Predicting the Interaction Between Energy Saving Devices on Surface Ships

by

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Abstract

Greenhouse gas reduction technology is an important area of research that spans across all industries. The looming carbon neutrality deadlines are drawing closer and change must occur in order to reduce carbon emissions and meet these goals. One of the sectors facing these deadlines is the commercial shipping industry. This research was motivated by Oldendorff Shipping Company who aims to find the best method to reduce carbon emissions on its bulk carriers. This research effort involved collaboration between various labs across MIT's campus who are each investigating different methods of reducing carbon emissions. This thesis and my contribution to the project involved investigating the carbon emission reduction through the addition of drag reduction devices to bulk carriers.

A literature review of existing energy saving devices was completed in order to understand what devices are in use today, how they work, how prevalent they are, and what drag reduction or energy saving claim is made. Often there was conflicting information or unfounded claims of energy savings that had been made, so this literature review also involved comparing and analyzing sources.

Two novel energy saving devices were explored: vortex generators and a morphing bow foil. A deep dive into how each of these devices work to reduce drag was completed and experiments were carried out in the Parson's Laboratory Towing Tank. The vortex generator designs were iterated many times to try to optimize their shape, size, spacing, and location. These results were discussed and generally show that flow reattachment occurs and once scaled up to full scale, energy savings do occur.

Finally, this thesis explored the concept of combining multiple devices at the same time. Meaningful combinations are ones that involve differing methods of drag reduction so that the presence of both devices lead to additive savings. Three combinations

were explored in depth and include microbubbles with vortex generators, Grothues Spoilers and Kappel Blades, and Becker Mewis Duct with rudder bulb.

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