MOST

MATLAB FOR OFWT SIMULATION TOOLS

User Manual

Introduction

MOST is a Beta release of the tool created by L. Cottura and R. Caradonna during their Master Thesis (https://www.mdpi.com/1996-1073/14/1/248/htm).

With MOST the user can easily simulate the behavior of an Offshore Floating Wind turbine in specific weather conditions.

Through the intuitive interface, the user can set waves and wind conditions, choose the turbine, platform and moorings. In this Beta version, only the NREL 5 MW Wind turbine and the Spar OC3 platform (with related moorings) are available. The team is working to provide in the next months a new cutting-edge tool, where the user can create any concept of platform or turbine. For this reason, the script used to create the structures related to wind turbine, platform and moorings are not included in the current package, but can be requested to *giovanni.bracco@polito.it*.

The current package presents several folders, containing the structure files necessary to run a simulation:
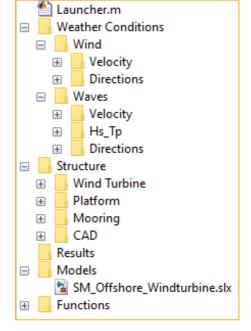
- Weather Conditions:
    - Wind contains the files related to the wind, created through Turbsim:
        - Spatial and temporal distribution of wind speed
        - Wind main direction in time domain
    - Waves contains the files related to the waves:
        - Loads of the waves acting on the hull in time domain
        - Velocity of the particles of the waves in time domain
        - Waves main direction in time domain
- Structure:
    - Wind turbine contains the structure files related to the turbine:
        - Wind turbine geometrical data
        - Wind turbine control settings
    - Platform contains the structure files related to the hydrodynamics of the platform
    - Moorings contains the structure files related to the moorings, created through Map++.
    - CAD contains the CAD data of the OFWT: it is used with *Simscape* for the Real Time 3D Simulation
- Results is where the results of the simulations are stored
- Model contains the *Simulink* file launched for the simulation. Some inner blocks of the model are encrypted in this Beta version
- Functions contains the function used to launch the simulation

After downloading the files and opening Matlab, type the following command on the Command Window: "Model_setting". This command is used to set the Simulink folders with those of the user. The Simulink SM_Offshore_Windturbine model will open automatically: before proceeding, save the model. Then, run the script 'Launcher.m': the user interface will appear.

In the following paragraph, it will be shown how to set the simulation parameters through the user interface.

User Interface

Through the user interface is possible to set all the necessary parameters to run a simulation.

As already said, in this Beta version some functions are restricted (choice of Wind turbine, Platform and Moorings) and the weather condition can be chosen in a defined range.

- **WEATHER**
  - Wave Heigth Hs (insert a value between 0.5 m and 5 m with step 0.5 m), Period Tp (between 1.5 s and 7.5 s with step 1 s) and main Direction (between -20° and 20° with step 5°).
  - Wind Speed V0 (insert a value between 5.5 m/s and 24.5 m/s with step 1 m/s) and main Direction (between -20° and 20° with step 5°).
- **SIMULATION**
  - Simulation Type: Offshore or Onshore
  - Simulation Time
  - Wind turbine: currently only NREL 5 MW
  - Platform: currently only Spar OC3
  - Moorings: currently only Spar OC3 moorings
- **CONTROL SETTINGS**
  - Power optimization: in Region 3 of the Generator Torque-Speed curve, Power is set constant.
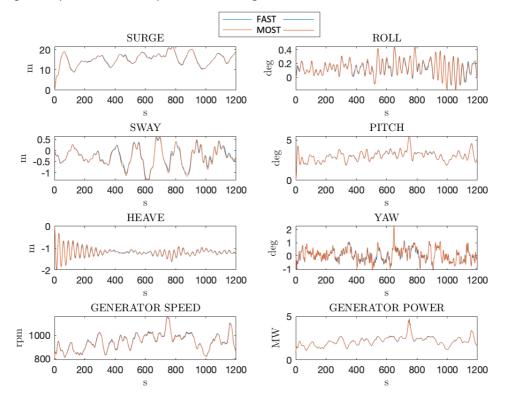 - Yaw control
- **REAL TIME VISUALIZATION**
  - Position & Power plot: shows plots of 6 DOF positions and generated power in real time during the simulation
  - 3D visualization: shows the 3D model in movement in real time during the simulation.

Comparison MOST vs FAST

As stated in L. Cottura and R. Caradonna article (https://www.mdpi.com/1996-1073/14/1/248/htm), MOST faithfully reproduces the FAST outcomes, resulting in RMSE (Root Mean Square Error) on position and output power lower than 2%. MOST is user-friendly and gives the user more flexibility in parameters setting. Furthermore, its computation time is a quarter of that of FAST. Its major limitation is the absence of the elastic theory.

In the following, a comparison of the output obtained using MOST and FAST:

In order to obtain these results, the following changes must be made to the FAST input files:

Input file	Parameter	Default value	Current value
Elastodyn	FlapDOF1	True	False
	FlapDOF2	True	False
	EdgeDOF	True	False
	DrTrDOF	True	False
	YawDOF	True	False
	TwFADOF1	True	False
	TwFADOF2	True	False
	TwSSDOF1	True	False
	TwSSDOF2	True	False
	Precone(1)	-2.5	0
	Precone(2)	-2.5	0
	Precone(3)	-2.5	0
	OverHang	-5.0191	0
	ShftTilt	-5	0
	NacCMxn	1.9	0
Hydrodyn	Rdtndt	0.0125	0.05
Aerodyn	AFAeroMod	2	1
	TwrPotent	1	0
	TwrAero	True	False
	TanInd	True	False