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THIRD PRIZE

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Investigating Hydrokinetic Energy Recovery in Wind-Assisted Warships

Wind-assistance for ships has seen a resurgence of academic and commercial interest recently, owing to stricter regulations on atmospheric pollution from their engines, and the ability for new wind-assistance technologies to significantly reduce fuel consumption on many shipping routes. However, the power available from the wind is sporadic, it may not always match a ship's operational profile, and it may exceed that needed for propulsion. As an alternative solution, the aim of this project is to consider combining wind-assistance with energy recovery via the propeller, acting as a hydrokinetic turbine driving a generator, its output being connected to the ship's electrical power system, thereby offering flexibility when capturing wind energy. Research into hydrokinetic turbines in ships suggests that there is a disjoint between modelling propeller and turbine operations, often addressed by considering the two modes independently. This research aims to overcome this issue by using multi-quadrant propeller series data to calculate the torque and thrust acting on the propeller during both propulsion and regeneration. A wing kite and a fixed pitch propeller on a nominal warship design has been considered, where the wing kite has been modelled using the zero-mass model. MATLAB models to represent ship resistance, kite thrust, and propeller performance have been developed to characterise the potential for energy recovery and have been applied to a typical warship operational profile. The results indicate a good level of reduction in fuel consumption when using wind-assistance, which is significantly further improved using hydrokinetic energy recovery.