NUMERICAL SIMULATION OF A MOORED OCEAN CURRENT TURBINE USING NATIONAL RENEWABLE ENERGY LABORATORY TOOLS

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Off the eastern cost of Florida, the Gulf Stream contains a time averaged power density of up to 3.0 kW/m^2 at a depth of 50m below mean sea level [1]. Although the energy available at this site can meaningfully assist with U.S. energy needs, Ocean Current Turbines (OCTs) have not yet been directly moored to the sea floor in this resource. Simulations are therefore vital for predicting system performance, evaluating the performance of proposed designs, and developing/testing control systems. While modeling of Horizontal Axis Wind Turbines (HAWTs) has been researched and certified thoroughly through open source programs such as the National Renewable Energy Laboratory's (NREL's) Fatigue, Aerodynamics, Structures, and Turbulence (FAST) and paid programs such as ADAMS, modeling of OCTs has primarily been accomplished through routines developed by individual users. The FAST code suite is a grouping of modules that allows the user to model HAWT's in a variety of configurations using Blade Element Momentum Theory (BEMT). FAST achieves results by coupling customizable discrete modules that each focus on key aspects of turbine modeling [hierarchy shown in ***Figure 1***]. The developed simulation is a moored HAWT FAST model adapted to be representative of an OCT. The primary obstacles to emulating the response of an OCT using software designed for HAWTs are the inability of the rotor to pierce the air sea interface and the requirement of having a tower. To overcome these constraints, the density and kinematic viscosity of air have been changed to those of water; the tower has been set to the minimum allowable height; and forces and moments have been added to the submerged portion of the tower to account for the buoyancy, weight, and translation of the true OCT. This model allows surge, sway, heave, pitch, roll, yaw, and drivetrain rotational degrees of freedom (DOFs).

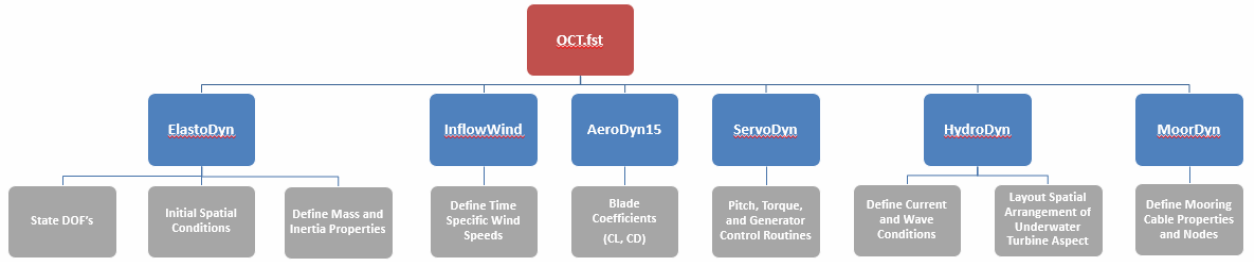

Figure 1. FAST flow chart

ACKNOWLEDGEMENTS

A sincere thank you is given to the Summer Undergraduate Research Fellowship (SURF) program at Florida Atlantic University for supporting this work. This material is also based upon work supported by the National Science Foundation under Grant No. ECCS-1307889. SNMREC is supported by the State of Florida and the US Department of Energy.

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