Master thesis (m/f/d): Assessment of the energy saving potential by using kites in shipping

The newly founded DLR Institute of Maritime Energy Systems (MS) researches and develops innovative solutions for the defossilisation as well as emission reduction in shipping and transfers them into practice by cooperation with the industry. Pursuing this goal, the department of Ship Performance researches and develops numerical and experimental tools to assess ship performance in general and with special emphasis on novel energy systems.

Legislative developments such as the IMO 2050 targets on reducing the total annual GHG emissions from international shipping by at least 50 % have driven ship owners and operators to re-think their propulsion systems by introducing environmentally friendly fuels and alternative propulsion technology. One green technology which is attracting a lot of attention are wind-assisted propulsion (WASP) devices. Several approaches, including Flettner rotors, sails and kites appear suitable. In order to assess their respective applicability and efficiency, simulations addressing the hydrodynamic behavior of WASP devices, hull and energy system of the vessel with respect to present weather conditions are required. The MS institute maintains the *Odyssa Framework*, which enables such investigations based on simplifying modelling assumptions. At this point in time, modelling of kites is not incorporated.

In this work, *Odyssa* is to be developed further to account for modelling of kites. The model will be based on lift and drag coefficients with respect to true wind speed and angle and needs to be integrated with the existing framework. In a subsequent step, the model is to be applied to assess the energy saving potential of using a kite with respect to a given vessel and transport task. To this end, simulations of different kite configurations and route options (fixed / optimized based on wind) need to be conducted and analyzed. Suitable kite parameters need to be identified based on an optimization algorithm. The generalizability of the results to different ships is to be investigated.

Due to the challenging nature of the task, we would also like to offer the option of performing a prior internship at DLR in order for the student to familiarize her- or himself with existing software and approaches.

Thus, your tasks could include a subset of the following:

Thesis:

Preparatory tasks:

- Research on state of the art regarding WASP with focus on kites
- Research on state of the art regarding performance prediction programs (PPP)

Practical tasks:

- Model development and integration
- Optimization of kite parameters
- Assessment of applicability and energy saving potential of kites with respect to specified vessel and transport task
- Investigation of generalizability of the results