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ICM-autoKite Project: Control Approaches for an Automated Kite Propulsion System for the KITE GAS/FUEL SHIP

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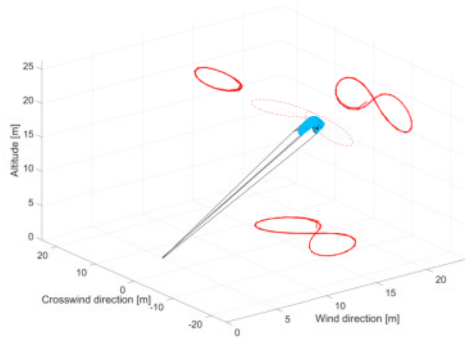
Tethered kites have become a popular option for generating green energy in so-called Airborne Wind Energy (AWE) systems. The kite can be used to unwind a rope from a spool and use it to power a generator or directly to pull a vehicle or ship in a certain direction. For the operation of such a plant, the automatic control system is of great importance. It ensures energy optimal trajectories and keeps the kite aloft in the first place. Additionally, it can be used to steer the kite in a certain direction if the kite is used in towing mode. There are different ways to develop such a control algorithm ranging from classical PID controller [1] to model predictive control (MPC) [2].

The automated control strategy for the operation of the kite, which will be the main propulsion system of the KITE GAS/FUEL SHIP, constitutes the centrepiece of the ICM-autoKite project. The prime objective is to track the kite on a figure-eight, that was found to be an energy optimal trajectory [4]. A nonlinear dynamic inversion guidance law with a basic proportional controller can precisely track the kite on such a figure-eight trajectory, as can be seen in the figure on the right. However, the basic controller is tuned for a certain trajectory given a certain wind speed. Varying conditions would need an adjustment of the control gains. Therefore, a reinforcement learning (RL) approach, valid for different trajectories and wind speeds, is proposed to potentially replace a classical basic controller for AWE applications.



Kite flight of a figure-eight trajectory using a nonlinear guidance law with a proportional controller [5].

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