Chris D. Breaux

US Citizen

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Education

Robotics and Autonomous Systems (Mechanical Engineering) M.S. | Arizona State University — Graduation: May 2021

Mechanical Engineering B.S.E. | Arizona State University, Barrett the Honors College — Graduation: May 2020

Experience

Robotics Engineer (Level 3 Software Developer)

Aurora Flight Sciences — June 2021 – Current

Behavior Management for Wisk Aero's Autonomous eVTOL

August 2021 – Current

Autonomous Flight | Behavior Trees | Certified Software Development | App Development

Joined the Flight Path and Contingency Management team to prototype autonomous behaviors for Wisk's Autonomous eVTOL. Developed the Behavior Management module which is the central decision-making module of the autonomy stack. Developed a python-based behavior tree execution algorithm and an IDE for designing and executing behavior trees alongside a flight simulation. Designed a behavior tree capable of nominal flight and conflict detection and resolution. Integrated the behavior tree with Wisk's simulation infrastructure and a primary flight display to conduct the first autonomous flight tests on Wisk's surrogate test helicopter.

Reimplemented the BM module in Simulink to align with Wisk's software standards and certification strategy. Reinvented the behavior tree algorithm within Simulink's model-based design while retaining all of the features of the python prototype. This Simulink-based implementation is on track to be the first certified implementation of behavior trees. Supported all simulation and flight test milestones, expanding the behavior tree to support contingency monitoring, planning, and execution, vector and hold commands, and mission modifications. Supported requirement development and matured behavior tree designs to align with requirements.

Neural-Network-Based Predictive Compensation (DoD Contract)

June 2021 – August 2021

Machine Learning | Predictive Compensation | Monte Carlo Experiments

Conducted a research project to investigate a predictive compensation controller's ability to increase safety and reduce aircraft wear when encountering an environmental danger. Used hyperparameter optimization to train and select a LSTM neural network that could predict the state of an environmental danger during flight. Integrated two instances of the neural network with a flight control model in Simulink where a temporary, closed-loop network predicted the time and state of the encounter while a persistent, open-loop network continued to observe the actual state to increase the accuracy of its forecasts as the aircraft approached the encounter. Performed Monte Carlo experiments with pairs of nominal and predictive simulations where an iterative loop was used to synchronize their final conditions at the encounter. Derived equations to project the results of the reduced-dimension simulation and suggest outcomes in a higher-dimensional space. The projections showed that the predictive controller increased accuracy and eliminated all critical failures. Delivered a 60-page report and presented the methods and analysis directly to a DoD representative.

Graduate Researcher | Optimal Control for Lunar Tumbling Robot

Arizona State University | Intelligent Control and Estimation of Things (ICE-T) Lab | NASA — Aug 2020 – April 2021

Optimal Control | Hybrid Control | Modeling | Code Acceleration | Simulation

Designed a hybrid control framework to handle multiple control modes and instantaneous jumps. Dynamics for three maneuvers were modelled and discretized for usage within the framework and the optimizer. Performance metrics were defined as cost functions and constraints. Code was accelerated to reduce process time. Optimized models were validated with a high-resolution simulation.

Summer Intern | Numerical Simulator for Lunar Tumbling Robot

NASA | Goddard Space Flight Center — Jun 2020 – Aug 2020

Simulation | State Machines | PID | Automation

Created a 3D simulation test bed as a platform to develop estimation and control algorithms for NASA's lunar tumbling robot. Created physically accurate robot assets and lunar environment with interchangeable components. Implemented a python-based state machine and motion control algorithms for manual and autonomous control. Optimized workflow with automated processes to rapidly adjust simulations and process data. Created a user manual and tutorials for others to reuse and reproduce all work from scratch.

Undergraduate Researcher | Autonomous Coupling of a UAV and UGV

Arizona State University | Human Oriented Robotics and Control (HORC) Lab — Nov 2018 – Nov 2019

Multi-Robot System | State Machines | Motion Capture | Rapid Prototyping

Developed a heterogeneous team of robots that navigate a space in coupled and decoupled configurations. Designed an electromagnetic coupling mechanism that allows a UAV to lift a UGV over an obstacle and allows the UGV to carry the UAV greater distances. Implemented python-based state machines and motion control for each robot. [Video]

Click here or scan the QR code to see more of my projects: