Hemjyoti Das | Research Engineer

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Date of Birth : 23 March 1994

PROFILE

A highly creative and experienced researcher, skilled in applying classical and optimal control techniques in aerial robots. My research interest lies in the intersection of autonomous agents and advanced control approaches to unravel some of the engineering challenges of the society, such as swarm-intelligence and manipulation using robots. A quick learner and self-motivated person who can dynamically adapt to new challenges, while possessing very good communication and team-work skills.

EDUCATION

Aug 2018 – Jul 2020

Masters in Aerospace Engineering (GPA: 7.93/10)
Delft University of Technology, The Netherlands

- **Specialization:** Control and Simulation
- **Relevant Coursework:** Automatic Flight Control System Design, Digital Control, Spacecraft Attitude Dynamics and Control, Robust and Multi-variable Control, Systems Theory, Autonomous Flight of MAV
- **Master's Thesis:** Incremental Nonlinear Dynamic Inversion Control of Pneumatic Actuators

Aug 2012 – May 2016

Bachelors in Electrical Engineering (GPA: 7.27/10)
National Institute of Technology, Silchar, India

- **Relevant Coursework:** Intelligent Control, Nonlinear Control, Advanced Control Systems, Optimal Control, Process Control, Neural Networks and Fuzzy Logic
- **Bachelor's Thesis:** Visual Servoing and Hand-Gesture Control of a Low-cost Mobile Robot

EXPERIENCE

Jun 2021 – present

External Researcher at the Faculty of Aerospace Engineering
Delft University of Technology, The Netherlands

- Working on reinforcement learning algorithms for resolving Air Traffic Control (ATC) conflict. Implemented Q-learning to optimize parameters of Modified Voltage Potential (MVP) method.
- Currently implementing Deep Q-learning from Demonstrations (DQfD) for ATC conflict resolution.

Key Skills: *Reinforcement Learning, Air Traffic Control (ATC), Conflict Resolution, Python*

Aug 2020 – present

Research Engineer at the Robotics and Mechatronics Lab
University of Twente, The Netherlands

- Working on Moving Horizon Estimation (MHE) for prediction of human intention. The prediction is then utilized by a Mixed-Initiative Model Predictive Controller (MI-MPC), to fly a quadrotor.
- Worked on perception-based cooperative target tracking with heterogeneous UAVs using Nonlinear Model Predictive Control (NMPC). Supervised a masters thesis student as a part of this project.
- Worked on closed-loop speed control of brushless DC motors using D-Shot Electronic Speed Controller (ESC) protocol. Supervised two bachelors thesis students as a part of this project.
- Developed a Gazebo simulation environment for the physical interaction between a human and a UAV. Served as the teaching assistant for a class on Control for UAVs, where I framed a simulation-based assignment in Gazebo and assisted the students in it.

Key Skills: *Model Predictive Control (MPC), Multi-agent System, Moving Horizon Estimation (MHE), Quadrotor Control, Human Intension Prediction, Gazebo Simulation, ROS, C++, Python*

May 2019 – Aug 2019

Summer Internship at the Institute of Robotics and Mechatronics
German Aerospace Center (DLR), Munich, Germany

- Formulated the closed-chain dynamic model of a cable suspended aerial manipulator platform and designed a damping controller to minimize the oscillations of the platform.

Key Skills: *System Modelling, Damping Controller, Aerial Manipulator, MATLAB*

Jan 2017 – July 2018 **Research Assistant at the Department of Aerospace Engineering**

Indian Institute of Science, Bangalore, India

- Implemented a bio-inspired Tau guidance law for the Parrot AR Drone, to facilitate its safe and smooth landing. Tau theory is based on the approach used by some birds for perching on a target.
- Designed an improved state estimation technique for the quadrotor, by utilizing an Extended Kalman Filter (EKF) to fuse visual odometry (VO) and inertial navigation system (INS).
- Integrated the developed bio-inspired guidance law and state estimation technique with a nonlinear dynamic inversion (NDI) controller, for trajectory tracking of the quadrotor.

Key Skills: *Bio-inspired Guidance, State Estimation, Quadrotor Landing, Visual Odometry, Inertial Navigation, Nonlinear Dynamic Inversion (NDI), ROS, Gazebo, C++, MATLAB*

ACADEMIC PROJECTS

Sep 2019 - July 2020 **Incremental Nonlinear Control of Pneumatic Actuators**

Masters Thesis Project at the Department of Aerospace Engineering, TU Delft

- Investigated the dynamics of a pneumatic actuator and implemented an Incremental Nonlinear Dynamic Inversion (INDI) controller for its trajectory tracking, by utilizing a cascaded control approach.
- Implemented a baseline PID controller and demonstrated the robustness of INDI over it, in the presence of realistic sensor noise, by introducing two different filtering schemes for the noise.

Key Skills: *Incremental Control, PID, Cascaded Control, Pneumatic Actuator, Sensor Noise, MATLAB*

Feb 2019 - Apr 2019 **Autonomous Drone Race Competition**

Academic Project at the Department of Aerospace Engineering, TU Delft

- Designed an obstacle avoidance algorithm for Parrot Bebop drone using computer vision techniques, with the goal to finish the race course in the minimum time. We ranked in top 5 amongst 15 teams.

Key Skills: *Obstacle Avoidance, Computer Vision, Quadrotor Control, C++*

SKILLS

- **Software Packages:** Matlab, Simulink, Robot Operating System (ROS), Gazebo, OpenCV
- **Programming Languages:** C, C++, Visual C++, Python, XML

SELECTED PUBLICATIONS

- G. Corsini, M. Jacquet, **H. Das**, A. Afifi, D. Sidobre and A. Franchi. **Model Predictive Control for Human-Robot Aerial Handover** (Submitted, IEEE/RSOJ International Conference on Intelligent Robots and Systems (IROS), 2022)
- M. Jacquet, M. Kivits, **H. Das** and A. Franchi. **Motor-level N-MPC for Cooperative Active Perception in Heterogeneous Multi-agent UAVs** (IEEE Robotics and Automation Letters (RAL), 2022)
- **H. Das**, D. Pool and E. van Kampen. **Incremental Nonlinear Dynamic Inversion Control of Long-Stroke Pneumatic Actuators** (European Control Conference (ECC), 2021)
- **H. Das**, K. Sridhar and R. Padhi. **Bio-inspired Landing of Quadrotor using Improved State Estimation** (IFAC 3rd International Conference on Advances in Control and Optimization of Dynamical Systems, 2018)
- **H. Das. Dynamic Inversion based Control of Quadrotor with a Suspended Load** (IFAC 3rd International Conference on Advances in Control and Optimization of Dynamical Systems, 2018)

LANGUAGES

English (Advanced), Hindi (Native), Dutch (Beginner)

EXTRACURRICULAR ACTIVITIES

Boxing, Football, Bodybuilding, Cycling, Rock Music, Travelling

REFERENCES

Dr. Antonio Franchi
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