Abstract

Towed cable-body systems are widely used in the marine industry for applications such as marine exploration, oceanographic research and defense. As a result of the wave -induced ship motion, the cable tension can vary significantly. If the variations are large the cable may become slack, potentially causing damage to the system or creating unsafe conditions for the ship's personnel. Accurate real-time estimation of the cable tension would enable the development of automated methods for preventing slack cable. Instead of measuring the tension using a force sensor, which may be costly and impractical in the marine environment, a Digital Twin could be used. A Digital Twin would utilize readily available sensor data, such as the ship motion, and simulate the cable dynamics in parallel with the physical system, outputting a virtual tension estimate in real-time
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This presentation details the development of a proof-of-concept Digital Twin of a towed cable-body system. First, the modelling and simulation of cables in real-time is explored. A novel semi-implicit numerical integration method is proposed for simulating models of stiff bodies, particularly nonlinear finite element cable models. The numerical integration method is then applied to a model of a towed cable-body system to produce a Digital Twin. An overview of the mathematical model is provided along with algorithms for integrating the simulation with real-time sensor data. Finally, an experimental study to demonstrate and verify the ability of the Digital Twin to estimate the tension in a small-scale cable-body system is discussed.

Bio

Cassidy Westin is a PhD candidate at Carleton University studying the development of dynamic simulations and digital twins of marine cable systems. Previously, he obtained a BSc in Mechanical Engineering at the University of Alberta and a MASc in Mechanical Engineering at Carleton University. His research interests include computational dynamics, numerical methods, control and robotics.