if NBlGages=0]
| | | OutList   - The next line(s) contains a list of output parameters. See OutListParameters.xlsx for a listing
| | "PtfmSurge"
| | "PtfmSway"
| | "PtfmHeave"
| | "PtfmRoll"
| | "PtfmPitch"
| | "PtfmYaw"
| | "TwrTpTDxi"
| | "TwrTpTDyi"
| | "TwrTpTDzzi"
| | "OoPDefl1"
END of OutList section (the word "END" must appear in the first 3 columns of the last OutList line)
```

- Specify formatting of outputs written to file

# ElastoDyn Primary Input File

```
-- FURLING --
False      Furling    - Read in additional model properties for furling turbine (flag) [must currently be FALSE)
"unused"   FurlFile   - Name of file containing furling properties (quoted string) [unused when Furling=False]
-- TOWER --
| | | 2 TwrNodes   - Number of tower nodes used for analysis (-)
|MHK_RM1_Floating_ElastoDyn_Tower.dat" TwrFile   - Name of file containing tower properties (quoted string)
-- OUTPUT --
True       SumPrint  - Print summary data to "<RootName>.sum" (flag)
| | | 1 OutFile    - Switch to determine where output will be placed: {1: in module output file only; 2: in glue code
True       TabDelim  - Use tab delimiters in text tabular output file? (flag) (currently unused)
"ES10.3E2"  OutFmt    - Format used for text tabular output (except time). Resulting field should be 10 characters. (qu
| | | 0 TStart     - Time to begin tabular output (s) (currently unused)
| | | 1 DecFact   - Decimation factor for tabular output {1: output every time step} (-) (currently unused)
| | | 0 NTwGages  - Number of tower nodes that have strain gages for output [0 to 9] (-)
| | | 0 TwrGagNd  - List of tower nodes that have strain gages [1 to TwrNodes] (-) [unused if NTwGages=0]
| | | 0 NBlGages  - Number of blade nodes that have strain gages for output [0 to 9] (-)
| | | 0 BldGagNd  - List of blade nodes that have strain gages [1 to BldNodes] (-) [unused if NBlGages=0]
| | | OutList    - The next line(s) contains a list of output parameters. See OutListParameters.xlsx for a listing
| | "PtfmSurge"
| | "PtfmSway"
| | "PtfmHeave"
| | "PtfmRoll"
| | "PtfmPitch"
| | "PtfmYaw"
| | "TwrTpTDxi"
| | "TwrTpTDyi"
| | "TwrTpTDzzi"
| | "OoPDefl1"
END of OutList section (the word "END" must appear in the first 3 columns of the last OutList line)
```

- List of user-selectable outputs  
(not comprehensive)

# AeroDyn Primary Input File

```
-- AERODYN v15 for OpenFAST INPUT FILE --
Floating MHK turbine hydrodynamic input properties, based on the RM1 tidal current rotor
===== General Options =====
False      Echo          - Echo the input to "<rootname>.AD.ech"? (flag)
"default"  DTAero       - Time interval for aerodynamic calculations {or "default"} (s)
                           - Type of wake/induction model (switch) {0=none, 1=BEMT, 2=DBEMT, 3=OLAF} [WakeMod cannot be 2 or 3]
                           - Type of blade airfoil aerodynamics model (switch) {1=steady model, 2=Beddoes-Leishman unsteady model}
                           - WakeMod options include steady and dynamic BEM and OLAF (vortex model)
                           - AFAeroMod options include steady and unsteady aerodynamics models
                           - TwrPotent
                           - TwrShadow
                           - TwrAero
                           - FrozenWake
                           - CavitCheck
                           - Buoyancy
                           - CompAA
                           - AA_InputFile
===== Environmental Conditions =====
"default"  AirDens      - Air density (kg/m^3)
"default"  KinVisc      - Kinematic viscosity of working fluid (m^2/s)
"default"  SpdSound     - Speed of sound in working fluid (m/s)
"default"  Patm         - Atmospheric pressure (Pa) [used only when CavitCheck=True]
"default"  Pvap         - Vapour pressure of working fluid (Pa) [used only when CavitCheck=True]
===== Blade-Element/Momentum Theory Options ===== [unused when WakeMod=0 or 3]
                           - SkewMod
                           - Type of skewed-wake correction model (switch) {1=uncoupled, 2=Pitt/Peters, 3=coupled} [unused when WakeMod=0 or 3]
                           - SkewModFactor
                           - Constant used in Pitt/Peters skewed wake model {or "default" is 15/32*pi} (-) [used only when SkewMod=2]
                           - TipLoss
                           - Use the Prandtl tip-loss model? (flag) [unused when WakeMod=0 or 3]
                           - HubLoss
                           - Use the Prandtl hub-loss model? (flag) [unused when WakeMod=0 or 3]
                           - TanInd
                           - Include tangential induction in BEMT calculations? (flag) [unused when WakeMod=0 or 3]
                           - AIDrag
                           - Include the drag term in the axial-induction calculation? (flag) [unused when WakeMod=0 or 3]
                           - TIDrag
                           - Include the drag term in the tangential-induction calculation? (flag) [unused when WakeMod=0,3 or 4]
                           - IndToler
                           - Convergence tolerance for BEMT nonlinear solve residual equation {or "default"} (-) [unused when WakeMod=0,3 or 4]
                           - MaxIter
                           - Maximum number of iteration steps (-) [unused when WakeMod=0]
```

- **WakeMod** options include steady and dynamic BEM and OLAF (vortex model)
  - **AFAeroMod** options include steady and unsteady aerodynamics models

# AeroDyn Primary Input File

```
----- AERODYN v15 for OpenFAST INPUT FILE -----
Floating MHK turbine hydrodynamic input properties, based on the RM1 tidal current rotor
===== General Options =====
False      Echo          - Echo the input to "<rootname>.AD.ech"? (flag)
"default"  DTAero       - Time interval for aerodynamic calculations {or "default"} (s)
                  2  WakeMod      - Type of wake/induction model (switch) {0=none, 1=BEMT, 2=DBEMT, 3=OLAF} [WakeMod cannot be 2 or
                  1  AFAeroMod    - Type of blade airfoil aerodynamics model (switch) {1=steady model, 2=Beddoes-Leishman unsteady m
                  1  TwrPotent    - Type tower influence on wind based on potential flow around the tower (switch) {0=none, 1=baseli
                  0  TwrShadow    - Calculate tower influence on wind based on downstream tower shadow? (switch) {0=none, 1=Powles m
True       TwrAero      - Calculate tower aerodynamic loads? (flag)
False      FrozenWake   - Assume frozen wake? (flag) [used only when WakeMod=0]
True       CavitCheck  - Perform cavitation calculations? (flag)
True       Buoyancy     - Include buoyancy effects? (flag)
False      CompAA       - Flag to compute AeroAcoustics calculation [used only when WakeMod = 1 or 2]
"unused"   AA_InputFile - AeroAcoustics input file [used only when CompAA=true]
===== Environmental Conditions =====
"default"  AirDens     - Air density (kg/m^3)
"default"  KinVisc     - Kinematic viscosity of working fluid (m^2/s)
"default"  SpdSound    - Speed of sound in working fluid (m/s)
"default"  Patm        - Atmospheric pressure (Pa) [used only when CavitCheck=True]
"default"  Pvap        - Vapour pressure of working fluid (Pa) [used only when CavitCheck=True]
===== Blade-Element/Momentum Theory Options ===== [unused when WakeMod=0 or 3]
                  2  SkewMod      - Type of skewed-wake correction model (switch) {1=uncoupled, 2=Pitt/Peters, 3=coupled} [unused wh
"default"  SkewModFactor - Constant used in Pitt/Peters skewed wake model {or "default" is 15/32*pi} (-) [used only when SK
True       TipLoss      - Use the Prandtl tip-loss model? (flag) [unused when WakeMod=0 or 3]
True       HubLoss      - Use the Prandtl hub-loss model? (flag) [unused when WakeMod=0 or 3]
True       TanInd       - Include tangential induction in BEMT calculations? (flag) [unused when WakeMod=0 or 3]
True       AIDrag       - Include the drag term in the axial-induction calculation? (flag) [unused when WakeMod=0 or 3]
True       TIDrag       - Include the drag term in the tangential-induction calculation? (flag) [unused when WakeMod=0,3 o
"default"  IndToler    - Convergence tolerance for BEMT nonlinear solve residual equation {or "default"} (-) [unused when W
                  1000 MaxIter     - Maximum number of iteration steps (-) [unused when WakeMod=0]
```

## • Options to calculate tower influence and loads

# AeroDyn Primary Input File

```
----- AERODYN v15 for OpenFAST INPUT FILE -----
Floating MHK turbine hydrodynamic input properties, based on the RM1 tidal current rotor
===== General Options =====
False      Echo          - Echo the input to "<rootname>.AD.ech"? (flag)
"default"  DTAero       - Time interval for aerodynamic calculations {or "default"} (s)
|           2  WakeMod    - Type of wake/induction model (switch) {0=none, 1=BEMT, 2=DBEMT, 3=OLAF} [WakeMod cannot be 2 or
|           1  AFAeroMod   - Type of blade airfoil aerodynamics model (switch) {1=steady model, 2=Beddoes-Leishman unsteady m
|           1  TwrPotent    - Type tower influence on wind based on potential flow around the tower (switch) {0=none, 1=baseli
|           0  TwrShadow   - Calculate tower influence on wind based on downstream tower shadow? (switch) {0=none, 1=Powles m
True       TwrAero      - Calculate tower aerodynamic loads? (flag)
False      FrozenWake   - Assume frozen wake during linearization? (flag) [used only when WakeMod=1 and when linearizing]
True       CavitCheck   - Perform cavitation check? (flag) [AFAeroMod must be 1 when CavitCheck=true]
True       Buoyancy     - Include buoyancy effects? (flag)
False      CompAA       - Flag to compute AeroAcoustics calculation [used only when WakeMod = 1 or 2]
"unused"   AA_InputFile - AeroAcoustics input file name
===== Environmental Conditions =====
"default"  AirDens     - Air density (kg/m^3)
"default"  KinVisc     - Kinematic viscosity (m^2/s)
"default"  SpdSound    - Speed of sound (m/s)
"default"  Patm        - Atmospheric pressure (Pa)
"default"  Pvap        - Vapour pressure (Pa)
===== Blade-Element/Momentum Theory Options =====
|           2  SkewMod    - Type of skewed-wake correction model (switch) {1=uncoupled, 2=Pitt/Peters, 3=coupled} [unused when WakeMod=0 or 3]
"default"  SkewModFactor - Constant used in Pitt/Peters skewed wake model {or "default" is 15/32*pi} (-) [used only when SkewMod=2]
True       TipLoss      - Use the Prandtl tip-loss model? (flag) [unused when WakeMod=0 or 3]
True       HubLoss      - Use the Prandtl hub-loss model? (flag) [unused when WakeMod=0 or 3]
True       TanInd       - Include tangential induction in BEMT calculations? (flag) [unused when WakeMod=0 or 3]
True       AIDrag       - Include the drag term in the axial-induction calculation? (flag) [unused when WakeMod=0 or 3]
True       TIDrag       - Include the drag term in the tangential-induction calculation? (flag) [unused when WakeMod=0,3 or 4]
"default"  IndToler    - Convergence tolerance for BEMT nonlinear solve residual equation {or "default"} (-) [unused when WakeMod=0 or 3]
|           1000  MaxIter   - Maximum number of iteration steps (-) [unused when WakeMod=0]
```

- Cavitation check for MHK turbines
- Buoyancy for MHK turbines
- Future releases will include options to calculate added mass

# AeroDyn Primary Input File

```
----- AERODYN v15 for OpenFAST INPUT FILE -----
Floating MHK turbine hydrodynamic input properties, based on the RM1 tidal current rotor
===== General Options =====
False      Echo          - Echo the input to "<rootname>.AD.ech"? (flag)
"default"  DTAero       - Time interval for aerodynamic calculations {or "default"} (s)
|           2   WakeMod    - Type of wake/induction model (switch) {0=none, 1=BEMT, 2=DBEMT, 3=OLAF} [WakeMod cannot be 2 or
|           1   AFAeroMod  - Type of blade airfoil aerodynamics model (switch) {1=steady model, 2=Beddoes-Leishman unsteady m
|           1   TwrPotent   - Type tower influence on wind based on potential flow around the tower (switch) {0=none, 1=baseli
|           0   TwrShadow   - Calculate tower influence on wind based on downstream tower shadow? (switch) {0=none, 1=Powles m
True       TwrAero      - Calculate tower aerodynamic loads? (flag)
False      FrozenWake   - Assume frozen wake during linearization? (flag) [used only when WakeMod=1 and when linearizing]
True       CavitCheck  - Perform cavitation check? (flag) [AFAeroMod must be 1 when CavitCheck=true]
True       Buoyancy     - Include buoyancy effects? (flag)
False      CompAA       -
"unused"   AA_InputFile
===== Environmental Conditions =====
"default"  AirDens     - Air density (kg/m^3)
"default"  KinVisc     - Kinematic viscosity of working fluid (m^2/s)
"default"  SpdSound    - Speed of sound in working fluid (m/s)
"default"  Patm        - Atmospheric pressure (Pa) [used only when CavitCheck=True]
"default"  Pvap        - Vapour pressure of working fluid (Pa) [used only when CavitCheck=True]
===== Blade-Element/Momentum Theory Options ===== [unused when WakeMod=0 or 3]
|           2   SkewMod    - Type of skewed-wake correction model (switch) {1=uncoupled, 2=Pitt/Peters, 3=coupled} [unused wh
| "default"  SkewModFactor - Constant used in Pitt/Peters skewed wake model {or "default" is 15/32*pi} (-) [used only when SK
True       TipLoss      - Use the Prandtl tip-loss model? (flag) [unused when WakeMod=0 or 3]
True       HubLoss      - Use the Prandtl hub-loss model? (flag) [unused when WakeMod=0 or 3]
True       TanInd       - Include tangential induction in BEMT calculations? (flag) [unused when WakeMod=0 or 3]
True       AIDrag       - Include the drag term in the axial-induction calculation? (flag) [unused when WakeMod=0 or 3]
True       TIDrag       - Include the drag term in the tangential-induction calculation? (flag) [unused when WakeMod=0,3 o
"default"  IndToler    - Convergence tolerance for BEMT nonlinear solve residual equation {or "default"} (-) [unused when
|           1000  MaxIter    - Maximum number of iteration steps (-) [unused when WakeMod=0]
```

## • Environmental conditions in driver input files

# AeroDyn Primary Input File

```
----- AERODYN v15 for OpenFAST INPUT FILE -----
Floating MHK turbine hydrodynamic input properties, based on the RM1 tidal current rotor
===== General Options =====
False      Echo          - Echo the input to "<rootname>.AD.ech"? (flag)
"default"  DTAero       - Time interval for aerodynamic calculations {or "default"} (s)
                  2  WakeMod      - Type of wake/induction model (switch) {0=none, 1=BEMT, 2=DBEMT, 3=OLAF} [WakeMod cannot be 2 or
                  1  AFAeroMod    - Type of blade airfoil aerodynamics model (switch) {1=steady model, 2=Beddoes-Leishman unsteady m
                  1  TwrPotent     - Type tower influence on wind based on potential flow around the tower (switch) {0=none, 1=baseli
                  0  TwrShadow     - Calculate tower influence on wind based on downstream tower shadow? (switch) {0=none, 1=Powles m
True       TwrAero       - Calculate tower aerodynamic loads? (flag)
False      FrozenWake   - Assume frozen wake during linearization? (flag) [used only when WakeMod=1 and when linearizing]
True       CavitCheck   - Perform cavitation check? (flag) [AFAeroMod must be 1 when CavitCheck=true]
True       Buoyancy     - Include buoyancy effects? (flag)
False      CompAA        2]
"unused"   AA_InputFile
===== Environmental Conditions =====
"default"  AirDens      - Kinematic viscosity of working fluid (m2/s)
"default"  KinVisc      - Speed of sound in working fluid (m/s)
"default"  SpdSound     - Atmospheric pressure (Pa) [used only when CavitCheck=True]
"default"  Patm         - Vapour pressure of working fluid (Pa) [used only when CavitCheck=True]
"default"  Pvap
===== Blade-Element/Momentum Theory Options ===== [unused when WakeMod=0 or 3]
                  2  SkewMod      - Type of skewed-wake correction model (switch) {1=uncoupled, 2=Pitt/Peters, 3=coupled} [unused when WakeMod=0 or 3]
"default"  SkewModFactor - Constant used in Pitt/Peters skewed wake model {or "default" is 15/32*pi} (-) [used only when SkewMod=2]
True       TipLoss       - Use the Prandtl tip-loss model? (flag) [unused when WakeMod=0 or 3]
True       HubLoss       - Use the Prandtl hub-loss model? (flag) [unused when WakeMod=0 or 3]
True       TanInd        - Include tangential induction in BEMT calculations? (flag) [unused when WakeMod=0 or 3]
True       AIDrag        - Include the drag term in the axial-induction calculation? (flag) [unused when WakeMod=0 or 3]
True       TIDrag        - Include the drag term in the tangential-induction calculation? (flag) [unused when WakeMod=0,3 or 2]
"default"  IndToler     - Convergence tolerance for BEMT nonlinear solve residual equation {or "default"} (-) [unused when WakeMod=0 or 3]
                  1000 MaxIter     - Maximum number of iteration steps (-) [unused when WakeMod=0]
```

- BEM options, including optional correction models

# AeroDyn Primary Input File

- Dynamic BEM, OLAF, and unsteady aerodynamics model options

```
===== Dynamic Blade-Element/Momentum =====
      2 DBEMT_Mod           - Type of blade element method
      4 tau1_const           - Tip loss factor
===== OLAF -- cOnvecting LAgrangian =====
"unused"   OLAFInputFileName - Input file for OLAF [used only when WakeMod=3]
===== Beddoes-Leishman Unsteady Airfoil Aerodynamics Options =====
True        3 UAMod            - Unsteady Aero Model Switch (switch) {2=B-L Gonzalez, 3=B-L Minnema/Pierce, 4=B-L Ho
              FLookup          - Flag to indicate whether a lookup for f' will be calculated (TRUE) or whether best-fit polynomials will be used
              0 UAStartRad        - Starting radius for dynamic stall (fraction of rotor radius [0.0,1.0]) [used only when WakeMod=3]
              1 UAEEndRad         - Ending radius for dynamic stall (fraction of rotor radius [0.0,1.0]) [used only when WakeMod=3]
===== Airfoil Information =====
      2 AFTabMod           - Interpolation method for multiple airfoil tables {1=1D interpolation on AoA (first column), 2=2D
      1 InCol_Alfa          - The column in the airfoil tables that contains the angle of attack (-)
      2 InCol_Cl             - The column in the airfoil tables that contains the lift coefficient (-)
      3 InCol_Cd             - The column in the airfoil tables that contains the drag coefficient (-)
      0 InCol_Cm             - The column in the airfoil tables that contains the pitching-moment coefficient; use zero if not needed
      4 InCol_Cpmin          - The column in the airfoil tables that contains the Cpmin coefficient; use zero if not needed
      9 NumAFFiles          - Number of airfoil files used (-)
"Airfoils/NACA6_1000.dat" AFNames       - Airfoil file names (NumAFFiles lines) (quoted strings)
"Airfoils/NACA6_0864.dat"
"Airfoils/NACA6_0629.dat"
"Airfoils/NACA6_0444.dat"
"Airfoils/NACA6_0329.dat"
"Airfoils/NACA6_0276.dat"
"Airfoils/NACA6_0259.dat"
"Airfoils/NACA6_0247.dat"
"Airfoils/NACA6_0240.dat"
```

# AeroDyn Primary Input File

```
===== Dynamic Blade-Element/Momentum Theory Options ===== [used only when
|   2  DBEMT_Mod          - Type of dynamic BEMT (DBEMT) model {1=constant tau1, 2=time-dependent tau1, 3=const
|   4  tau1_const          - Time constant for DBEMT (s) [used only when WakeMod=2 and DBEMT_Mod=1 or 3]
===== OLAF -- cOnvecting LAgrangian Filaments (Free Vortex Wake) Theory Options ===== [used only when
"unused"    OLAFInputFileName - Input file for OLAF [used only when WakeMod=3]
===== Beddoes-Leishman Unsteady Airfoil Aerodynamics Options ===== [used only when
|   3  UAMod              - Unsteady Aero Model Switch (switch) {2=B-L Gonzalez, 3=B-L Minnema/Pierce, 4=B-L Ho
True        FLookup           - Flag to indicate whether a lookup for f' will be calculated (TRUE) or whether best-
|   0  UAStartRad         - Starting radius for dynamic stall (fraction of rotor radius [0.0,1.0]) [used only w
|   1  UAEndRad           - Ending radius for dynamic stall (fraction of rotor radius [0.0,1.0]) [used only wh
===== Airfoil Information =====
|   2  AFTabMod            - Interpolation method for multiple airfoil tables {1=1D interpolation on AoA (first
|   1  InCol_Alfa          - The column in the airfoil tables that contains the angle of attack (-)
|   2  InCol_Cl             - The column in the airfoil tables that contains the lift coefficient (-)
|   3  InCol_Cd             - The column in the airfoil tables that contains the drag coefficient (-)
|   0  InCol_Cm             - The column in the airfoil tables that contains the pitching-moment coefficient; use zero if t
|   4  InCol_Cpmin          - The column in the airfoil tables that contains the Cpmin coefficient; use zero if t
|   9  NumAFFiles           - Number of airfoil files used (-)
AFNames      - Airfoil file names (NumAFFiles lines) (quoted strings)
"Airfoils/NACA6_1000.dat"
"Airfoils/NACA6_0864.dat"
"Airfoils/NACA6_0629.dat"
"Airfoils/NACA6_0444.dat"
"Airfoils/NACA6_0329.dat"
"Airfoils/NACA6_0276.dat"
"Airfoils/NACA6_0259.dat"
"Airfoils/NACA6_0247.dat"
"Airfoils/NACA6_0240.dat"
```

- Specify airfoil input file format and names

# AeroDyn Primary Input File

- Specify blade input files

```
===== Rotor/Blade Properties =====
False      UseBlCm          - Include aerodynamic pitching moment in calculations? (flag)
"MHK_RM1_AeroDyn15_Blade.dat" ADBlFile(1)    - Name of file containing distributed aerodynamic properties
"MHK_RM1_AeroDyn15_Blade.dat" ADBlFile(2)    - Name of file containing distributed aerodynamic properties
"unused"     ADBlFile(3)    - Name of file containing distributed aerodynamic properties for Blade #3 (-) [used only]
===== Hub Properties =====
    7.2   VolHub            - Hub volume (m^3)
    0.2222  HubCenBx        - Hub center of buoyancy x direction offset (m)
===== Nacelle Properties ===== [used only]
    38.6   VolNac           - Nacelle volume (m^3)
    0.43,      0,           0   NacCenB       - Position of nacelle center of buoyancy from yaw bearing
===== Tail Fin Aerodynamics =====
False      TFinAero         - Calculate tail fin aerodynamics model (flag)
"unused"   TFinFile         - Input file for tail fin aerodynamics [used only when TFinAero=True]
===== Tower Influence and Aerodynamics ===== [used only]
    4   NumTwrNds          - Number of tower nodes used in the analysis (-) [used only when TwrPotent/=0, TwrElev<0]
TwrElev      TwrDiam          TwrCd           TwrTI           TwrCb ! TwrTI used only when TwrShadow=2; TwrCb used only when TwrShadow=1
(m)          (m)             (-)            (-)            (-)
-9.0000000E+00 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00
-1.4000000E+01 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00
-1.9000000E+01 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00
-2.4000000E+01 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00
```

# AeroDyn Primary Input File

```
===== Rotor/Blade Properties =====
False      UseBlCm          - Include aero
"MHK_RM1_AeroDyn15_Blade.dat" ADBlFile(1)
"MHK_RM1_AeroDyn15_Blade.dat" ADBlFile(2)
"unused"    ADBlFile(3)       - Name of file
===== Hub Properties =====
  7.2  VolHub              - Hub volume (m^3)
  0.2222  HubCenBx         - Hub center of buoyancy x direction offset (m)
===== Nacelle Properties ===== [used only]
  38.6  VolNac              - Nacelle volume (m^3)
  0.43,     0,           0  NaccenBx   - Nacelle center of buoyancy x direction offset (m)
===== Tail Fin Aerodynamics =====
False      TFinAero          - Calculate tail fin aerodynamics model (flag)
"unused"    TFinFile          - Input file for tail fin aerodynamics [used only when TFinAero=True]
===== Tower Influence and Aerodynamics ===== [used only]
  4  NumTwrNds             - Number of tower nodes used in the analysis (-) [used only when TwrPotent/=0,
TwrElev      TwrDiam          TwrCd        TwrTI        TwrCb ! TwrTI used only when TwrShadow=2; TwrCb us
(m)          (m)            (-)        (-)        (-)
-9.0000000E+00  3.2530000E-01  2.0000000E-01  0.0000000E+00  1.0000000E+00
-1.4000000E+01  3.2530000E-01  2.0000000E-01  0.0000000E+00  1.0000000E+00
-1.9000000E+01  3.2530000E-01  2.0000000E-01  0.0000000E+00  1.0000000E+00
-2.4000000E+01  3.2530000E-01  2.0000000E-01  0.0000000E+00  1.0000000E+00
```

- Specify hub buoyant properties
- Note that VolHub must  $\neq 0$  or blade root forces will be incorrect
- Specify nacelle buoyant properties

# AeroDyn Primary Input File

```
===== Rotor/Blade Properties =====
False      UseBlCm          - Include aerodynamic pitching moment in calculations? (flag)
"MHK_RM1_AeroDyn15_Blade.dat" ADBlFile(1)      - Name of file containing distributed aerodynamic properties
"MHK_RM1_AeroDyn15_Blade.dat" ADBlFile(2)      - Name of file containing distributed aerodynamic properties
"unused"    ADBlFile(3)      - Name of file containing distributed aerodynamic properties for Blade #3 (-) [used only]
===== Hub Properties =====
    7.2   VolHub            - Hub volume (m^3)
  0.2222  HubCenBx        - Hub center of buoyancy x direction offset (m)
===== Nacelle Properties ===== [used only]
  38.6   VolNac            - Nacelle volume (m^3)
  0.43,     0,           0   NacCenB            - Position of nacelle center of buoyancy from yaw bearing
===== Tail Fin Aerodynamics =====
False      TFinAero         - Calculate tail fin aerodynamics model (flag)
"unused"    TFinFile        - Input file for tail fin aerodynamics [used only when TFinAero=True]
===== Tower Influence and Aerodynamics ===== [used only]
    4   NumTwrNds          - Number of tower nodes used in the analysis (-) [used only when TwrPotent/=0, TwrElev<0]
TwrElev    TwrDiam          TwrCd             TwrTI             TwrCb
(m)        (m)              (-)              (-)              (-)
-9.0000000E+00 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00
-1.4000000E+01 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00
-1.9000000E+01 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00
-2.4000000E+01 3.2530000E-01 2.0000000E-01 0.0000000E+00 1.0000000E+00 }
```

- Tower geometric, hydrodynamic, and buoyant properties

# AeroDyn Primary Input File

```
===== Outputs =====
True      SumPrint      - Generate a summary file listing input options and interpolated properties to "<root>
          9  NBlOuts      - Number of blade node outputs [0 - 9] (-)
          1,      5,      9,      13,      17,      21,      25,      27,      30  BlOutNd
          4  NTwOuts      - Number of tower node outputs [0 - 9] (-)
          1,      2,      3,      4  TwOutNd      - Tower nodes whose values will be output (-)
          OutList      - The next line(s) contains a list of output parameters. See OutListParameters.xlsx -
"TwN1Fbx"
"TwN3Fby"
"TwN4Fbz"
"TwN1Mbx"
"TwN2Mby"
"TwN3Mbz"
"B2N4Fbn"
"B1N7Fbt"
"B2N8Fbs"
"B1N2Mbn"
"B2N3Mbt"
"B1N6Mbs"
"B1FlxFz"
"B2FlxFm"
"HbFbx"
"HbFby"
"HbFbz"
"HbMbx"
"HbMby"
"HbMbz"
"NcFbx"
"NcFby"
"NcFbz"
"NcMbx"
"NcMby"
"NcMbz"
"RtFlxFxh"
"RtFlxFyh"
"RtFlxFzg"
"RtFlxFmh"
"RtFlfMyg"
"RtFlfMzh"
"B1N3SigCr"
"B2N5SigCr"
"B1N2SgCav"
"B2N6SgCav"
          - x-component of buoyant force per unit length at Tw node 1
          - y-component of buoyant force per unit length at Tw node 3
          - z-component of buoyant force per unit length at Tw node 4
          - x-component of buoyant moment per unit length at Tw node 6
          - y-component of buoyant moment per unit length at Tw node 5
          - z-component of buoyant moment per unit length at Tw node 2
          - Buoyant force normal to chord per unit length at blade 2 node 4
          - Buoyant force tangential to chord per unit length at blade 1 node 7
          - Buoyant spanwise force per unit length at blade 2 node 8
          - Buoyant moment normal to chord per unit length at blade 1 node 2
          - Buoyant moment tangential to chord per unit length at blade 2 node 3
          - Buoyant spanwise mo
          - Total blade aerodyn
          - Total blade aerodyn
          - x-component of buoy
          - y-component of buoy
          - z-component of buoy
          - x-component of buoy
          - y-component of buoyant moment at hub node
          - z-component of buoyant moment at hub node
          - x-component of buoyant force at nacelle node
          - y-component of buoyant force at nacelle node
          - z-component of buoyant force at nacelle node
          - x-component of buoyant moment at nacelle node
          - y-component of buoyant moment at nacelle node
          - z-component of buoyant moment at nacelle node
          - Total rotor aerodynamic/hydrodynamic and buoyant load (force in x direction)
          - Total rotor aerodynamic/hydrodynamic and buoyant load (force in y direction)
          - Total rotor aerodynamic/hydrodynamic and buoyant load (force in global z direction)
          - Total rotor aerodynamic/hydrodynamic and buoyant load (moment in x direction)
          - Total rotor aerodynamic/hydrodynamic and buoyant load (moment in global y direction)
          - Total rotor aerodynamic/hydrodynamic and buoyant load (moment in z direction)
          - Critical cavitation number blade 1 node 3
          - Critical cavitation number blade 2 node 5
          - Cavitation number blade 1 node 2
          - Cavitation number blade 2 node 6
```

- Specify formatting of outputs written to file
- Select blade/tower nodes for output

# InflowWind Primary Input File

```
----- InflowWind INPUT FILE -----
Steady 1.9 m/s inflow for floating MHK turbine, based on the RM1 tidal current rotor

----- Parameters for WindType -----
False      Echo          - Echo input data to <RootName>.ech (flag)
           1 WindType       - switch for wind file type (1=steady; 2=uniform; 3=binary TurbSim FF; 4=binary Bladed-style FF; 5=binary HAWC FF; 6=binary HAWC binary; 7=binary Bladed-style binary; 8=binary TurbSim binary; 9=binary HAWC binary)
           0 PropagationDir - Direction of wind propagation (meteorological rotation from aligned with X (positive rotation) to aligned with Y (positive rotation))
           0 VFlowAng        - Upflow angle (degrees) (not used for native Bladed format WindType=7)
False      VelInterpCubic - Use cubic interpolation for velocity in time (false=linear, true=cubic) [Used with WindType=1]
           1 NWindVel        - Number of wind velocity components
           0 WindVxiList     - List
           0 WindVyList      - List
           24.8 WindVziList   - List
===== Parameters for Steady =====
           1.9 HWindSpeed    - Horizontal wind speed
           24.8 RefHt         - Reference height
           0.1429 PLExp        - Power law exponent
===== Parameters for Uniform =====
"unused"  FileName_Uni   - File name for uniform wind
           30 RefHt_Uni       - Reference height
           125.88 RefLength    - Reference length
===== Parameters for Binary TurbSim Full-Field files [used only for WindType = 3] =====
"unused"  FileName_BTS   - Name of the Full field wind file to use (.bts)
===== Parameters for Binary Bladed-style Full-Field files [used only for WindType = 4 or WindType = 7] =====
"unused"  FileNameRoot   - WindType=4: Rootname of the full-field wind file to use (.wnd, .sum); WindType=7: name of the tower file (.twr)
False      TowerFile      - Have tower file (.twr) (flag) ignored when WindType = 7
===== Parameters for HAWC-format binary files [Only used with WindType = 5] =====
"unused"  FileName_u      - name of the file containing the u-component fluctuating wind (.bin)
"unused"  FileName_v      - name of the file containing the v-component fluctuating wind (.bin)
"unused"  FileName_w      - name of the file containing the w-component fluctuating wind (.bin)
```

- Type of wind specification

- Steady
- Uniform
- TurbSim
- Bladed
- HAWC
- Etc.

# InflowWind Primary Input File

```
----- InflowWind INPUT FILE -----
Steady 1.9 m/s inflow for floating MHK turbine, based on the RM1 tidal current rotor

----- Parameters for Steady Wind Conditions [used only for WindType = 1] -----
    1.9 HWindSpeed      - Horizontal wind speed          (m/s)
    24.8 RefHt           - Reference height for horizontal wind speed (m)
    0.1429 PLExp         - Power law exponent          (-)

----- Parameters for Uniform wind file [used only for WindType = 2] -----
"unused"   FileName_Uni  - Filename of time series data for uniform wind field (.bin)
    30     RefHt_Uni      - Reference height             (m)
    125.88 RefLength       - Reference length            (m)

----- Parameters for Binary -----
"unused"   FileName_BTS   - Name of the binary file (.bin)
----- Parameters for Binary -----
"unused"   FileNameRoot    - WindType=4
False      TowerFile       - Have tower file (True/False)

----- Parameters for HAWC-format -----
"unused"   FileName_u      - name of the u-component file (.bin)
"unused"   FileName_v      - name of the v-component file (.bin)
"unused"   FileName_w      - name of the w-component fluctuating wind (.bin)
```

- Steady current speed
  - Should match current speed in SeaState
  - Future release will couple the current from inflow wind and waves from SeaState
- Reference height
- Shear exponent

# HydroDyn Primary Input File

```
-- HydroDyn Input File --
Floating MHK turbine hydrodynamic support structure
False           Echo
                - Echo the input file
                - Potential flow
                - Wave-excitation
                - Method of characteristics
                - Cutoff (coincidence)
                - Radiation damping
                - Analysis type
                - Time step
                - Number of WAMIT bodies to be used (-) [>=1; only used when PotMod=1. If NBodyMod=1, the WAMIT bodies are defined by the PtfmVol0 parameter]
                - Body coupling model {1: include coupling terms between each body and NBody in HydroDyn equations}
                - Root name of potential-flow model data; WAMIT output files containing the linear, nondimensionalized hydrodynamic coefficients
                - Characteristic body length scale used to redimensionalize WAMIT output (meters) [1 to NBody]
                - The xt offset of the body reference point(s) from (0,0,0) (meters) [1 to NBody] [only used when PtfmRefxt is specified]
                - The yt offset of the body reference point(s) from (0,0,0) (meters) [1 to NBody] [only used when PtfrmRefyt is specified]
                - The zt offset of the body reference point(s) from (0,0,0) (meters) [1 to NBody] [only used when PtfrmRefzt is specified]
                - The rotation about zt of the body reference frame(s) from xt/yt (degrees) [1 to NBody] [only used when PtfrmRefztr is specified]
                - Displaced volume of water when the body is in its undisplaced position (m^3) [1 to NBody]
                - The xt offset of the center of buoyancy (COB) from (0,0) (meters) [1 to NBody] [only used when PtfrmCOBxt is specified]
                - The yt offset of the center of buoyancy (COB) from (0,0) (meters) [1 to NBody] [only used when PtfrmCOByt is specified]
--> FLOATING PLATFORM
    1   PotMod
    1   ExctnMod
    0   ExctnDisp
    0   ExctnCutOff
    1   RdtmMod
    60  RdtmTMax
    "DEFAULT" RdtmDT
    1   NBody
    2   NBodyMod
--> "MHK_RM1_Floating"  PotFile
    1   WAMITULEN
    0   PtfrmRefxt
    0   PtfrmRefyt
    0   PtfrmRefzt
    0   PtfrmRefztr
    2671.85 PtfrmVol0
    0   PtfrmCOBxt
    0   PtfrmCOByt
--> 2ND-ORDER FLOATING PLATFORM FORCES
    0   MnDrift
    0   NewmanApp
    0   DiffQTF
    0   SumQTF
```

- Define if potential flow is used
- Point to WAMIT files
- Platform volume should match WAMIT.hst or be 0 if potential flow is not used
  - Full strip theory Morrison elements often used for slender membered platforms
- 2<sup>nd</sup> order potential flow forces available

# HydroDyn Primary Input File

- Additional matrices can be added
    - Often used to tune to free decays
  - Only applied if potential flow files are present
  - Dummy files can be used if additional matrices are desired with full strip theory elements

# HydroDyn Primary Input File

AXIAL COEFFICIENTS							
AxCoefID	AxCd	AxCa	AxCp	AxFDMod	AxVnCOff	AxFDLoFSc	
(-)	(-)	(-)	(-)	(-)	(-)	(-)	
1	0.00	0.00	0.00	0	-1.00	1.00	! Columns / Braces (r)
2	1.00	1.00	1.00	0	-1.00	1.00	! Heave Plates

MEMBER JOINTS						
JointID	Jointxi	Jointyi	Jointzi	JointAxID	JointOvrlp [JointOvrlp= 0: do nothing]	
(-)	(m)	(m)	(m)	(-)	(switch)	
0	28.00000	0.00000	-10.00000	1	0	! Downstream Column
1	28.00000	0.00000	6.00000	1	0	! Upstream Column
2	-28.00000	0.00000	-10.00000	1	0	! Starboard Column
3	-28.00000	0.00000	6.00000	1	0	! Port Column
4	0.00000	-12.00000	-10.00000	1	0	! Upper Braces
5	0.00000	-12.00000	6.00000	1	0	
6	0.00000	12.00000	-10.00000	1	0	
7	0.00000	12.00000	6.00000	1	0	
8	3.67658	10.42430	4.50000	1	0	
9	24.32340	1.57568	4.50000	1	0	
10	3.67658	-10.42430	4.50000	1	0	
11	24.32340	-1.57568	4.50000	1	0	
12	-3.67658	10.42430	4.50000	1	0	
13	-24.32340	1.57568	4.50000	1	0	
14	-3.67658	-10.42430	4.50000	1	0	
15	-24.32340	-1.57568	4.50000	1	0	! Lower Brace
16	3.67658	10.42430	-8.50000	1	0	
17	24.32340	1.57568	-8.50000	1	0	
18	3.67658	-10.42430	-8.50000	1	0	
19	24.32340	-1.57568	-8.50000	1	0	
20	-3.67658	10.42430	-8.50000	1	0	
21	-24.32340	1.57568	-8.50000	1	0	
22	-3.67658	-10.42430	-8.50000	1	0	
23	-24.32340	-1.57568	-8.50000	1	0	
24	0.00000	-8.00000	4.50000	1	0	! Tower Braces
25	0.00000	8.00000	4.50000	1	0	
26	0.00000	-8.00000	-8.50000	1	0	
27	0.00000	8.00000	-8.50000	1	0	
28	0.00000	0.00000	-8.50000	1	0	
29	28.00000	0.00000	-10.50000	2	0	
30	-28.00000	0.00000	-10.50000	2	0	
31	0.00000	-12.00000	-10.50000	2	0	
32	0.00000	12.00000	-10.50000	2	0	! Heave Plates

- Member axial drag and added mass forces

- Define location of all platform joints
- Corresponding axial force ID
- Ovrlp turns off axial forces for members that intersect other members

# HydroDyn Primary Input File

----- MEMBER CROSS-SECTION PROPERTIES -----		
PropSetID	PropD (m)	PropThck (m)
0	8.00000	0.02000
1	2.00000	0.02000
2	2.00000	0.08100
3	12.00000	0.39250

! Columns  
! Braces  
! Flooded Braces (not flooded in hydrodyn)  
! Flooded Heave Plates (not flooded in hydrodyn)

----- SIMPLE HYDRODYNAMIC COEFFICIENTS (model 1) -----											
SimplCd	SimplCdMG	SimplCa	SimplCaMG	SimplCp	SimplCpMG	SimplAxCd	SimplAxCdMG	SimplAxCa	SimplAxCaMG	SimplAxCp	SimplAxCpMG
(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1.20	0.00	1.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00

----- DEPTH-BASED HYDRODYNAMIC COEFFICIENTS (model 2) -----												
Dpth	DpthCd	DpthCdMG	DpthCa	DpthCaMG	DpthCp	DpthCpMG	DpthAxCd	DpthAxCdMG	DpthAxCa	DpthAxCaMG	DpthAxCp	DpthAxCpMG
(m)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)

----- MEMBER-BASED HYDRODYNAMIC COEFFICIENTS (model 3) -----											
MemberID	MemberCd1	MemberCd2	MemberCdMG1	MemberCdMG2	MemberCa1	MemberCa2	MemberCaMG1	MemberCaMG2	MemberCp1	MemberCp2	
(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	

• Member ID with diameter

- Member hydrodynamic coefficients
- Can apply to all members
- Can be grouped by member ID or by depth

# HydroDyn Primary Input File

----- MEMBERS -----										
MemberID	MJointID1	MJointID2	MPropSetID1	MPropSetID2	MDivSize (m)	MCoefMod (switch)	MHstLMod (switch)	PropPot (flag)	[MCoefMod=1: use simp	
									20 NMembers	- Number of members (-)
(-)	(-)	(-)	(-)	(-)	(m)	(switch)	(switch)	(flag)		
0	0	1	0	0	0.1000	1	1	TRUE	! Columns	
1	2	3	0	0	0.1000	1	1	TRUE		
2	4	5	0	0	0.1000	1	1	TRUE		
3	6	7	0	0	0.1000	1	1	TRUE		
4	8	9	1	1	0.1000	1	1	TRUE	! Upper Braces	
5	10	11	1	1	0.1000	1	1	TRUE		
6	12	13	1	1	0.1000	1	1	TRUE		
7	14	15	1	1	0.1000	1	1	TRUE		
8	16	17	2	2	0.1000	1	1	TRUE	! Lower Braces	
9	18	19	2	2	0.1000	1	1	TRUE		
10	20	21	2	2	0.1000	1	1	TRUE		
11	22	23	2	2	0.1000	1	1	TRUE		
12	24	25	1	1	0.1000	1	1	TRUE	! Tower Braces	
13	26	27	1	1	0.1000	1	1	TRUE		
14	24	28	1	1	0.1000	1	1	TRUE		
15	25	28	1	1	0.1000	1	1	TRUE		
16	0	29	3	3	0.1000	1	1	TRUE	! Heave Plates	
17	2	30	3	3	0.1000	1	1	TRUE		
18	4	31	3	3	0.1000	1	1	TRUE		
19	6	32	3							

- Members connect between defined joints
- Assign property ID

# HydroDyn Primary Input File

```
-- FILLED MEMBERS --
| | | | 0 NFillGroups      - Number of filled member groups (-) [If FillDens = DEFAULT, then FillDens = WtrDens;
FillNumM FillMList           FillFSLoc   FillDens
(-)      (-)                  (m)        (kg/m^3)
-- MARINE GROWTH --
| | | | 0 NMGDepths       - Number of marine-growth depths specified (-)
MGDpth   MGThck    MGDenS
(m)       (m)        (kg/m^3)
-- MEMBER OUTPUT LIST --
| | | | 0 NMOutputs       - Number of member ou
MemberID  NOutLoc   NodeLocs [NOutLoc < 10; node locations are normalized distance from the start of the member, and
| (-)      (-)        (-)
-- JOINT OUTPUT LIST --
| | | | 0 NJOutputs       - Number of joint outputs [Must be < 10]
| | | | 0 JOutLst         - List of JointIDs which are to be output (-)[unused if NJOutputs=0]
-- OUTPUT --
True      HDSum          - Output a summary file [flag]
False     OutAll          - Output all user-specified member and joint loads (only at each member end, not inter
| | | | 2 OutSwtch        - Output requested channels to: [1=Hydrodyn.out, 2=GlueCode.out, 3=both files]
"E15.7e2"  OutFmt         - Output format for numerical results (quoted string) [not checked for validity!]
"A11"     OutSFmt         - Output format for header strings (quoted string) [not checked for validity!]
-- OUTPUT CHANNELS --
Wave1Elev          - Wave elevation at the platform reference point (0, 0)
HydroFxi           - Buoyancy force [N]
HydroFyi           - Buoyancy force [N]
HydroFzi           - Buoyancy force [N] in the vertical direction (Z).
END of output channels and end of file. (the word "END" must appear in the first 3 columns of this line)
```

- Ballast included in platform mass and inertia instead of filled members
- List outputs

# SeaState Primary Input File

```
----- SeaState Input File -----
Floating MHK turbine hydrodynamic support structure input properties, based on the RM1 tidal current rotor with a
False          Echo           - Echo the input file data (flag)
----- ENVIRONMENTAL CONDITIONS -----
"DEFAULT"      WtrDens        - Water density (kg/m^3)
"DEFAULT"      WtrDpth        - Water depth (meters) relative to MSL
"DEFAULT"      MSL2SWL       - Offset between still-water level and mean sea level (meters) [positive upward];
----- SPATIAL DISCRETIZATION -----
 30  X_HalfWidth    Half-width of the domain in the X direction (m) [>0, NOTE: X[nX] = nX*dX, where
 30  Y_HalfWidth    Half-width of the domain in the Y direction (m) [>0, NOTE: Y[nY] = nY*dY, where
 50  Z_Depth        Depth of the domain the Z direction (m) relative to SWL [0 < Z_Depth <= WtrDpth]
 11  NX             Number of nodes in half of the X-direction domain (-) [>=2]
 11  NY             Number of nodes in half of the Y-direction domain (-) [>=2]
 10  NZ             Number of nodes in the Z direction (-) [>=2]
```

- Define grid for wave generation
- Should cover full expected range of displacements

# SeaState Primary Input File

WAVES		- Incident wave kinematics model {0: none=still water, 1: regular (periodic), 1P#: regular with user-specified phase, 2: random, 3: narrow banded, 4: wide banded, 5: narrow multi-peaked, 6: wide multi-peaked, 7: user input time series} [only used when WaveMod=1 or 2]
1	WaveMod	- Incident wave kinematics model {0: none=still water, 1: regular (periodic), 1P#: regular with user-specified phase, 2: random, 3: narrow banded, 4: wide banded, 5: narrow multi-peaked, 6: wide multi-peaked, 7: user input time series} [only used when WaveMod=1 or 2]
0	WaveStMod	- Model for stretching incident wave kinematics to instantaneous free surface {0: none=no stretching, 1: vertical stretch}
600	WaveTMax	- Analysis time for incident wave calculations (sec) [unused when WaveMod=0; determines WaveDOmega=2Pi/WaveTMax in the analysis time calculation]
0.1	WaveDT	- Time step for incident wave calculations (sec) [unused when WaveMod=0 or 7; 0.1<=WaveDT<=1.0 recommended; determined by WaveTMax]
2.0	WaveHs	- Significant wave height of incident waves (meters) [used only when WaveMod=1, 2, or 3]
6.75	WaveTp	- Peak-spectral period of incident waves (sec) [used only when WaveMod=1 or 2]
"DEFAULT"	WavePkShp	- Peak-shape parameter of incident wave spectrum (-) or DEFAULT (string) [used only when WaveMod=2; use 1.0 for Pierson-Moskowitz spectrum]
0.314159	WvLowCOff	- Low cut-off frequency for incident wave spectrum (rad/s)
1.570796	WvHiCOff	- High cut-off frequency for incident wave spectrum (rad/s)
0	WaveDir	- Incident wave propagation direction (degrees) [only used when WaveMod=2, 3, or 4]
0	WaveDirMod	- Directional spread of incident wave spectrum (degrees) [only used when WaveMod=2, 3, or 4]
1	WaveDirSpread	- Wave direction spread (degrees) [only used when WaveMod=2, 3, or 4]
1	WaveNDir	- Number of wave directions (0 to 360) [only used when WaveMod=2, 3, or 4]
0	WaveDirRange	- Range of wave directions (full range: waveDir +/- 1/2*waveDirRange) (degrees) [only used when waveMod=2, 3, or 4 and WaveDirMod>0]
123456789	WaveSeed(1)	- First random seed of incident waves [-2147483648 to 2147483647] (-) [unused when WaveMod=0, 5, or 6]
"RANLUX"	WaveSeed(2)	- Second random seed of incident waves [-2147483648 to 2147483647] for intrinsic pRNG, or an alternative pRNG: "RanLux"
FALSE	WaveNDamp	- Flag for normally distributed amplitudes (flag) [only used when WaveMod=2, 3, or 4]
" "	WvKinFile	- Root name of externally generated wave data file(s) (quoted string) [used only when WaveMod=5, 6 or 7]
2ND-ORDER WAVES		[unused with WaveMod=0 or 6]
FALSE	WvDiffQTF	- Full difference-frequency 2nd-order wave kinematics (flag)
FALSE	WvSumQTF	- Full summation-frequency 2nd-order wave kinematics (flag)
0	WvLowCOffD	- Low frequency cutoff used in the difference-frequencies (rad/s) [Only used with a difference-frequency method]
1.256637	WvHiCOffD	- High frequency cutoff used in the difference-frequencies (rad/s) [Only used with a difference-frequency method]
0.618319	WvLowCOffS	- Low frequency cutoff used in the summation-frequencies (rad/s) [Only used with a summation-frequency method]
3.141593	WvHiCOffS	- High frequency cutoff used in the summation-frequencies (rad/s) [Only used with a summation-frequency method]

- Regular wave
- Options for irregular wave and user input time series

# SeaState Primary Input File

```
-- CURRENT ----- [unused with WaveMod=6]
  1 CurrMod      - Current profile model {0: none=no current, 1: standard, 2: user-defined from routine User
  0 CurrSSV0     - Sub-surface current velocity at still water level (m/s) [used only when CurrMod=1]
  0 CurrSSDir    - Sub-surface current heading direction (degrees) or DEFAULT (string) [used only when CurrM
12.2 CurrNSRef   - Near-surface current reference depth                      (meters) [used only when CurrMod=1]
  0 CurrNSV0     - Near-surface current velocity at still water level (m/s) [used only when CurrMod=1]
  0 CurrNSDir    - Near-surface current heading direction                  (degrees) [used only when CurrMod=1]
  1.9 CurrDIV    - Depth-independent current velocity                   (m/s) [used only when CurrMod=1]
  0 CurrDIDir    - Depth-independent current heading direction       (degrees) [used only when CurrMod=1]
-- MacCamy-Fuchs diffraction model -----
  0 MCFD         - MacCamy-Fuchs member radius (ignored if radius <= 0) [must be 0 when WaveMod 0 or 6]
-- OUTPUT -----
True          SeaStSum      - Output a s
  2 OutSwtch     - Output re
  "E15.7e2"     OutFmt        - Output fo
  "A11"          OutSFmt      - Output fo
  1 NWaveElev    - Number of
  0 WaveElevxi   - List of xi-coordinates for points where the incident wave elevations can be output (meter
  0 WaveElevyi   - List of yi-coordinates for points where the incident wave elevations can be output (meter
  2 NWaveKin    - Number of points where the wave kinematics can be output (-) [maximum of 9 output l
  14.43376,     -18.4752   WaveKinxi  - List of xi-coordinates for points where the wave kinematics can be output (met
  25,           -6          WaveKinyi  - List of yi-coordinates for points where the wave kinematics can be output (met
  -14,          -17         WaveKinzi - List of zi-coordinates for points where the wave kinematics can be output (met
-- OUTPUT CHANNELS -----
"Wave1Elev"    - Wave elevation at the platform reference point
END of output channels and end of file. (the word "END" must appear in the first 3 columns of this line)
```

• Current speed  
• Should match inflow wind  
• Future release will couple to inflow wind

# MoorDyn Primary Input File

```
----- MoorDyn Input File -----
Floating MHK turbine mooring input properties, based on the RM1 tidal current rotor with a quad-style
FALSE    Echo      - echo the input file data (flag)
----- LINE TYPES Chain studless 0.018m -----
Name     Diam     MassDen     EA          BA/-zeta   EI    Cd    Ca    CdAx   CaAx
(--)     (m)      (kg/m)     (N)        (N-s/-)   (-)   (-)   (-)   (-)    (-)
main    0.324    644.8     85.4e8    -0.8       0.8   2.4   1.0   1.15   0.5
----- POINTS -----
Node    Type      X          Y          Z          M          V          CdA    CA
(--)    (-)      (m)        (m)        (m)        (kg)       (m^3)      (m^2)   (-)
1       Fixed    -152.0    -50.0     -50.0     0           0           0       0
2       Fixed    -152.0     0.0      -50.0     0           0           0       0
3       Fixed    -152.0     50.0     -50.0     0           0           0       0
4       Fixed    152.0    -50.0     -50.0     0           0           0       0
5       Fixed    152.0     0.0      -50.0     0           0           0       0
6       Fixed    152.0     50.0     -50.0     0           0           0       0
7       Vessel   -34.0     0.0      -10.0     0           0           0       0
8       Vessel   -34.0     0.0      -10.0     0           0           0       0
9       Vessel   -34.0     0.0      -10.0     0           0           0       0
10      Vessel   34.0     0.0      -10.0     0           0           0       0
11      Vessel   34.0     0.0      -10.0     0           0           0       0
12      Vessel   34.0     0.0      -10.0     0           0           0       0
```

- Define line properties
- New release includes bending

- Define fairlead and anchor locations
- If multiple line types or mooring components are used – define initial location

# MoorDyn Primary Input File

LINES							
Line	LineType	AttachA	AttachB	UnstrLen	NumSegs	Outputs	(-)
1	main	1	7	160.0	30	-	
2	main	2	8	152.0	30	-	
3	main	3	9	160.0	30	-	
4	main	4	10	160.0	30	-	
5	main	5	11	152.0	30	-	
6	main	6	12	160.0	30	-	

SOLVER OPTIONS							
0.5e-4	dtM	-	time step to use in mooring integration (s)				
3.0e6	kbot	-	bottom stiffness (Pa/m)				
3.0e5	cbot	-	bottom damping (Pa-s/m)				
1.0	dtIC	-	time interval for analyzing convergence during IC gen (s)				
10.0	TmaxIC	-	max time for ic gen (s)				
4.0	CdScaleIC	-	factor by which to scale drag coefficients during dynamic relaxation (-)				
0.1	threshIC	-	threshold for IC convergence (-)				

- Lines connect between defined points

- Bottom stiffness must support chain
- Time and time step used in initialization convergence

# Supporting Files

- ElastoDyn blade structural properties
  - Pre-calculated mode shapes
- ElastoDyn tower structural properties
  - Pre-calculated mode shapes
- AeroDyn blade geometric properties
- AeroDyn blade aerodynamic properties
- Foil polars

# Running OpenFAST

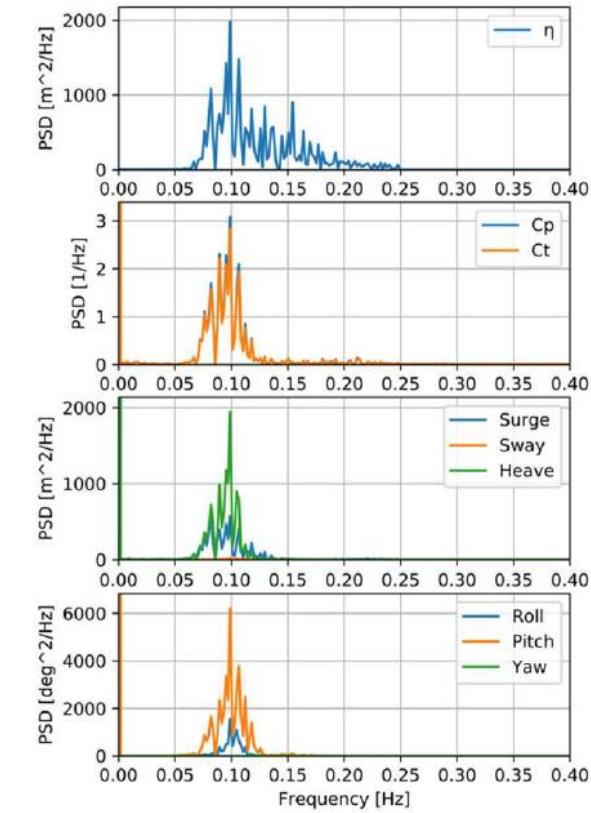
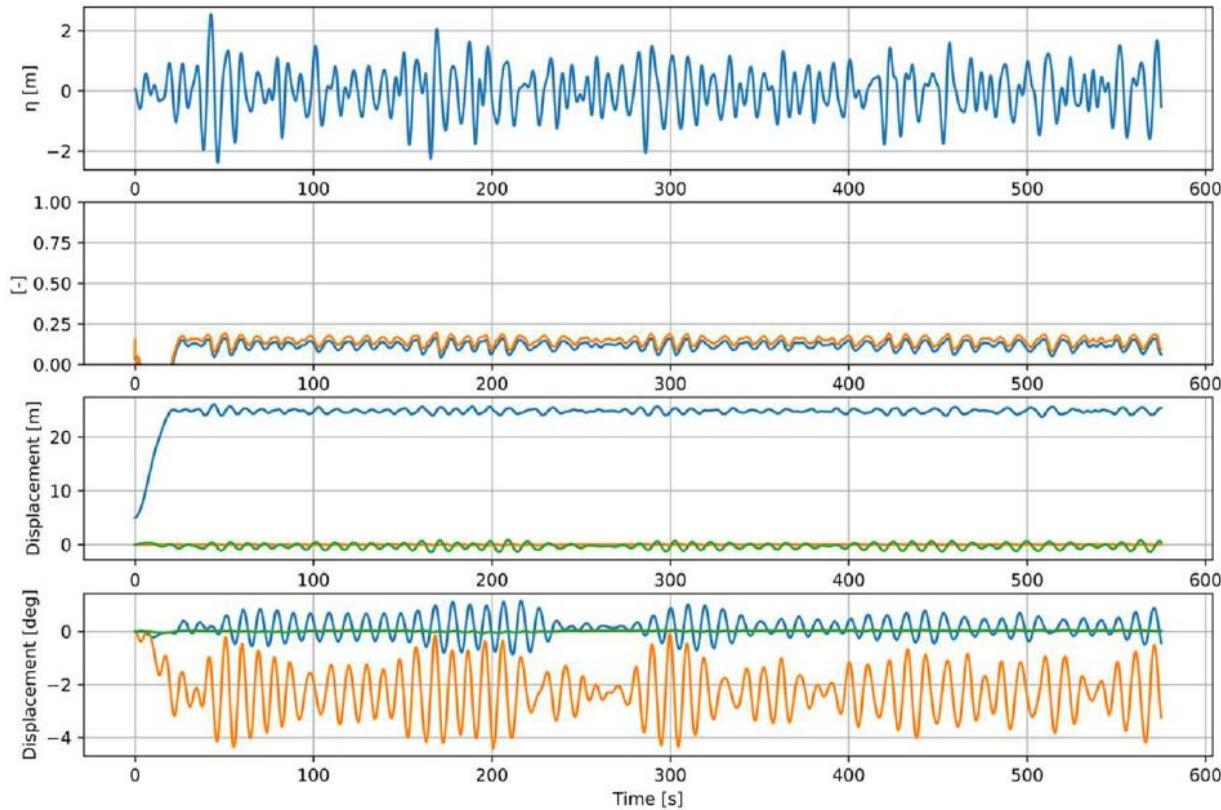
- In a terminal, navigate to the folder containing the relevant OpenFAST executable for your system and the simulation input files
- For Mac users, run OpenFAST using the following command for the example
  - ./openfast\_Mac “Onshore/ MHK\_RM1\_Floating.fst”
- For Windows users, run OpenFAST using the following command for the example
  - openfast\_Windows.exe Onshore\ MHK\_RM1\_Floating.fst
- For Linux users, run OpenFAST using the following command for the example
  - ./openfast\_Linux Onshore/MHK\_RM1\_Floating.fst

# OpenFAST Outputs

- Summary files
  - OpenFAST (MHK\_RM1\_Floating.sum)
  - ElastoDyn (MHK\_RM1\_Floating.sum)
  - AeroDyn (MHK\_RM1\_Floating.sum)
- Output file
  - MHK\_RM1\_Floating.out

Predictions were generated on 16-Jan-2022 at 20:07:40 using OpenFAST, compiled as a 64-bit application using double precision at commit v3.0.0 linked with NWTC Subroutine Library; ElastoDyn; InflowWind; AeroDyn																			
Description from the FAST input file: MECC OpenFAST Webinar: NREL 5.0 MW Baseline Wind Turbine (Onshore)																			
Time	Wind1VelX	Wind1VelY	Wind1VelZ	OoPDefl1	IPDefl1	TwstDefl1	BldPitch1	Azimuth	RotSpeed	GenSpeed	TTDspFA	TTDspSS	TTDspTwst	Spn2MLxb1	Spn2MLyb1	RootFxb1	RootFyb1		
(s)	(m/s)	(m/s)	(m/s)	(m)	(deg)	(deg)	(rpm)	(rpm)	(kN-m)	(kN)	(kN)	(kN-m)	(kN-m)	(kN-m)	(kN-m)	(kN)	(kN)	(kN)	
0.0000	8.000E+00	-0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.000E+00	8.730E+02	0.000E+00	-0.000E+00	0.000E+00	3.179E+00	-8.463E+00				
0.0125	8.000E+00	-0.000E+00	0.000E+00	4.536E-03	-7.934E-05	0.000E+00	0.000E+00	6.752E-01	9.005E+00	8.730E+02	-6.648E-06	-9.360E-08	0.000E+00	2.637E+00	-1.772E+01				
0.0250	8.000E+00	-0.000E+00	0.000E+00	1.753E-02	-2.317E-04	0.000E+00	0.000E+00	1.351E+00	9.010E+00	8.730E+02	-2.619E-05	-1.031E-06	0.000E+00	-4.740E+00	-1.089E+01				
0.0375	8.000E+00	-0.000E+00	0.000E+00	3.791E-02	-3.428E-04	0.000E+00	0.000E+00	2.027E+00	9.014E+00	8.730E+02	-5.740E-05	-3.834E-06	0.000E+00	-1.259E+01	-1.121E+00				
0.0500	8.000E+00	-0.000E+00	0.000E+00	6.530E-02	-5.111E-04	0.000E+00	0.000E+00	2.703E+00	9.018E+00	8.730E+02	-9.823E-05	-9.546E-06	0.000E+00	-2.322E+01	1.254E+01				
0.0625	8.000E+00	-0.000E+00	0.000E+00	9.902E-02	-8.166E-04	0.000E+00	0.000E+00	3.379E+00	9.020E+00	8.730E+02	-1.460E-04	-1.920E-05	0.000E+00	-3.524E+01	2.920E+01				
0.0750	8.000E+00	-0.000E+00	0.000E+00	1.385E-01	-1.409E-03	0.000E+00	0.000E+00	4.056E+00	9.021E+00	8.730E+02	-1.973E-04	-3.379E-05	0.000E+00	-4.819E+01	4.890E+01				
0.0875	8.000E+00	-0.000E+00	0.000E+00	1.833E-01	-2.459E-03	0.000E+00	0.000E+00	4.732E+00	9.020E+00	8.730E+02	-2.481E-04	-5.421E-05	0.000E+00	-6.136E+01	7.130E+01				
0.1000	8.000E+00	-0.000E+00	0.000E+00	2.329E-01	-4.153E-03	0.000E+00	0.000E+00	5.409E+00	9.018E+00	8.730E+02	-2.940E-04	-8.127E-05	0.000E+00	-7.405E+01	9.622E+01				
0.1125	8.000E+00	-0.000E+00	0.000E+00	2.869E-01	-6.672E-03	0.000E+00	0.000E+00	6.085E+00	9.014E+00	8.730E+02	-3.300E-04	-1.156E-04	0.000E+00	-8.555E+01	1.235E+02				
0.1250	8.000E+00	-0.000E+00	0.000E+00	3.448E-01	-1.018E-02	0.000E+00	0.000E+00	6.761E+00	9.010E+00	8.730E+02	-3.508E-04	-1.577E-04	0.000E+00	-9.529E+01	1.529E+02				
0.1375	8.000E+00	-0.000E+00	0.000E+00	4.063E-01	-1.481E-02	0.000E+00	0.000E+00	7.436E+00	9.004E+00	8.730E+02	-3.510E-04	-2.078E-04	0.000E+00	-1.028E+02	1.843E+02				
0.1500	8.000E+00	-0.000E+00	0.000E+00	4.711E-01	-2.066E-02	0.000E+00	0.000E+00	8.112E+00	8.999E+00	8.730E+02	-3.249E-04	-2.660E-04	0.000E+00	-1.083E+02	2.174E+02				
0.1625	8.000E+00	-0.000E+00	0.000E+00	5.388E-01	-2.777E-02	0.000E+00	0.000E+00	8.786E+00	8.994E+00	8.730E+02	-2.670E-04	-3.322E-04	0.000E+00	-1.102E+02	2.520E+02				
0.1750	8.000E+00	-0.000E+00	0.000E+00	6.086E-01	-3.611E-02	0.000E+00	0.000E+00	9.461E+00	8.989E+00	8.730E+02	-1.719E-04	-4.059E-04	0.000E+00	-1.085E+02	3.070E+02				
0.1875	8.000E+00	-0.000E+00	0.000E+00	6.799E-01	-4.561E-02	0.000E+00	0.000E+00	1.013E+01	8.985E+00	8.730E+02	-3.381E-05	-4.866E-04	0.000E+00	-1.063E+02	3.219E+02				
0.2000	8.000E+00	-0.000E+00	0.000E+00	7.532E-01	-5.617E-02	0.000E+00	0.000E+00	1.081E+01	8.983E+00	8.730E+02	1.537E-04	-5.737E-04	0.000E+00	-1.006E+02	3.656E+02				
0.2125	8.000E+00	-0.000E+00	0.000E+00	8.280E-01	-6.764E-02	0.000E+00	0.000E+00	1.148E+01	8.983E+00	8.730E+02	3.964E-04	-6.664E-04	0.000E+00	-9.368E+01	4.036E+02				
0.2250	8.000E+00	-0.000E+00	0.000E+00	9.044E-01	-7.987E-02	0.000E+00	0.000E+00	1.216E+01	8.984E+00	8.730E+02	6.999E-04	-7.639E-04	0.000E+00	-8.589E+01	4.420E+02				
0.2375	8.000E+00	-0.000E+00	0.000E+00	9.823E-01	-9.269E-02	0.000E+00	0.000E+00	1.283E+01	8.986E+00	8.730E+02	1.069E-03	-8.651E-04	0.000E+00	-7.733E+01	4.803E+02				
0.2500	8.000E+00	-0.000E+00	0.000E+00	1.061E+00	-1.059E-01	0.000E+00	0.000E+00	1.350E+01	8.990E+00	8.730E+02	1.510E-03	-9.692E-04	0.000E+00	-6.742E+01	5.224E+02				

# OpenFAST Outputs



# OpenFAST Post Processing

[openfast](#)

Public

Main repository for the NREL-supported OpenFAST whole-turbine and FAST.Farm wind farm simulation codes.

● Fortran ⭐ 326 📂 292

[matlab-toolbox](#)

Public

Collection of Matlab tools developed for use with OpenFAST

● MATLAB ⭐ 28 📂 47

[python-toolbox](#)

Public

● Python ⭐ 25 📂 22

[r-test](#)

Public

● Roff ⭐ 22 📂 53

[KiteFAST](#)

Public

KiteFAST is a simulator for airborne wind energy systems based on the OpenFAST whole turbine simulator.

● Fortran ⭐ 6 📂 1

[openfast-feedstock](#)

Public

Forked from conda-forge/openfast-feedstock

A conda-smithy repository for openfast.

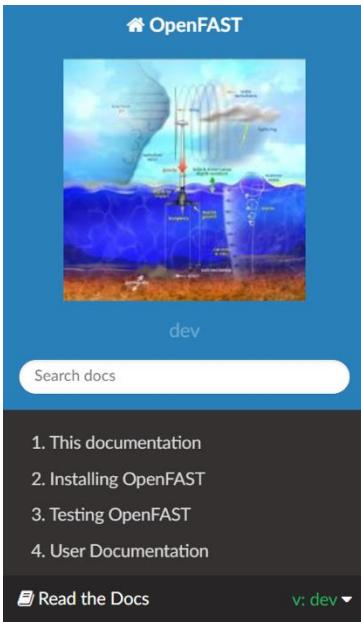
● Shell

Two post-processing tools using Matlab and Python languages are being actively developed and supported.

<https://github.com/OpenFAST>

# OpenFAST GitHub Resources

## OpenFAST Documentation <https://openfast.readthedocs.io/en/main/index.html>



A screenshot of the OpenFAST GitHub repository page. The top navigation bar shows 'OpenFAST / openfast' and 'Public'. The main area displays a list of recent commits. At the top of the commit list is a commit by 'abksr' titled 'Update this\_doc.rst (#911) ...' with a timestamp of 'ebff1b4 on Nov 8, 2021' and '7,666 commits'. Other visible commits include: '.github Improve the GH Actions path filters' (7 months ago), 'cmake Update rules for Intel OneAPI compiler detection (#727)' (9 months ago), 'docs Update this\_doc.rst (#911)' (2 months ago), 'glue-codes Build FAST.Farm when configured via BUILD\_FASTFARM' (9 months ago), 'modules Issue a deprecation warning for AD 14' (8 months ago), and 'req\_tests CTest: Add FF req tests when FF build is enabled (#741)' (9 months ago). To the right, there is an 'About' section with links to 'openfast.readthedocs.io', 'Readme', 'Apache-2.0 License', '325 stars', '66 watching', and '292 forks'. A 'Show all' button is at the bottom right.

OpenFAST GitHub repository <https://github.com/OpenFAST/openfast>

# OpenFAST GitHub Resources

**Discussion Forum:** <https://wind.nrel.gov/forum/wind/index.php>

Highly recommended to find useful information before posting questions on GitHub or this forum?

The image shows two side-by-side screenshots. On the left is the NREL phpBB forum homepage, featuring sections for Information and Announcements, Wind External, and Water Power (MHK) External. On the right is the GitHub issues page for the 'openfast' repository, showing a list of open and closed issues.

**NREL phpBB Forum Home Page:**

- INFORMATION AND ANNOUNCEMENTS:**
  - Forum Access Requests (READ THIS FIRST BEFORE CREATING AN ACCOUNT)**: Information on accessing our forums. Moderator: Bonnie.Jonkman
  - Answers to Frequently Asked Questions (FAQ) - Read this first before posting**: Answers to some of the most frequently asked questions can be found here. Moderator: Bonnie.Jonkman
  - News and Announcements**: Announcements of new or updated CAE and systems engineering software tools, upcoming and past meetings, workshops, and other news. Moderators: Bonnie.Jonkman, Jason.Jonkman, Katherine.Dykes, Matthew.Lackner
- WIND EXTERNAL**
  - Computer-Aided Engineering Software Tools**: Provide feedback, request enhancements, and get help with wind-turbine computer-aided engineering tools. Moderators: Bonnie.Jonkman, Jason.Jonkman, Pat.Moriarty, Paula.Doudrawa
- WATER POWER (MHK) EXTERNAL**
  - Wave Energy**: Discuss wave-energy device design and modeling. Moderator: Bonnie.Jonkman
  - Tidal Current**: Discuss tidal-current device design and modeling. Moderator: Bonnie.Jonkman
  - Instrumentation**: Discuss measurement instrumentation development. Moderator: Bonnie.Jonkman
  - Inflow Turbulence**: Discuss inflow turbulence measurement and modeling. Moderator: Bonnie.Jonkman

**MHK forum**

**GitHub Issues Page:**

**OpenFAST / openfast** (Public)

Issues 108 | Pull requests 19 | Discussions | Actions

Filters ▾ Q is:issue is:open

## GitHub issues

- 108 Open ✓ 417 Closed
- No CMAKE\_Fortran\_COMPILER could be found [Windows]  
#968 opened 14 hours ago by alberto-bortoni
- P and I Interpolation in ROSCO for the PI pitch controller?  
#967 opened 14 hours ago by QusayHawari
- Consistent documentation of AD input files Type: Enhancement  
#966 opened yesterday by bjonkman

by Joannes.Olondriz ▾  
Wed Jan 04, 2017 8:10 am