WEC-Sim Training Course

Online Training Materials

PRESENTED BY

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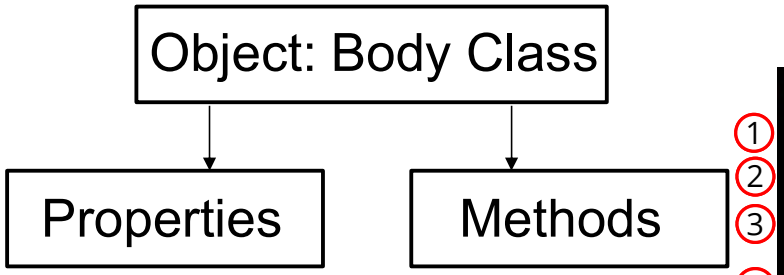
Body Class

Body Class: Overview



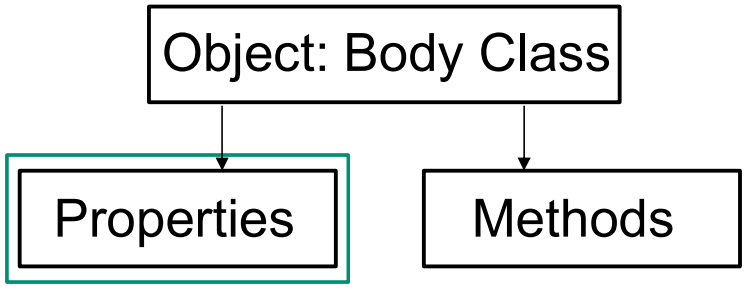
OSWEC Example

```
%% Body Data
% Flap
body(1) = bodyClass('hydroData/oswec.h5');      % Initialize bodyClass for Flap
body(1).geometryFile = 'geometry/flap.stl';     % Geometry File
body(1).mass = 127000;                          % User-Defined mass [kg]
body(1).inertia = [1.85e6 1.85e6 1.85e6];       % Moment of Inertia [kg-m^2]
body(1).initial.displacement= [0, 0, 0.1];      % Initial displacement [x, y, z] m
body(1).initial.axis        = [0, 1, 0];        % Axis of initial angle disp.
body(1).initial.angle       = 1;                % Initial ang. disp. in rad.
% Base
body(2) = bodyClass('hydroData/oswec.h5');      % Initialize bodyClass for Base
body(2).geometryFile = 'geometry/base.stl';     % Geometry File
body(2).mass = 999;                             % Placeholder mass for a fixed body
body(2).inertia = [999 999 999];                % Placeholder inertia for a fixed body
```

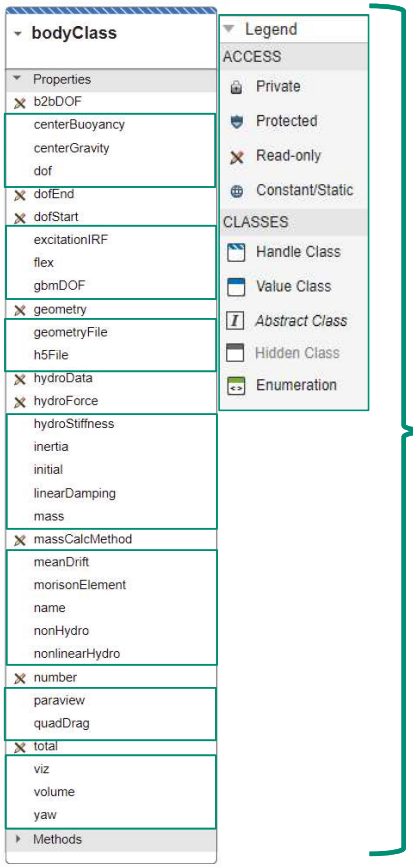
1. Generate Body Object
2. Identify geometry file in .stl format
3. Specify mass and moment of inertia properties,
4. Specify initial position initial cartesian position of the center of the center of gravity and initial angular orientation if different from the geometry file.

The definition of linear and quadratic damping parameters for the heave mode in the *wecSimInputFile.m* for the OSWEC example.

Body Class: Properties

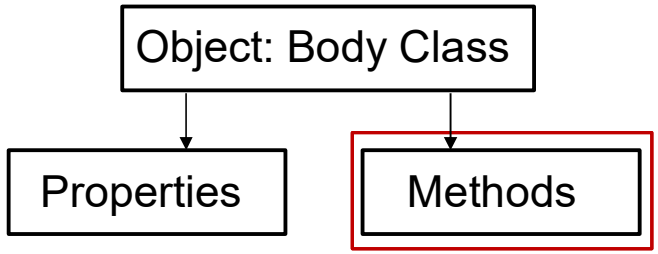


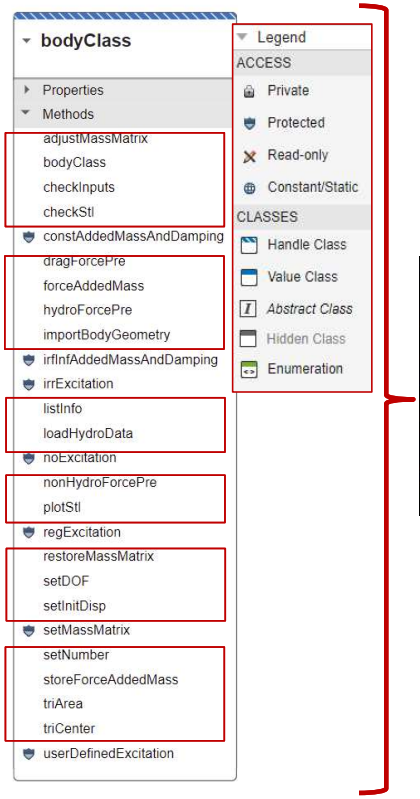
The properties inside green rectangles can be accessed by the user




```
>> body
body =
  1×2 bodyClass array with properties:

    centerBuoyancy
    centerGravity
    dof
    excitationIRF
    flex
    gbmDOF
    geometryFile
    h5File
    hydroStiffness
    inertia
    initial
    largeXYDisplacement
    linearDamping
    mass
    meanDrift
    morisonElement
    name
    nonHydro
    nonlinearHydro
    quadDrag
    paraview
    viz
    volume
    yaw
    dofEnd
    dofStart
    hydroData
    b2bDOF
    hydroForce
    massCalcMethod
    number
    total
    geometry
```

Body Class: Methods

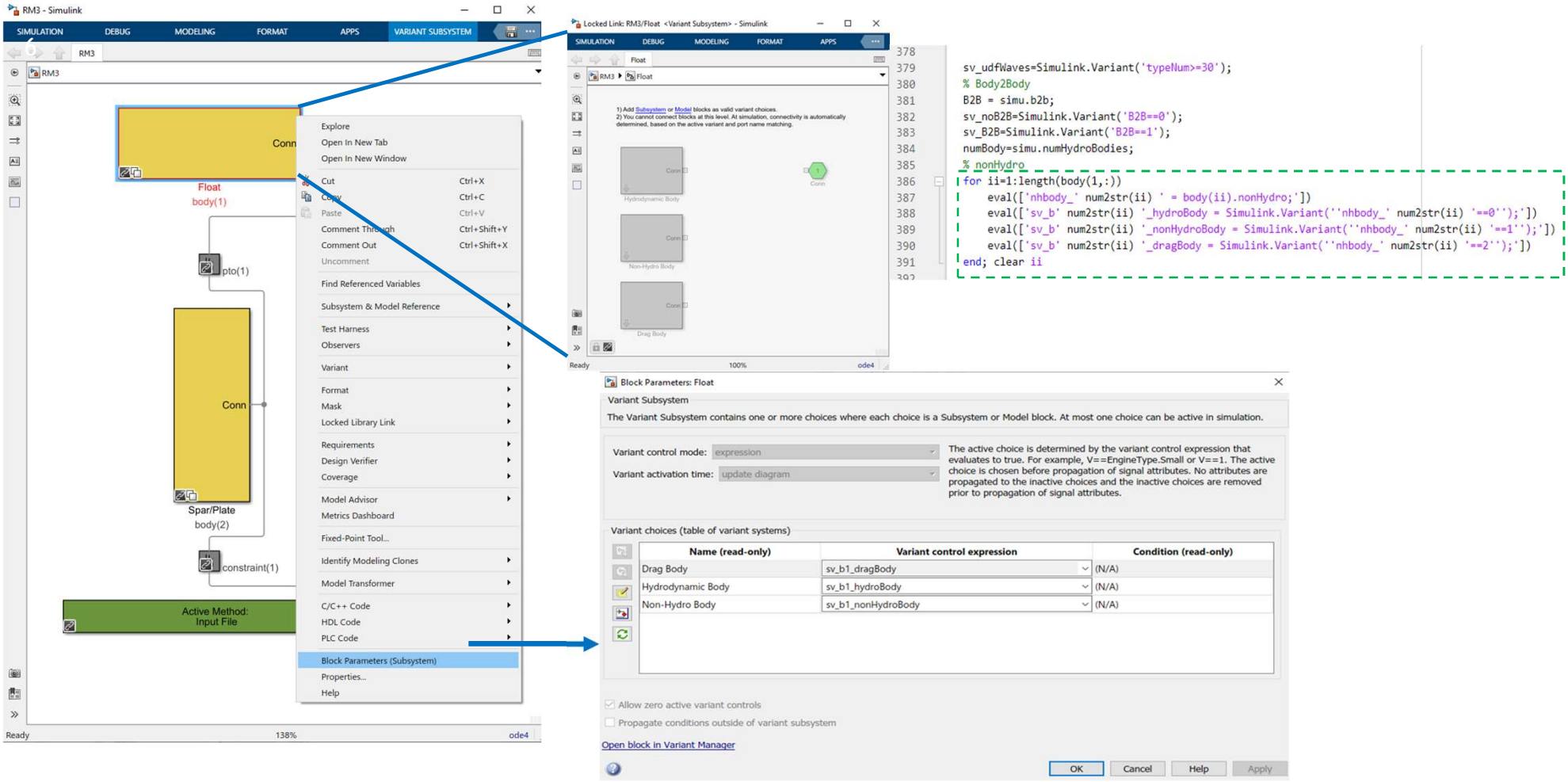




The methods inside red rectangles can be accessed by the user

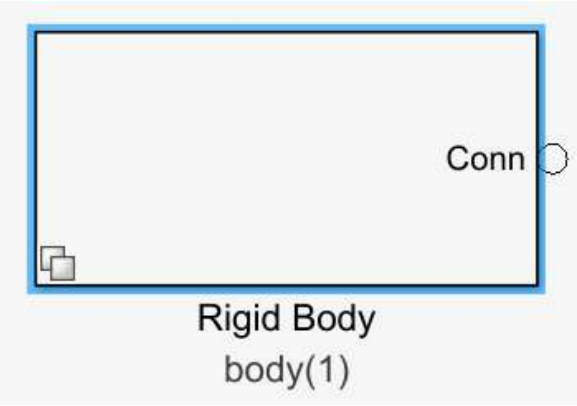
```
>> methods(body)

Methods for class bodyClass:

adjustMassMatrix     checkStl            hydroForcePre       loadHydroData       restoreMassMatrix    setNumber            triCenter
bodyClass            dragForcePre        importBodyGeometry  nonHydroForcePre    setDOF               storeForceAddedMass
checkInputs          forceAddedMass      listInfo            plotStl             setInitDisp          triArea

Methods of bodyClass inherited from handle.
```

Variant Subsystems



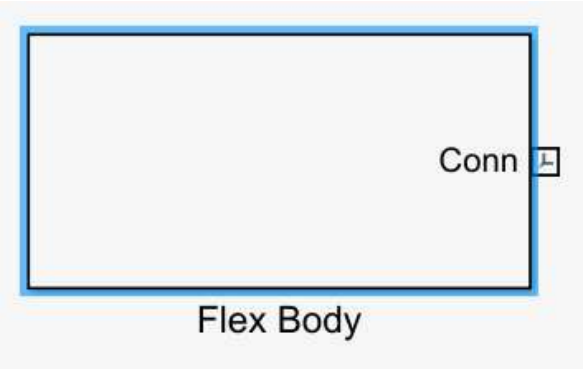
Body Blocks

Rigid body block



Rigid bodies that move in 6 DOF (surge, sway, heave, roll, pitch, yaw)

Flexible body block

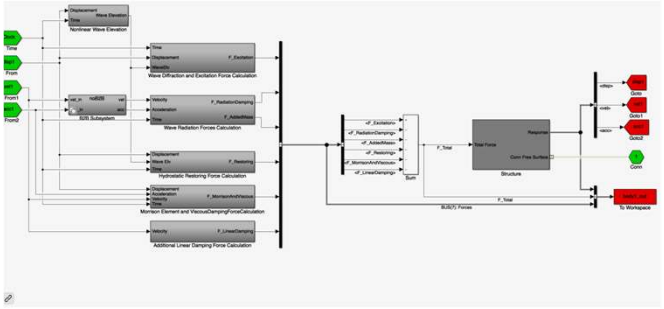


Flexible bodies with additional movement modes defined in BEM

*** See Advanced Features → Generalized Body Modes for more information on the flexible body block.**

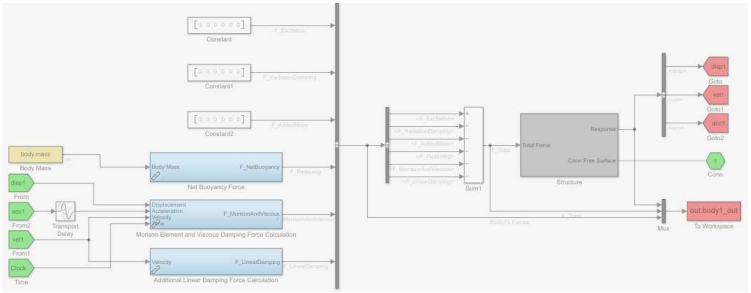
Rigid Body Block

Hydrodynamic body block



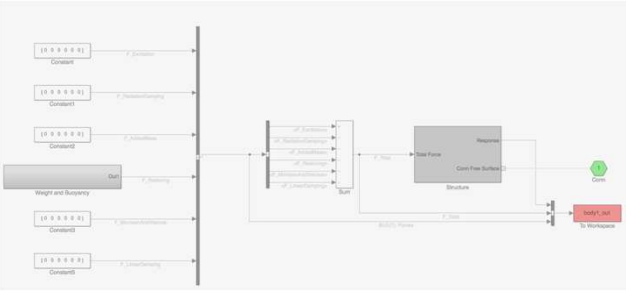
Includes blocks for calculating all the different forcing terms

Drag body block



Wave exerted forces are zero, but weight, buoyancy, and drag forces calculated

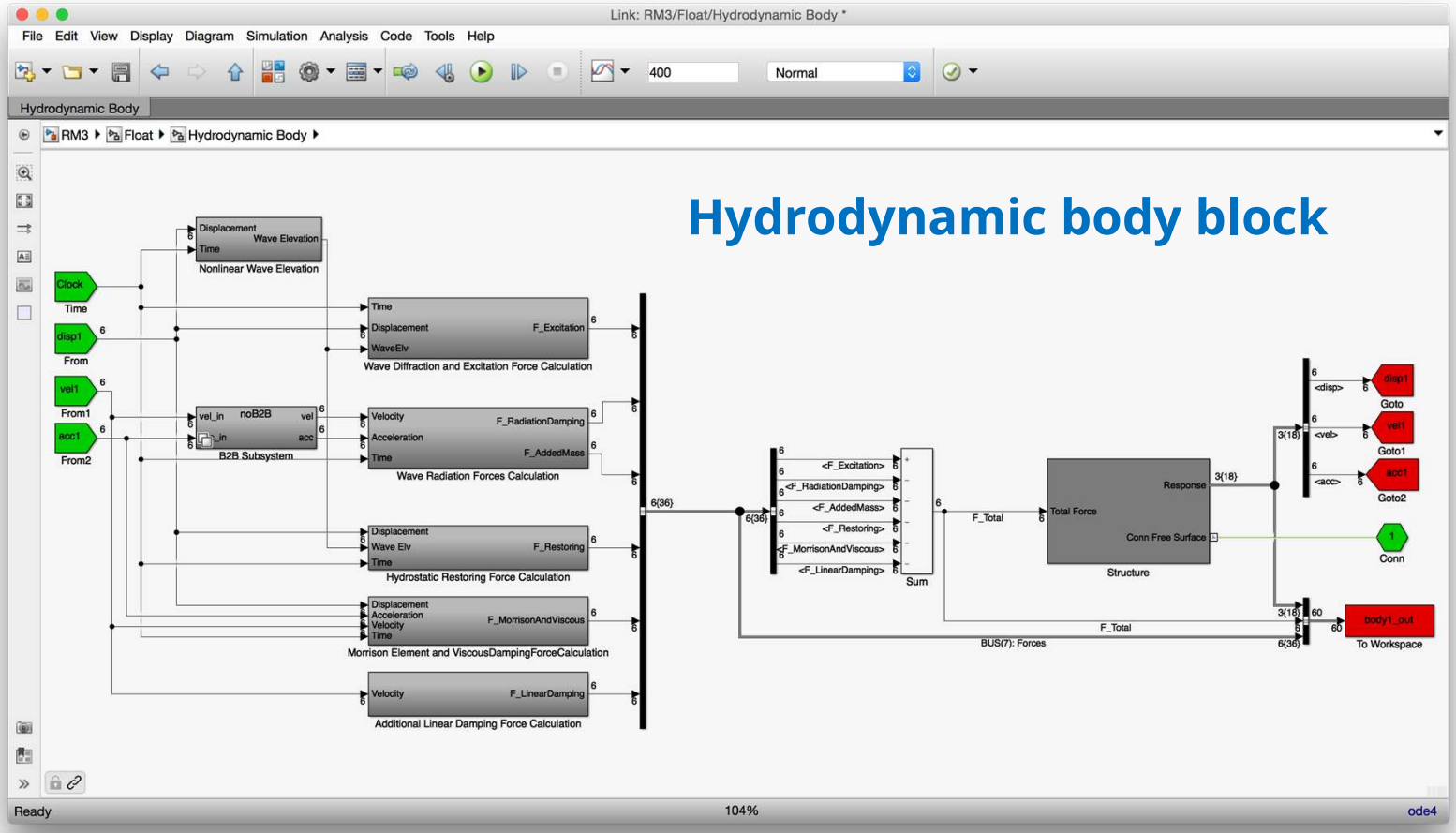
Non- hydrodynamic body block



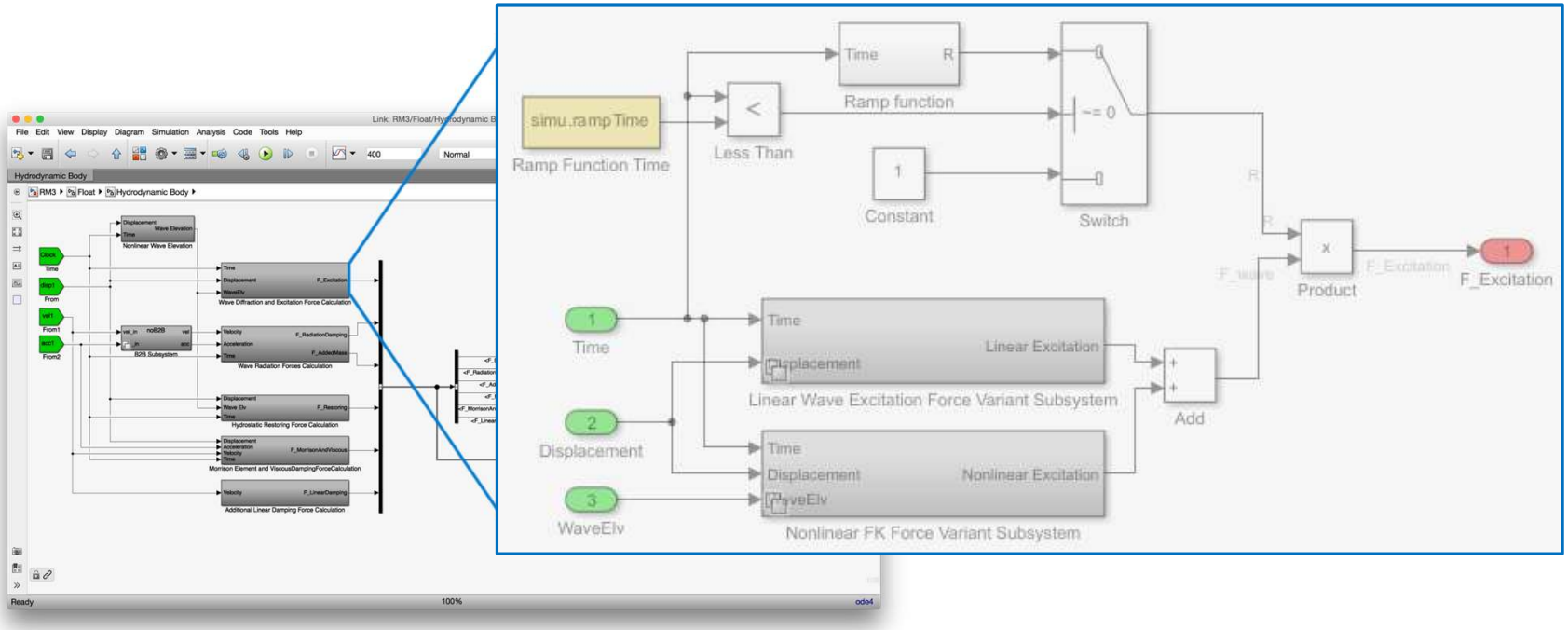
Everything is zero except for weight and buoyancy

Note: Connection forces between multiple bodies from the joint/PTO are handled by **Simscape Multibody**

Body Force Dimension Display



Body Class: Excitation Force

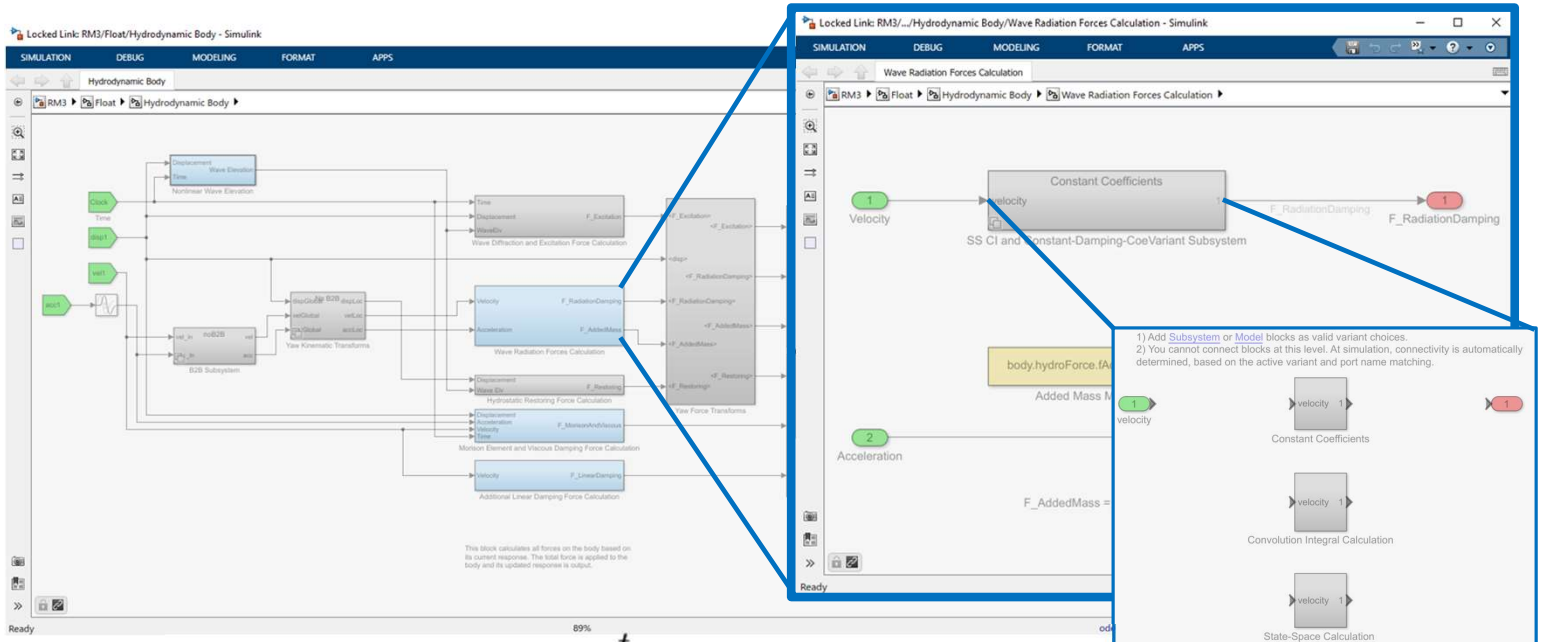


$$f_{ex}(t) = Re\left[R_f F_x(\omega_r) e^{i(\omega_r t+\phi)} \int_0^{\infty} \sqrt{2S(\omega_r)d\omega_r}\right]$$

$$f_{ex}(t) = \int_0^{t-\tau} \eta(\tau) h_f(t-\tau) d\tau$$

Hydrodynamic Body Block:

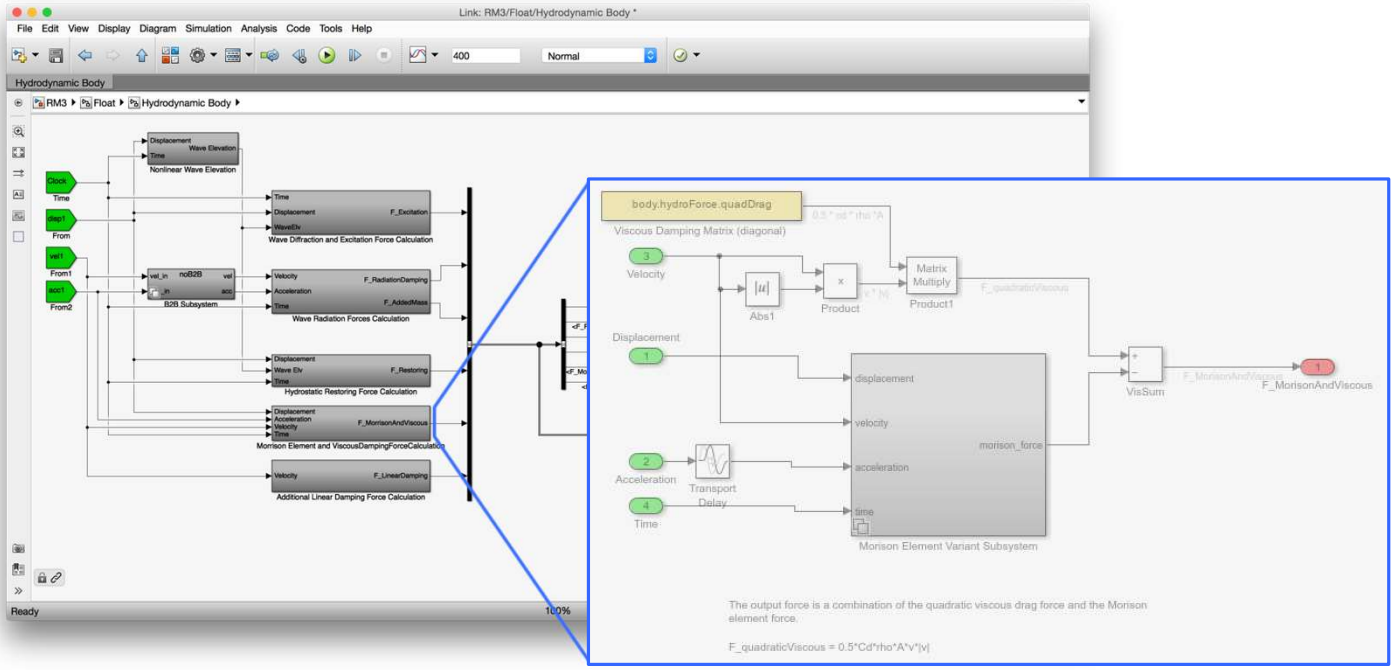
Wave Radiation Force Calculation Block



$$F_{rad}(t) = -A_\infty \ddot{X} - \int_0^t K_r(t-\tau)\dot{X}(\tau)d\tau$$

$$K_r(t) = \frac{2}{\pi}\int_0^\infty B(\omega)cos(\omega t)d\omega$$

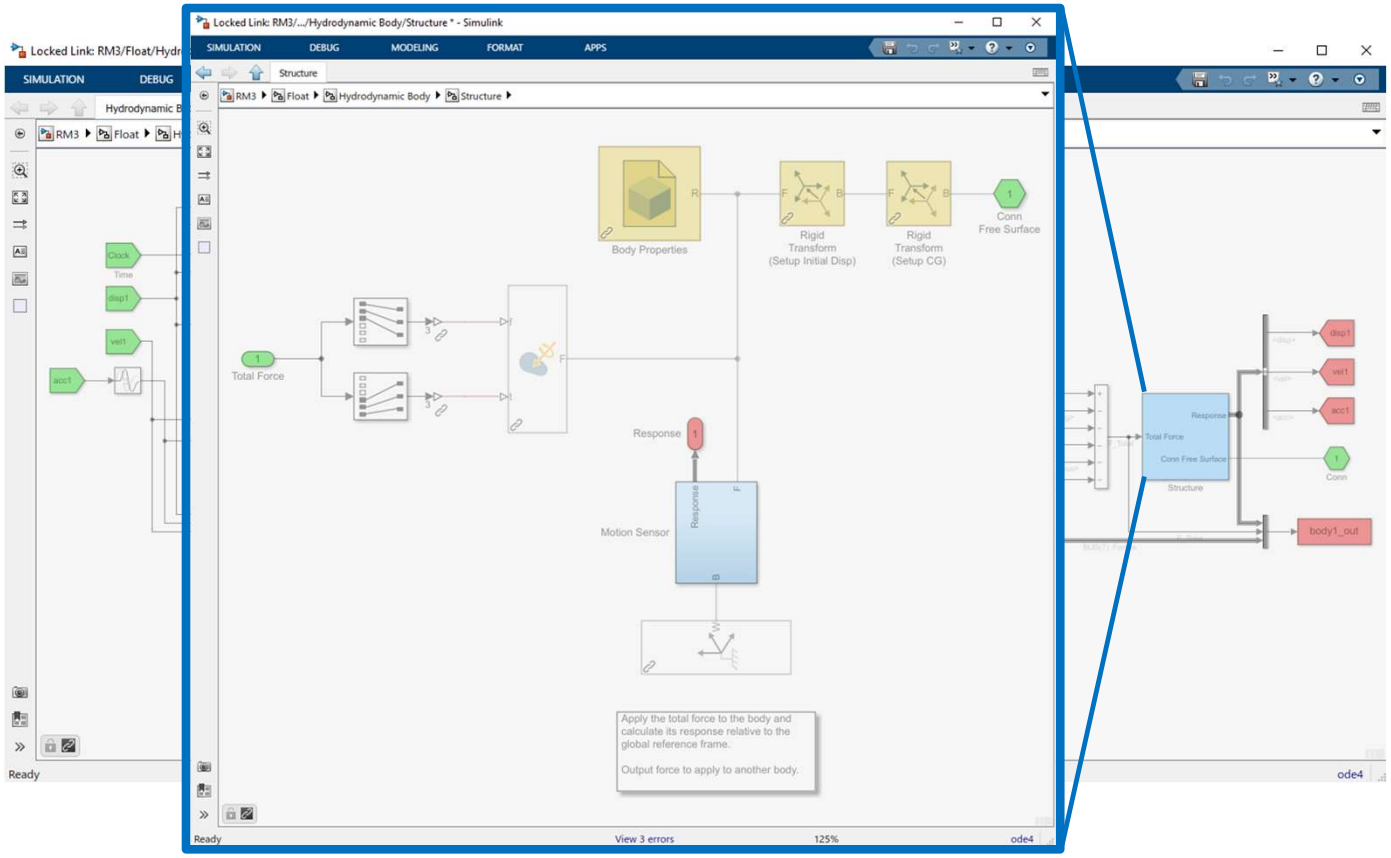
Body Class: Morrison and Viscous Damping Force



$$F_v = -C_v\dot{X} - \frac{C_d\rho A_d}{2}\dot{X}|\dot{X}| = -C_v\dot{X} - C_D\dot{X}|\dot{X}|$$

$$F_{me} = \rho\forall\dot{v} + \rho\forall C_a(\dot{v} - \ddot{X}) + \frac{C_d\rho A_d}{2}(v - \dot{X})|v - \dot{X}|$$

Simscape Multibody



Thank you

For more information please visit the WEC-Sim website:

http://wec-sim.github.io/WEC-Sim

If you have questions on this presentation please reach out to any of the WEC-Sim Developers on GitHub:

https://github.com/WEC-Sim/WEC-Sim

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This work was authored in part by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308.

Funding provided by the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Water Power Technologies Office. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.