Bárbara Barros Carlos
PhD candidate

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Rome, Italy

PhD student in Automatica at Sapienza Università di Roma, with a bachelor degree in Mechatronics Engineering by IFCE, Brazil (2017). I've been working with underactuated systems, aerial robotics, dynamic modeling, trajectory generation and tracking, estimator design, and controller design with focus on Nonlinear Model Predictive Control (NMPC). I've dabbled with numerical optimization using CMA-ES incorporating it into modern control theory. I've been involved in embedded numerical optimization applied to a quadrotor and a pendubot at the Systems Control and Optimization Laboratory (syscop), Freiburg, Germany. I'm currently working on embedded NMPC for the quadcopters at LAAS-CNRS, Toulouse, France.

Formation

Present – Nov 2017 | **Sapienza Università di Roma, Rome, Italy**
PhD in Automatica, Bioingegneria e Ricerca Operativa
- Concentration on nonlinear model predictive control applied to quadrotors.

Jun 2017 | **Instituto Federal do Ceará, Fortaleza, Brazil**
B.Sc. in Mechatronics Engineering
- *Modeling, Control and Simulation of a Quadrotor for Attitude Stabilization*.

Professional Experience

Present – Oct 2019 | **Laboratoire d'analyse et d'architecture des systèmes (LAAS-CNRS), Visiting PhD student, France**
- Embedded NMPC applied to quadrotors.
- NMPC design for quadrotor-slung payload system for the task of transportation on suspension.
- Shared control between human and drone using numerical optimization

NMPC | Modeling | Quadrotor | C/C++ | Python | GenoM3 | acados

Oct 2019 – May 2019 | **IMTEK, University of Freiburg, Visiting PhD student, Germany**
- Trajectory generation and tracking using NMPC for collision avoidance with dynamic obstacles for the Crazyflie nanoquadcopter.
- Development of a tangential predictor for fast and real-time NMPC applied to a quadrotor.
- Design of an optimal control problem for periodic trajectory generation to orbital stabilization of a pendubot.
- Gain expertise in embedded numerical optimization methods.

NMPC | NLP | Direct Method | Multiple Shooting | Quadrotor | Pendubot | MATLAB | Simulink | CasADi | acados | C/C++ | Python

Present – Nov 2017 | **Sapienza Università di Roma, PhD student, Italy**
- Dynamic modeling.
- Underactuated systems.
- Trajectory generation and tracking.
- Numerical Optimization Methods
- Nonlinear model predictive control applied to quadrotors.

NMPC | MHE | EKF | Modeling | Quadrotor | Pendubot | Underactuated Systems | MATLAB | C/C++ | Python | AprilTags

Jun 2017
Mar 2015

Instituto de Tecnologia da Informação e Comunicação (ITIC), Researcher, Brazil

- Quadrotor hardware technician.
- Technical project writer.
- Development of a quadrotor for remote and autonomous operation, used to perform inspections in indoor and outdoor environments.
- Development of an autopilot using BeagleBone Black.

PID | Quadrotor | Python | C | Assembly | BeagleBone Black

Aug 2017
Aug 2014

Laboratório de Inovação Tecnológica (LIT/IFCE), Undergraduate Research Assistant, Brazil

- Development of an autopilot using BeagleBone Black.
- Mechanical construction of a quadrotor frame.
- Quadrotor hardware technician.
- Design and implementation of a PID controller for attitude stabilization of a quadrotor.
- Development of an inspection solution to distribution low-voltage transformers using quadrotor and computer vision algorithms in order to recognize the environment and target objects.
- Exploration of communications' API and control strategies for drones.
- Adaptation of classical pattern and object recognition algorithms to parallel embedded platforms (such as the Jetson TK1 NVidia).

PID | Quadrotor | Python | C | Assembly | Pattern Recognition

Dec 2014
Dec 2013

Instituto de Tecnologia da Informação e Comunicação (ITIC), Educational Robotics Teacher, Brazil

- PIC 18FXX5X-based embedded systems development.
- Teacher of logic, programming language, electricity and basic electronics.

Programming | Electronics | Electricity | MIT Scratch | Code : :Blocks | Hardware | PIC18

Publications

2017 Carlos, Bárbara B.; de Oliveira, Antonio É. R. M.; de Alexandria, Auzuir R.; Sá, Rejane C.; Rodrigues, Antonio W. O. (2017) Modeling, Control and Simulation of a Quadrotor for Attitude Stabilization. In : Juan Carlos Figeroa-García; Eduyn Ramiro López-Santana; José Luis Villa-Ramírez; Roberto Ferro-Escobar. (Org.). Communications in Computer and Information Science. 4ed. Switzerland : Springer International Publishing, pp. 12-23, DOI : 10.1007/978-3-319-66963-2_2

2015 Carlos, Bárbara B.; Neto, Aluísio. C. Q. (2015) An Open-Source Hardware-Software Architecture for Educational Robotics. VI WORKSHOP DE ROBÓTICA EDUCACIONAL. 6ed. Uberlândia, Brazil : Sociedade Brasileira de Computação - SBC (WRE), pp. 58-63

Skills

Building Systems	Catkin, CMake, Make
Development Tools	MATLAB, Vim, Terminal (Linux/MacOS)
Numerical Optimization Tools	CasADi, ACADO, acados
Operating Systems	Linux, MacOS, ROS
Hardware	AVR Family (Atmega32), PIC18 Family, ARM Cortex-A8 Microprocessor
Misc	Rviz, Git, LaTeX, GenoM3

Programming Languages

C/C++ ●●●●●
MATLAB ●●●●○
Python ●●●○○

Idioms

Portuguese ●●●●●
English ●●●●●
Italian ●●●○○
French ●○○○○

Projects

NMPC for the crazyflie 2.1 Jun 2019 - Oct 2019

github.com/bcbarbara/crazyflie_nmpc

This package contains an efficient and modular implementation of a Nonlinear Model Predictive Control (NMPC) tailored for the Crazyflie's online trajectory generation and tracking problem. A Real-Time Iteration (RTI) scheme through a Sequential Quadratic Programming (SQP) online algorithm is used in order to solve the Nonlinear Program (NLP).

ROS | C++ | acados | HPIPM | BLASFEO

Mentoring

2018 **Sapienza Università di Roma, Projects Supervisor, Italy**

- *A flying inverted pendulum*. 1st year student of Scuola superiore di studi Avanzati Sapienza (SsaS). Tutor : professor Alessandro De Luca.
- *The Dynamic Bearing Observability Matrix Nonlinear Observability and Estimation for Multi-Agent Systems*. Project supervision for the Control of Autonomous Multi-Agent Systems course.

LQR | EKF | Geometric Control | Quadrotors Formation

Certifications

2018 *Model Predictive Control (MPC)*. Scuola IMT Alti Studi Lucca.
2017 *Robotics :Aerial Robotics*. Coursera. Credential ID AA6KBS8T8NAW .
2012 *6.002x : Circuits and Electronics*. edX. Credential ID d6294aa7fab348ecbe395669399a687d.