**XI International Conference on Computational Methods in Marine Engineering**

# A Data-Driven Method for Performance Evaluation of Wind-Assisted Ship Propulsion

Kevin J. Maki[1,*], Paolo Geremia[2] and Benedetto di Paolo[2]

[1] Department of Naval Architecture and Marine Engineering,
University of Michigan, Ann Arbor, MI, USA.

[2] Engys SRL
Strada per Vienna, 9, 34151 Trieste, Italy

[*] kjmaki@umich.edu

## ABSTRACT

Wind assisted ship propulsion (WASP) is an attractive way to practically reduce fuel consumption for commercial ships. For example the paper by Lu and Ringsberg (2020) compares three different WASP technologies for use on a real ship on its transatlantic route, and they estimate net fuel savings of 5-9%. Another example of WASP technology is the paper by Viola et. al (2015) that shows how a high-performance wing sail on a crude carrier can provide more than 10% of the total propulsive force. The activity on WASP has flourished to the point where the ITTC has a new specialist committee to track and recommend best practices to support the adoption of this promising technology.

The number of concepts to harness propulsion from the wind are many, and each must be evaluated in a full range of wind and sea conditions. Computational fluid dynamics can help evaluate different ship and WASP designs, but the complex aerodynamic and hydrodynamic interaction requires dense grids with small time-steps, and the computational costs of using overset meshes or sliding grids prohibit CFD from being widely used.

In this paper the author team will present a data-driven method (based on the work of Knight and Maki 2024) to efficiently assess the performance of a WASP vessel. The method trains the data-driven model by performing simulations of the WASP technology for a range of wind conditions, and then the model is applied to the equations of motion for simulation of the vessel in calm-water and waves. The method is shown to significantly reduced the computational expense and to be effective to evaluate many different types of WASP technologies in a full range of wind and ocean conditions.

## References

Bradford G. Knight and Kevin J. Maki. “Fast-running CFD calculations of the ONR Tumblehome performing maneuvers in calm water and in waves using a Gaussian process regression propeller and rudder model.” *Ocean Engineering*, 2024, vol. 303, 117671.

Ruihua Lu and Jonas W. Ringsberg. “Ship energy performance study of three wind-assisted ship propulsion technologies including a parametric study of the Flettner rotor technology.” *Ships and Offshore Structures.* 2020, vol. 15, no. 3, pp 249-258.

I.M. Viola, M. Sacher, J. Xu, and F. Wang. “A Numerical Method for the Design of Ships with Wind-Assisted Propulsion.” *Ocean Engineering*, 2015, vol. 105, pp 33-42.