# Seminário em Engenharia Matemática

**5 de Dezembro de 2023**
**11h00**
**Sala H211**

## Trajectory Optimization and NMPC Tracking for a Fixed–Wing UAV in Deep Stall with Perch Landing
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**Abstract:**
In normal operations, aircraft are constrained to stay out of stall, preventing them from the sudden loss of lift. However, if we attempt to bring the aircraft out of their 'comfort zone' by increasing the angle-of-attack, interesting phenomena occur, namely deep-stall and perching.
This talk presents a novel recovery technique for a fixed-wing UAV (Unmanned Aerial Vehicle) based on constrained optimization. First, we propose a trajectory generation for landing the UAV where it first reduces its altitude by deep stalling, then perches on a recovery net. Next, we design an NMPC (Nonlinear Model Predictive Control) tracking controller with terminal constraints for the optimal generated trajectory under disturbances. Compared to nominal net recovery procedures, this technique greatly reduces the landing time and the final airspeed of the UAV. Simulation results and animations for various wind conditions demonstrate the feasibility of the idea.
This talk is an intriguing example of optimization and optimal control technique applications. The results of this talk were presented at the 2023 Wind Energy Science Conference, Scotland, United Kingdom, and the 2023 European Control Conference, Bucharest, Romania.

**Short biography**:
**Huu Thien Nguyen** obtained the Mechatronics Engineering degree from the Ho Chi Minh City University of Technology, Ho Chi Minh, Vietnam, in 2019. From February to July 2019, he was doing his masters thesis at the Laboratory of Conception and Integration of Systems (LCIS) of Grenoble INP, University Grenoble Alpes, Valence, France, focusing on the control of multicopters under the quaternion attitude representation. Since 2020, he has been a researcher at the R&D Unit SYSTEC (ISRP/FEUP) and since 2021, part of ARISE-LA, Portugal. He is now pursuing a Ph.D. in Applied Mathematics at the University of Porto, Porto, Portugal, under the supervision of Prof. Fernando A. C. C. Fontes, and co-supervised by Prof. Ionela Prodan (Grenoble INP-UGA, France). His research interests are optimization, optimal control, and Model Predictive Control with applications in UAVs, including hybrid UAVs, fixed-wing UAVs, and multicopters.