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OpenAWE: An Open Source Toolbox for the Optimization of AWE Flight Trajectories

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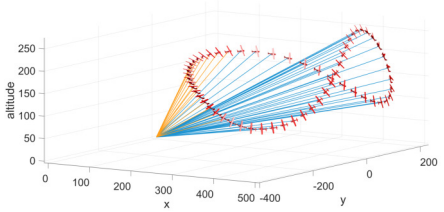
We present OpenAWE [1], a Matlab/Octave toolbox for solving optimal control problems with an airborne wind energy (AWE) system. For example, the toolbox can be used to find a flight path that produces maximal power (see Figure), or to find launch and landing trajectories. Parameters of the system can be optimized. Therefore, using the toolbox can accelerate the design process in the development of an airborne wind energy system and help with the implementation of a control system.

OpenAWE is implemented using object oriented programming and provides functionality to easily specify the objectives of the optimal control problem. The objectives of the optimization problem are specified by a user supplied cost function that is being minimized, and a set of constraints that are satisfied in the solution of the problem.

The toolbox contains a library for modeling the system which consists of the airborne components, the tether, and the winch. The current prototype of Ampyx Power named AP2 serves as a reference model [2]. Two types of tether models are provided: a straight-line tether and a static tether approximation that is capable of representing the tether shape [4].

To benefit from ongoing research and state of the art algorithms, the toolbox is built upon our own developed Open Optimal Control Library (OpenOCL) [5]. It uses CasADi for automatic generation of derivatives [6], and Ipopt to numerically solve the non-linear optimization problem [7].



An optimal flight path for generating power with an AWE system computed by OpenAWE. Here, a periodic power cycle at 8 $\frac{m}{s}$ wind speed with logarithmic profile is shown for the current prototype AP2 of Ampyx Power.

References:

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