Open Datasets and a Graphical User Interface For High-Fidelity Wave Energy Converter Simulations in OpenFOAM

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To improve the accessibility of high-fidelity simulation of Wave Energy converters, we have developed: (1) a repository of templates, examples, and open data sets, and (2) a graphical user interface for CFD WEC simulations in OpenFOAM.

Open Datasets for OpenFOAM CFD

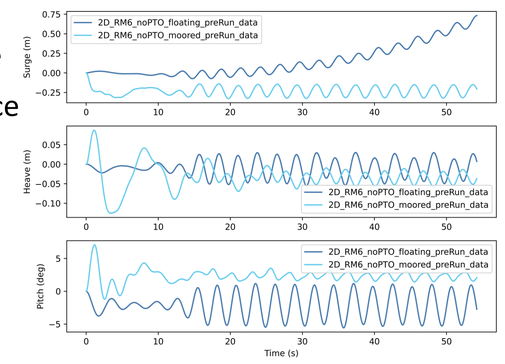
We have developed a repository of open datasets for the simulation of Wave Energy Converters using OpenFOAM, including:

- Templates and examples for WEC numerical simulation, including configuration files and documentation
- Auxiliary python and bash scripts for setting up, running, and analyzing simulation results
- Pre-packaged simulation results for users to compare to

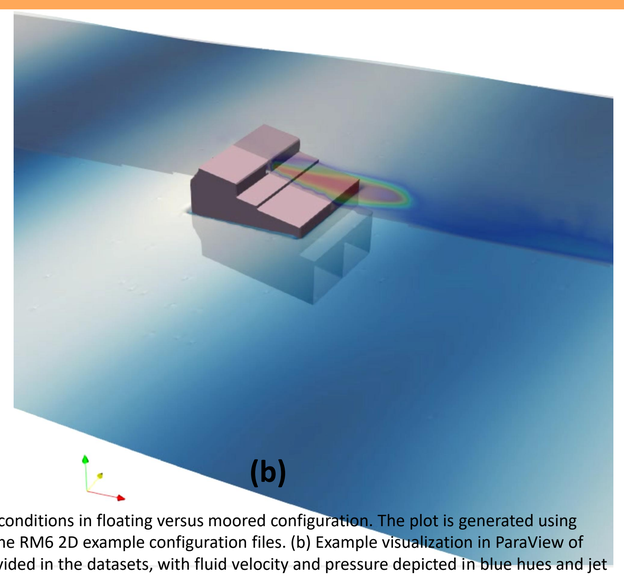
https://github.com/sandialabs/WEC-OpenFOAM-Open-Datasets

Example cases are provided for each step of the WEC analysis workflow, using the WEC Reference Model 6, including:

- Wave condition setup
- Mesh generation
- Rigid body motion solvers
- Simple mooring system modeling
- Power Take-Off modeling



(a)

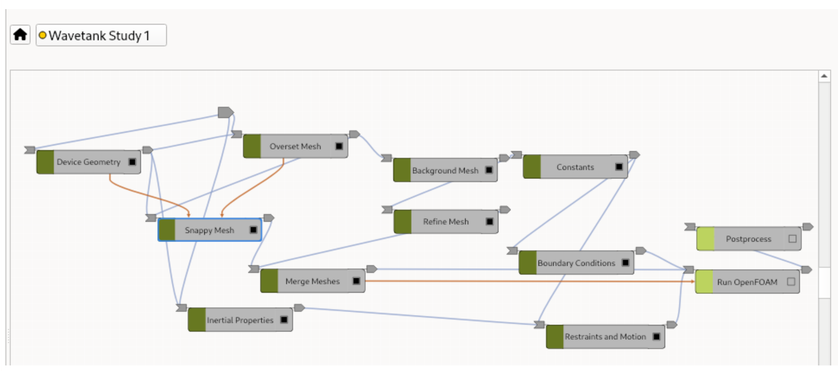


(b)

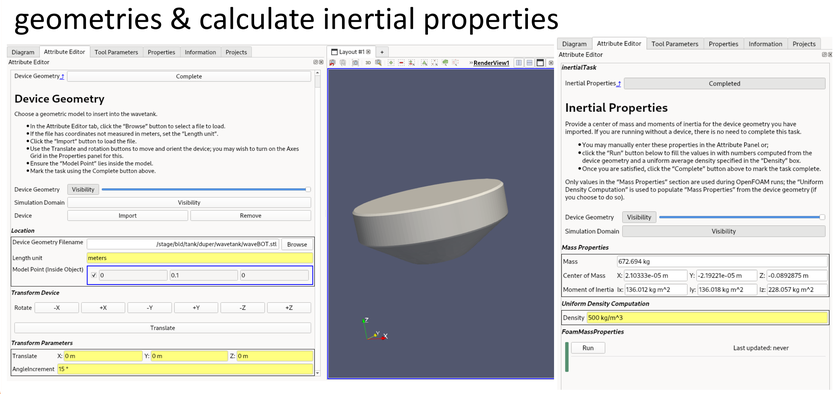
(a) Comparison of Reference Model 6 device motion under wave conditions in floating versus moored configuration. The plot is generated using provided auxiliary scripts, using simulation data generated from the RM6 2D example configuration files. (b) Example visualization in ParaView of simulation output from the 3D RM6 unmoored example case provided in the datasets, with fluid velocity and pressure depicted in blue hues and jet colormap, respectively.

Graphical User Interface for OpenFOAM

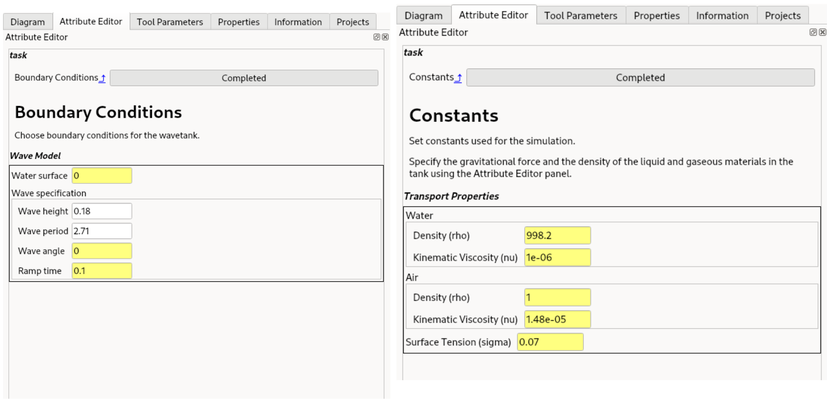
Plug-and-play component-wise design → can design studies with increasing complexity, building off of each other



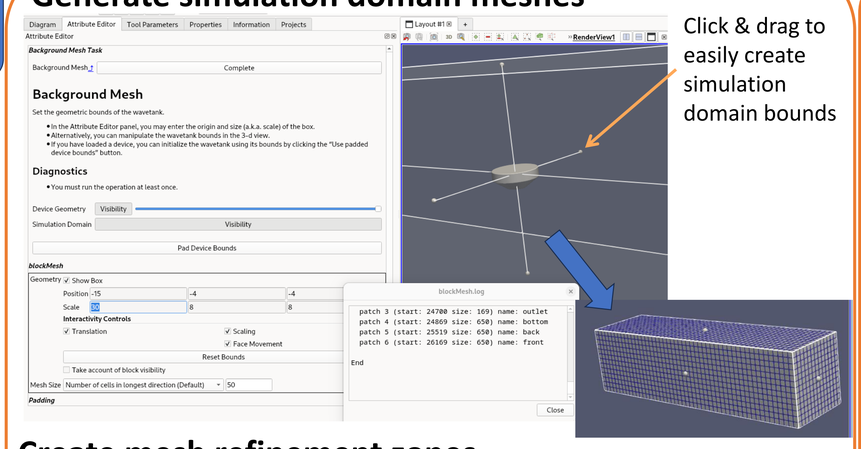
Manage devices → Import, translate, and rotate device geometries & calculate inertial properties



Set wave conditions & problem constants

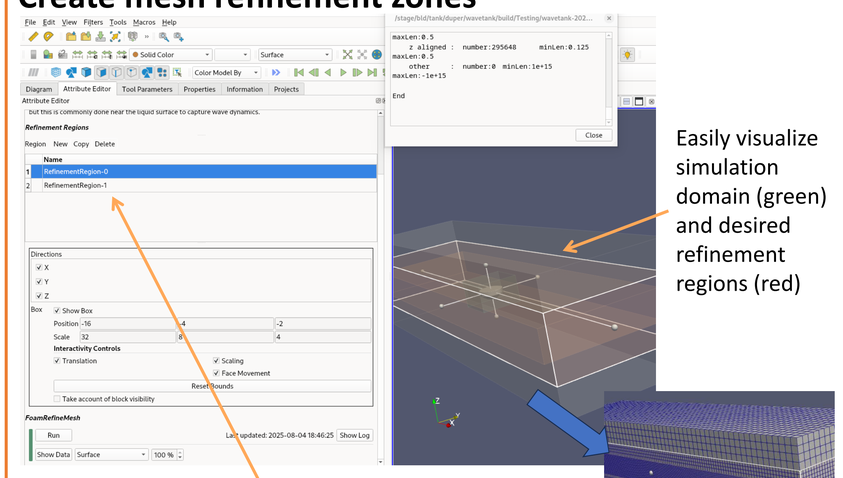


Generate simulation domain meshes



Click & drag to easily create simulation domain bounds

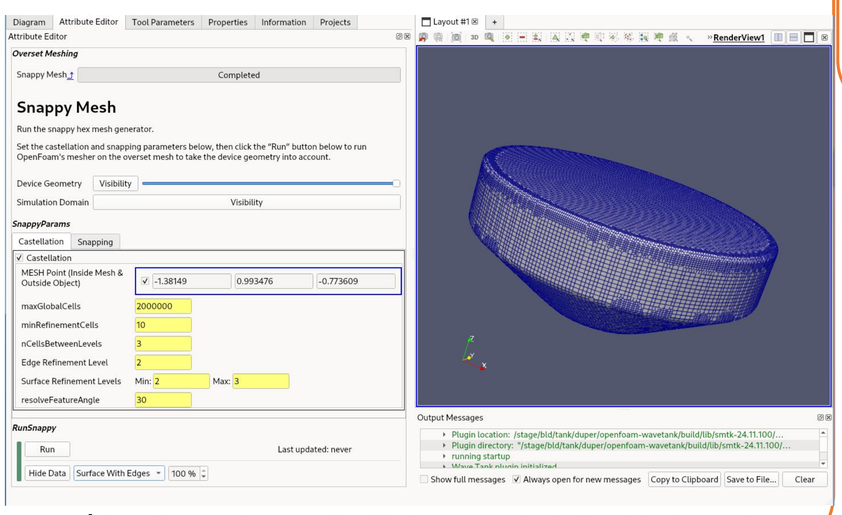
Create mesh refinement zones



Easily visualize simulation domain (green) and desired refinement regions (red)

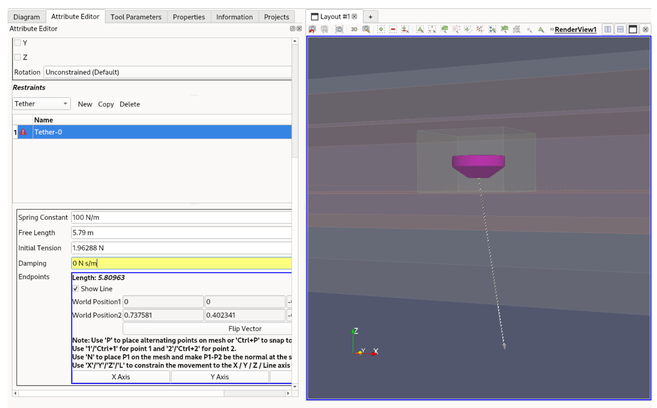
Manage multiple regions of refinement, with custom configurations for each one

Generate body-fitted device meshes



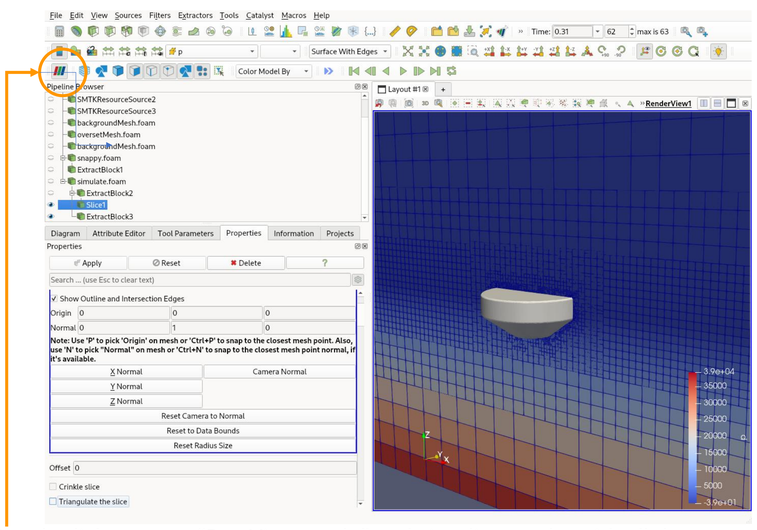
→ Interfaces with snappyHexMesh to create body-fitted device meshes

Create simple mooring systems



Point, click, and edit values to add simplified spring tethers as a mooring system

Run simulation and visualize results within the GUI



Simply click to enter “ParaView mode” and visualize results with all the capabilities of ParaView → Design, run, and visualize all in one place

- → All-in-one design + visualization tool in familiar ParaView-like environment developed in collaboration with Kitware
- → Point-and-click format, with OpenFOAM dictionaries auto-generated and managed by the GUI

Please reach out if there are cases or features you are interested in seeing developed in the GUI!

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