CISMaRT

CANADIAN NETWORK FOR INNOVATIVE SHIPBUILDING, MARINE RESEARCH AND TRAINING | RÉSEAU CANADIEN POUR L'INNOVATION DANS LA CONSTRUCTION NAVALE, LA RECHERCHE MARINE ET LA FORMATION

2020 CISMaRT Online Workshop – Advancing Canadian Marine Technology

Zoom Webinar, November 25 – 26, 2020

Website: http://cismart.ca/2020-online-workshop-advancing-canadian-marine-technology/

Day 2: Maritime Autonomous Surface Ships (MASS)

12:30 – 17:00 (Newfoundland Time Zone); Thursday, November 26, 2020

Overview

The Canadian Network for Innovative Shipbuilding, Marine Research and Training (CISMaRT) held a workshop in Quebec City on November 27-28, 2019 on Autonomous Surface Ships. As a follow-on, the second day of the 2020 CISMaRT Online Workshop will focus on new MASS projects and/or extending the work already undertaken in partnership with National Research Council Canada (NRC). NRC are undertaking a number of projects on MASS and has earmarked funds to support MASS projects. CISMaRT is pleased to work with NRC to facilitate this initiative and the second day of the Workshop is designed to further this objective.

Workshop Approach

The overall objective of the Workshop is to help recommend follow-on projects that will further the overall aim of facilitating the introduction of MASS in the Canadian context. The focus of the Workshop is on projects that will extend and augment NRC's existing programs and other Canadian initiatives. The workshop agenda will comprise the following elements:

1. Presentation - Overview of NRC's Ocean Program
2. Presentation - Overview of Transport Canada MASS activities
3. Presentations describing NRC MASS initiatives – see Annex for outlines of presentations focusing on technology, such as sensors and decision support systems, and operations in Canadian environment
4. Panel Session – invited talks on relevant aspects of MASS
5. Breakout Sessions – brainstorming sessions by workshop participants to help identify possible follow-on projects
6. Plenary summary – suggested projects identified in Breakout Sessions
7. Next Steps – mechanism for call for project proposals
8. Concluding remarks

Annex: Current NRC Initiatives on MASS

The following describe in outline form most of current NRC projects on MASS. The lead for each project is in brackets:

MASS Navigation in Ice (Bob Gash)
This presentation will summarize recent work performed in autonomous path planning and navigation through ice-covered waters in both numerical simulation as well as in physical model testing. Additionally, a full-scale test platform will be discussed. It will discuss capabilities being developed as well as next steps forward in development.

Extension of Driving Automation Research Activities at NRC to the Marine Use Case (Taufiq Rahman)
Automation of vehicles must have three competencies: (a) perception: characterizing the operating environment in terms of detection, identification, and ranging of objects and obstacles, (b) path-planning: determining a trajectory informed by the perceived constraints imposed by the dynamic operating environment, and (c) controls: engaging the actuators to follow the desired trajectories. Regardless of the use case, this high-level work-flow is considered universal for vehicle autonomy. This presentation will give an overview of the research work in the driving automation systems that NRC has completed or currently involved in and how this knowledge can be applied to marine autonomy research.

Development of ship situational awareness in ice (Matt Garvin)
The development of autonomous navigation will be a gradual process. For the foreseeable future, humans will be the primary decision makers for navigation; either on the bridge or from a shore control center. Developing the tacit skill to safely navigate in ice is a career-long process that relies on information from an array of sources on and off the ship. In the short term, ship-based sensors are needed to provide situational awareness of ice severity and augment the information available to humans on the ship through, for example, Decision Support Systems. As autonomy progresses and the human decision maker is removed from the ship to a shore control center, sensor-based situational awareness becomes even more critical. In both cases, the manner in which the information is presented to the human is critical; it must augment existing situational awareness without distracting, overloading, or eroding skills over time. As automation begins to take over navigational decision making, ship-based sensors (and longer-range information) will provide the data needed to allow these autonomous navigational systems to make safe and robust decisions.

Digital Twin Technology for Autonomous Operation in Harsh Environment: CFD-DEM Coupled Method for Ship-Ice Interaction in Waves (Dong Cheol Seo)
Digital twin technology can simulate how the ship will perform without needing to test or train the system in the real world. It will be more useful for extreme conditions where it is difficult to obtain sufficient data to develop/train autonomous system. This presentation will show the current development of numerical model that can be used to consider harsh

environments such as ship-ice interaction in extreme waves. Some representative cases of CFD-DEM method will be presented. A brief discussion will follow focusing on the current validation process for quantitative analysis on the ice contact force by duplicating the ice tank tests numerically.

Use of ML for Identification and Characterization of Vessel Operational Best Practices (Allison Kennedy)

This presentation describes a project that is still in planning stages with partners at the NRC, Simon Fraser University and a Ferry operator. The goal of the project is to analyze historic operational data from a ferry, using data science techniques, to identify and characterize a set of best practices for operating the vessel in a fuel-efficient manner along a given route. This information will be integrated into a decision support framework to provide support to navigators to operate the vessel efficiently.

St Lawrence Seaway Autonomous Marine Testbed (Kevin Murrant)

The Autonomous Marine Testbed is primarily based on numerical simulation to focus on manoeuvring and navigation in Canadian waters including operation in a conceptual "Autonomous Test Area" located along the St Lawrence Seaway. The testbed will allow experiments to be designed and conducted in real- or fast-time simulation to develop technologies and provide supporting data for the development and introduction of autonomous vessels in the St Lawrence. The testbed will be able to interface with new and existing models of sea ice, ship manoeuvring, and environmental weather and will allow the integration of sensor modeling and control approach to facilitate a variety of potential test purposes. This work is in coordination with internal research development at OCRE to leverage test facilities to support Canada's involvement in autonomous marine vessel development and adoption and is being supported by Transport Canada.