The Effect of Realistic Wind Profiles on Multiple-Kite System Optimal Control

Rachel Leuthold1, Jochem De Schutter1, Elena Malz2, Sébastien Gros2, Moritz Diehl1
1Department of Microsystems Engineering (IMTEK), University of Freiburg
2Chalmers University of Technology

Multiple-kite airborne wind energy systems (MAWES) have raised interest recently, as systems that are expected to be more efficient than other airborne wind energy (AWE) systems. This is because Loyd’s limit for the power produced by an airborne wind energy (AWE) system is inversely proportional to the square of the system drag coefficient [3], and single-kite systems may have significant tether drag. MAWES, in contrast, aim to limit tether drag by balancing the forces on multiple kites to prevent the tether from flying cross-wind.

Existing studies of MAWES [2,4,5] typically consider the wind-field to follow a logarithmic wind profile. However, logarithmic wind profiles are known to be approximate, and are not generally considered valid at altitudes above 500 m [1].

It is not known to what extent this logarithmic wind profile assumption influences the results of MAWES optimal control studies. The purpose of this work is to study the effect of realistic wind profiles on optimal MAWES pumping-cycle kite trajectories. A periodic optimal control problem (OCP) is solved for a MAWES, using wind profiles based on realistic wind data measurements in Göteborg, Sweden. This study focuses on the effects to the optimal flight path and the optimal flight altitude as a result of these realistic wind profiles.

References: