



Ali Arshad Uppal

Post-Doctoral Researcher
Universidade do Porto
Faculdade de Engenharia
Dept. of Electrical & Computer Engineering
SYSTEC-ISR, UPWIND Project

Rua Dr. Roberto Frias, s/n
4200-465 Porto
Portugal

ali@fe.up.pt
www.upwind.pt



Ground Station Control of an Airborne Wind Energy System in a Complete Operational Cycle

Ali Arshad Uppal^{1,2}, Manuel C.R.M. Fernandes¹, Sérgio Vinha¹, Fernando A.C.C. Fontes¹

¹Universidade do Porto

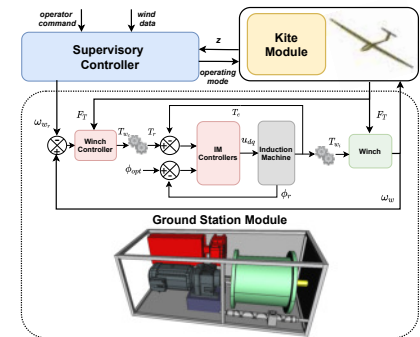
²COMSATS University Islamabad

In this work, we develop and integrate a ground station controller together with a supervisory controller for an airborne wind energy system (AWES) in all its operational modes, covering a complete operational cycle. The main focus of this research is the robust control of the GSM, however, we also analyse the integration of the supervisory controller with the GSM and with an already developed kite module (KM) controller [1].

In order to obtain a reliable performance of the AWES during all the operational modes, we propose a cascade control strategy for the ground station module (GSM), which is adapted from [2]. The proposed control strategy includes two control loops. The outer loop uses sliding mode control (SMC) algorithm to maintain a desired winch velocity which serves as an input to the KM, whereas, the fast, inner control-loop is for obtaining the desired torque of the IM. A rotor flux oriented control (RFOC) technique is used, to achieve high performance control of the IM and enabling a DC machine like control of the two phase IM model. By using the RFOC technique, the torque and flux control problems are decoupled in such a way that the decentralized control of both torque and flux is possible. Moreover, back-stepping based SMC is employed for the IM controllers. The torque controller tracks the desired trajectory of the torque, which is required to obtain a desired winch speed. Simultaneously, the flux controller tracks an optimum flux trajectory, which minimizes the losses in the IM.

To evaluate the performance of the control scheme, sim-

ulations are carried out in MATLAB/Simulink. The simulation results show the desired behaviour in all operational modes.



Control architecture integrating the supervisor controller with the GSM and KM, detailing the GSM cascade controller. .

References:

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