

BÁRBARA BARROS CARLOS

PhD candidate

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PhD student in Automatica at Sapienza Università di Roma, with a bachelor degree in Mechatronics Engineering by IFCE, Brazil (2017). My research focuses on optimization-based motion planning applied to aerial systems. 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 quadrotors at the Systems Control and Optimization Laboratory (syscop), Freiburg, Germany. I've been working with embedded NMPC for quadcopters and optimization-based shared control at the Robotics and InteractionS (RIS) team at LAAS-CNRS, Toulouse, France.

FORMATION

Present	Sapienza Università di Roma, ROME, Italy
Nov 2017	PhD in Automatica, Bioingegneria e Ricerca Operativa <ul style="list-style-type: none">➤ Concentration on numerical optimization applied to motion planning of quadrotors
Jun 2017	Instituto Federal do Ceará, FORTALEZA, Brazil
	B.Sc. in Mechatronics Engineering <ul style="list-style-type: none">➤ <i>Modeling, Control and Simulation of a Quadrotor for Attitude Stabilization.</i>

PROFESSIONAL EXPERIENCE

Present	Sapienza Università di Roma, PHD STUDENT, Italy
Nov 2017	<ul style="list-style-type: none">➤ Dynamic modeling.➤ Underactuated systems.➤ Trajectory generation and tracking.➤ Numerical Optimization Methods➤ Nonlinear model predictive control applied to quadrotors. <div>NMPC MHE EKF Modeling Quadrotor Pendubot Underactuated Systems MATLAB C/C++ Python AprilTags</div>
Mar 2020	Laboratoire d'analyse et d'architecture des systèmes (LAAS-CNRS), VISITING PHD STUDENT, France
Oct 2019	<ul style="list-style-type: none">➤ 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 <div>NMPC Modeling Quadrotor C/C++ Python GenoM3 acados</div>
Oct 2019	IMTEK, University of Freiburg, VISITING PHD STUDENT, Germany
May 2019	<ul style="list-style-type: none">➤ 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. <div>NMPC NLP Direct Method Multiple Shooting Quadrotor Pendubot MATLAB Simulink CasADi acados C/C++ Python</div>

Jun 2017 Mar 2015	Instituto de Tecnologia da Informação e Comunicação (ITIC), RESEARCHER, Brazil <ul style="list-style-type: none"> > 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. <div>PID Quadrotor Python C Assembly BeagleBone Black</div>
Aug 2017 Aug 2014	Laboratório de Inovação Tecnológica (LIT/IFCE), UNDERGRADUATE RESEARCH ASSISTANT, Brazil <ul style="list-style-type: none"> > 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). <div>PID Quadrotor Python C Assembly Pattern Recognition</div>
Dec 2014 Dec 2013	Instituto de Tecnologia da Informação e Comunicação (ITIC), EDUCATIONAL ROBOTICS TEACHER, Brazil <ul style="list-style-type: none"> > PIC 18FXX5X-based embedded systems development. > Teacher of logic, programming language, electricity and basic electronics. <div>Programming Electronics Electricity MIT Scratch Code::Blocks Hardware PIC18</div>

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 Figueroa-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, Adobe Illustrator

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 ROS stack contains the implementation of a position controller for the Crazyflie 2.1 based on NMPC with time delay compensation and bounds enforcement on the actuators. Due to the limited computational resources onboard, an offboard high-level position controller is proposed using the recently released high-performance software package **acados** which exploits the real-time iteration (RTI) scheme with Gauss-Newton Hessian approximation. The quadratic problems (QPs) arising in the NMPC problem are solved with **HPiPM**, an interior-point solver, based on the linear algebra library **BLASFEO** which is hand optimized for most recent CPU architectures.

ROS C++ real-time NMPC 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](#).