Modeling a Swivel-Based Mooring System to Improve Reliability of Wave Energy Converters in Coastal NC

Reagan DeCaro, College of Engineering
Dr. Michael Smith, College of Engineering

UNIVERSITY OF NORTH CAROLINA CHARLOTTE

Introduction

- The powering the blue economy initiative (PBE) seeks to advance renewable marine energy technologies
- Wave energy converters (WECs) are being developed for desalinating seawater using a hydraulic reverse osmosis (RO) system
- Twisting of the primary mooring line damages cables and decreases performance
- Secondary anchor solution (Figure 2) causes other issues: marine life entanglement, increased installation cost, and reduced energy production

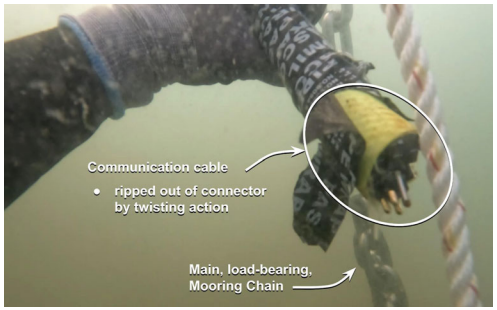

Figure 1. Communication cables torn by ocean environment

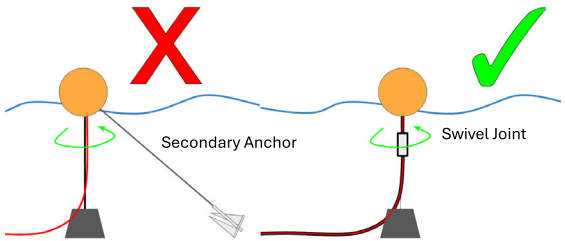

Figure 2. Comparison of secondary anchor vs. swivel joint system

Objectives

- Develop a simulation in MATLAB Simulink to model swivel joint rotation and spring mass damper component
- Integrate swivel joint simulation into WECSim software
- Research and develop instrumentation requirements to monitor rotation and flow rate

Model

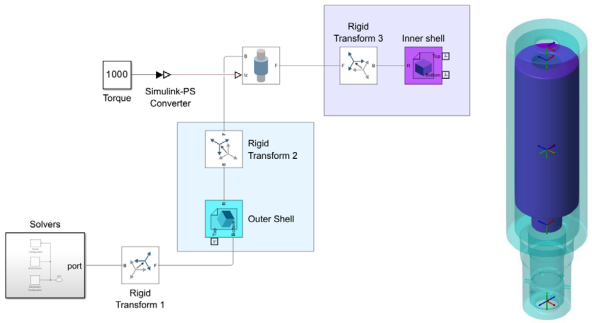

Figure 3. Simulink model of angular motion of swivel joint and 3D swivel representation

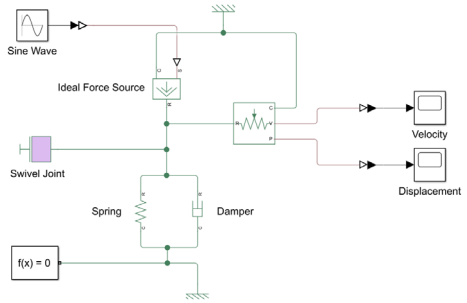

Figure 4. Simulink model of spring mass damper component

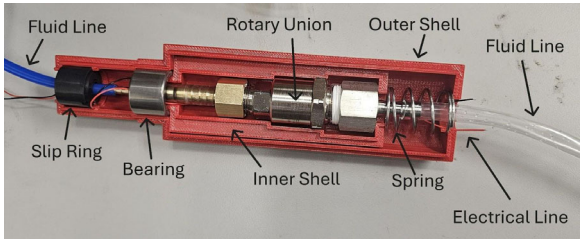

Figure 5. Swivel joint prototype used to design Simulink simulation

Results

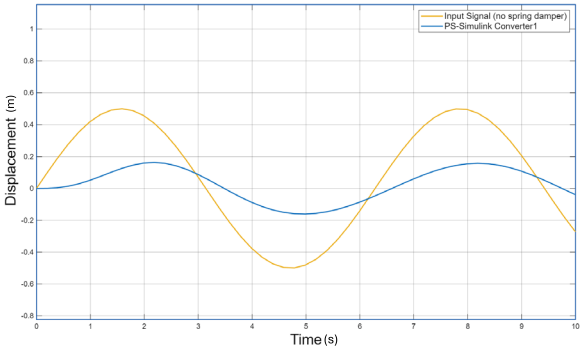

Figure 7. Plot of linear displacement of swivel joint with and without spring damper

- Plot shows heave motion mitigated by spring damper
- Equation of mass spring damper

$$m\ddot{x} + c\dot{x} + kx = f_x(t)$$

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  - UNC Charlotte Team Members: Michael Smith, Ph.D.; Reagan DeCaro, and Jacob Hawkins.