GRENOBLE INP UGA

LCIS
Laboratoire de Conception et d'Intégration des Systèmes

UGA Université Grenoble Alpes

Seminar

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Title: Automatic Circular Take-off and Landing of Tethered Aircraft in Airborne Wind Energy Systems

Abstract: In this talk, I describe the development of an automatic take-off and landing framework for tethered airplanes. In particular, we develop a control system for circular take-off and landing of a self-propelled, fixed-wing, tethered aircraft. The aim is to include the framework in an Airborne Wind Energy System.
Airborne Wind Energy Systems (AWES) are devices that convert wind energy into electricity using autonomous aircraft attached to the ground by a tether. These devices can harvest wind energy at high altitudes, where the wind is stronger and more consistent, being able to generate electricity from a yet unexplored renewable energy resource.
One of the main challenges in the development of AWES into a commercially viable and competitive renewable energy technology is the ability to operate safely, reliably, and autonomously for long periods of time in several weather and environmental conditions. To achieve fully autonomous operation it is crucial to develop reliable Automatic Take-Off and Landing (ATOL) schemes for tethered aircraft.
In the developed control system, we use a hierarchical control architecture. In the top layer, we design a supervisory controller that is responsible for governing the transition between flight phases, for path-planning, and for setting the references to the lower-level controllers at each phase of operation. The controllers designed for each phase range from simple PID, designed for one control-variable, to multivariable optimal regulators for the locally linearized systems.The developed framework has been tested in simulations and in a small-scale prototype. The results show the viability of the approach to take-off, attain a certain altitude, and landing. The analysis also reveals the limits on the maximum altitude attainable with a fixed-tether length as a function of the path radius.

Short bio: Fernando A.C.C. Fontes is an Associate Professor in the Department of Electrical and Computer Engineering, Faculty of Engineering, University of Porto (FEUP) and Senior Researcher in the SYSTEC-ARISE research centre.
He received his first degree and the Habilitation degree in Electrical and Computer Engineering from the University of Porto, the M.Sc. and the Ph.D. degrees from Imperial College London, U.K. He started his academic career in University of Minho, Portugal. He taught in the Department of Operational Research at LSE - The London School of Economics, was a Research Assistant at Imperial College London, and a Visiting Scholar at Texas AM University.
He has been teaching in FEUP in the areas of Mathematics, Signal Processing, Systems and Control, as well as Automation and Robotics. In SYSTEC-ARISE he coordinates the thematic lines SYSTEC-Control and the ARISE-Intelligent Systems and Robotics. His research interests are in optimization and control theory, having a specific interest in nonlinear and constrained problems, optimal control, and model predictive control. His main scientific contributions are in model predictive control (stability and robustness conditions for nonlinear and sampled-data systems), in optimal control (stronger forms of the maximum principle and numerical methods), and in nonlinear optimization methods (dynamic programming based and other global optimization algorithms). Lately, he has been interested in the application of these methodologies to robotics and to energy systems, in particular to Airborne Wind Energy Systems.