Integrated Wind Assist Ship Performance Prediction(WASPP) and Voyage Level Model (VLM) Analysis Tool

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The performance and application of wind assist technologies has become an increasingly popular topic of discussion in recent times, but there remains a great deal of uncertainty over the actual performance to be expected in the operating conditions that real ships experience over their lifecycle. To address this complex issue a Wind Assist Ship Performance Prediction software package (WASPP) has been developed. WASPP accounts for all aerodynamic and hydrodynamic forces acting on a ship, and includes not only the forces generated by the kite, sail, or rotor selected, but also the resultant heel, yaw, and rudder angles, changes to propeller inflow, and numerous other factors which combine to affect the total ship resistance and powering.

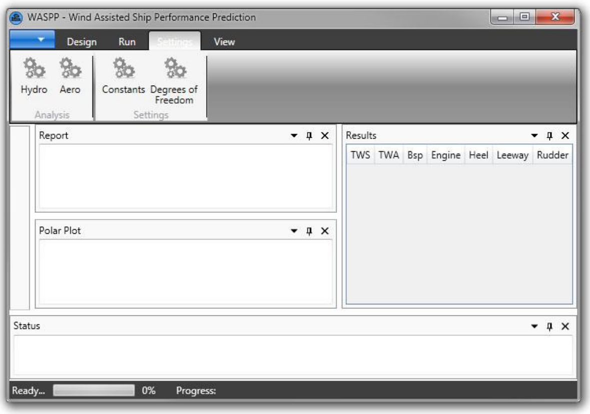

Figure 1: WASPP User Interface

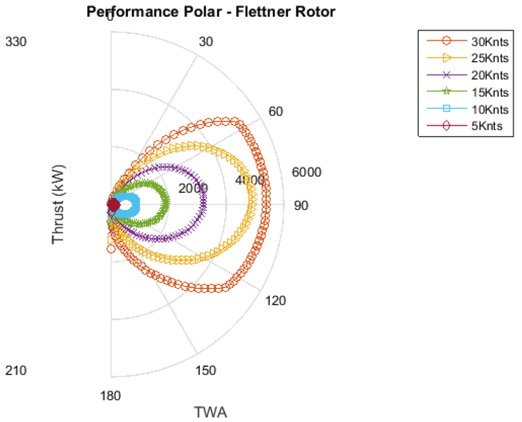

Figure 2: Thrust Performance Polar for Flettner rotor on a case study ship at a range of windspeeds and angles

Using WASPP the power, fuel consumption, or any other variable of interest can be plotted for any combination of wind and wave angle and severity to produce a complete performance profile for any given ship. This data is passed to the Voyage Level Model (VLM) which combines over 3 decades of global wind, wave, and current data with an in-house weather routing code to allow statistical analysis of the cumulative impact of this change in ship performance over time. Routes and operating regions can be specified for a given ship, or route profiles based on similar ships can be drawn from our route database populated by satellite AIS tracking data from the world fleet.

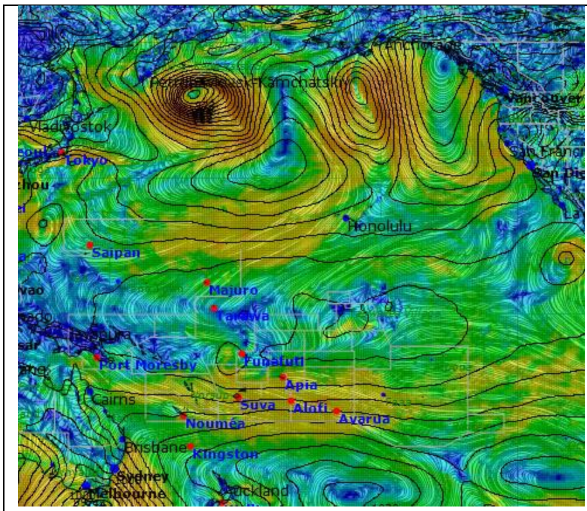

Figure 3: Visualisation of wind data as a single timestep for the Pacific region

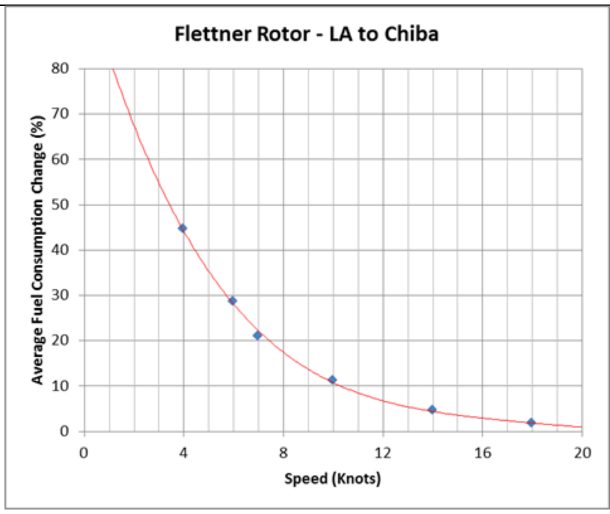

Figure 4: Fuel savings possible using a Flettner Rotor vs. a conventional ship for a range of average voyage speeds on a single route case study

The combination of these technologies allows us to examine the performance of wind assist technologies, and their potential effect on ship design and operational practices with a new level of detail. Varying parameters such as the size or type of the wind assist technology chosen, the average operating speed, hull shape, or operating regions help us to examine how different wind technologies might be applied and what realistic effect they will have on the future of shipping. The tool can be utilised for any type of Wind Assist technology.

Lead Author Ben Howett is currently completing a PhD at the University of Strathclyde on the topic of step-changes in ship design for reduced carbon emissions. His work on wind assist technologies contributes to the Shipping in Changing Climates project, and he was previously a part of the Low Carbon Shipping project. His other research interests include the optimisation of ship hullforms and the prediction and analysis of yacht performance. Outside of his academic work Ben develops performance instrumentation and navigation systems for both cruising and racing yachts.

Cui Tong is working on a PhD on Route Assessment and Voyage Optimisation of motorised andwind assisted ships. Rui Hua has developed a Weather Routing Model focusing on added wave resistance as well as fouling. Both Professors Osman Turan and Sandy Day have been working on energy efficiency and low carbon technologies in terms of design and operations.