# Estimation of Unknown Aerodynamic Forces of an AWE System

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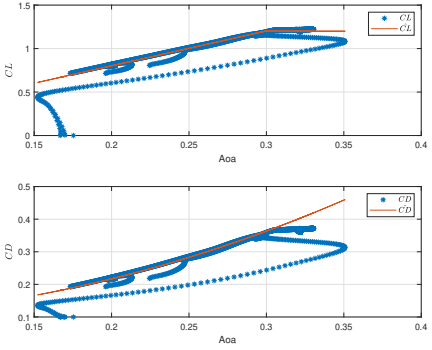
Airborne Wind Energy systems (AWE) represent a promising solution to environmental challenges that has revolutionized research in the wind industry.

The studied AWE system in this work is equipped with a multicopter drone in order to perform take-off and landing maneuvers. An estimation strategy based on an Extended Kalman Filter (EKF) is proposed to obtain precise information regarding the state vector of the system, the unknown forces that acting on it and its aerodynamic coefficients.

The proposed method is implemented and tested in a numerical and experimental environments. The obtained results show the effectiveness of the introduced method, numerically and experimentally, at estimating the unknown forces that are acting on the system despite the presence of several sources of uncertainties (neglected nonlinearities, poorly known parameters, physical constraints of the actuators, etc.). Moreover, if a reliable model of the aerodynamic coefficients is available the proposed algorithm is capable to estimate the wind velocity.

Integrating the estimation results in the control design step has also improved the performance of the nonlinear controller previously introduced in [1] where the lift and drag forces were only considered as disturbances and not as control inputs. In addition, the knowledge of these aerodynamic forces allows one to improve the robustness of the studied AWE system during the critical take-off and landing phases.




*The evolution of the aerodynamic coefficients $C_L$ and $C_D$ computed from the estimated data and those given by the system's model.*

*References:*

*[1] A. Schanen, J. Dumon, N. Meslem, A. Hably, A. Negre, A. Sarazin, Tethered drone-based airborne wind energy system launching and retrieving, Journal of Guidance, Control, and Dynamics (2021) .*