THOMAS ANTONY

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EDUCATION

Purdue University, West Lafayette, IN — May 2018
Doctor of Philosophy, Aeronautics & Astronautics — GPA: 3.74
Advisor: Prof. Michael J. Grant
Dissertation: Large Scale Constrained Trajectory Optimization using Indirect Methods

Purdue University, West Lafayette, IN — December 2014
Master of Science in Aeronautics & Astronautics — GPA: 3.74
Major: Aerospace Systems, Minor: Astrodynamics
Advisor: Prof. Michael J. Grant
Thesis: Rapid Indirect Trajectory Optimization on Highly Parallel Computing Architectures

Cochin University of Science and Technology, Kochi, India — June 2011
Bachelor of Technology in Mechanical Engineering — Graduated top 5% of class

Udacity — 2016 – 2017
Self Driving Car Engineer Nano-Degree

AREAS OF INTEREST

Automation, Robotics, Trajectory Optimization, Guidance, Navigation and Control, State Estimation, Multi-Disciplinary Design Optimization, Parallel Computing, Computer Vision

WORK EXPERIENCE

Autonomous Vehicle Engineer — February 2018–present
Smart Ag, Ames, IA

- Developed guidance algorithm to for "sync" operation between a combine harvester and grain cart using behavior trees
- Designed simulator for automated testing of guidance algorithms

Software Engineering Intern — January 2017–August 2017
Smart Ag, Ames, IA

- Designed an A* path planning algorithm for an autonomous tractor
- Developed high-level, modular middleware for autonomous tractor using Python
- Designed and tested PID guidance software for autonomous tractor that allows waypoint-to-waypoint guidance
- Designed model-predictive controller for autonomous tractor using optimal control theory
- Developed autonomous tractor simulator using PyGame for offline testing of guidance software

RESEARCH EXPERIENCE

Visiting Researcher — May 2015–August 2015
AFRL Mathematical Modeling and Optimization Institute, Eglin AFB, FL

- Developed an adaptive numerical method for solving two-point boundary value problems called the Generalized Adaptive Chebyshev-Picard Iteration Method
- Demonstrated the viability and performance of the method by applying it to trajectory optimization problems

Graduate Research Assistant — August 2013–December 2017
School of Aeronautics and Astronautics, Purdue University, West Lafayette, IN

- Developed a mission design framework in Python for optimization of large scale dynamic systems

- Performed optimal trajectory design for a hypothetical long range weapon system
- Performed case study about the range performance of a hypersonic boost-glide vehicle
- Developed a GPU-accelerated trajectory optimization library
- Developed and published open source libraries for Python that facilitates modular user interface design and functional pipelining

PUBLICATIONS & TALKS

- "Path Constraint Regularization in Optimal Control Problems using Saturation Functions", **Antony, T.** and Grant, M.J., *2018 AIAA Atmospheric Flight Mechanics Conference, AIAA SciTech Forum, Kissimmee, FL, 8–12 Jan 2018*, AIAA 2018-0018
- "Rapid Indirect Trajectory Optimization on Highly Parallel Computing Architectures" **Antony, T.** and Grant, M.J., *Journal of Spacecraft & Rockets*, Vol. 54, No. 5 (2017), pp. 1081-1091. doi:10.2514/1.A33755
- "Rapid Indirect Trajectory Optimization of a Hypothetical Long Range Weapon System" Grant M.J. and **Antony, T.**, *AIAA Atmospheric Flight Mechanics Conference, San Diego, CA, 4–8 Jan. 2016*, AIAA 2016-0276
- "Optimization of Interior Point Cost Functionals Using Indirect Methods", **Antony, T.**, Grant, M.J. and Bolender, M.A., *AIAA Atmospheric Flight Mechanics Conference, Dallas, TX, 22–26 Jun. 2015*, AIAA 2015-2399
- "A Generalized Adaptive Chebyshev-Picard Iteration Method for Solution to Two-Point Boundary Value Problems" **Antony, T.** and Grant, M.J., *3rd Annual Meeting of the AFRL Mathematical Modeling and Optimization Institute, Shalimar FL, 27–31 Jul. 2015*
- "Enabling Mars Exploration Using inflatable Purdue Aerodynamic Decelerator with Deployable Entry Systems (iPADDLES) Technology" Sparapany, M., **Antony, T.**, Saranathan, H., Klug, L., Libben, B., Shibata, E., Williams, J., Grant, M. J. and Saikia, S. J., *13th International Planetary Probe Workshop, Laurel, MD, 13–17 Jun. 2016*

PROJECTS

Traffic Sign Classification using Deep Learning
Udacity Self-Driving Car Engineer Nano-Degree

- Developed a convolutional neural network model to classify traffic signs from the German Traffic Signs dataset using Tensorflow
- Trained and tested the model to obtain a testing accuracy of 97%
- Tested the model on American traffic signs and found that it still performed with reasonable accuracy for similar signs.

Lane Detection using OpenCV
Udacity Self-Driving Car Engineer Nano-Degree

- Used OpenCV Hough transforms to detect and overlay lanes in a video stream.
- Developed methodology to extract lane positions out of the lines detected by the Hough Transform.
- Applied a least-squares fit and smoothing to remove noisy data.

Model Predictive Controller for a Self-Driving Car
Udacity Self-Driving Car Engineer Nano-Degree

- Used IPOPT and direct transcription method to develop a model predictive controller for a self-driving car in C++
- Tuned the weights on multi-objective cost function to attain a stable driving speed of 60 mph in simulator

Design of a deployable HIAD and guidance system for a high-mass Mars entry mission
Finalist, 2016 NASA/NIA BIG Idea Challenge

- Performed conceptual design of a deployable HIAD system capable of delivering a 50 metric ton payload to the surface of Mars
- Designed a Sideslip Augmented Apollo Guidance (SAAG) algorithm to provide robustness to errors in environment and vehicle parameters
- Performed Monte-Carlo simulations to obtain the dispersion-ellipse corresponding to errors and uncertainties in entry conditions, environment and vehicle parameters

Range Performance Study of a Hypersonic Boost-Glide Vehicle April 2015

- Modeled the aerodynamics of a hypersonic boost-glide vehicle using Newtonian aerodynamics
- Designed maximum-range trajectories for varying conditions of booster-burnout altitude and terminal altitude

GPU-Accelerated Trajectory Optimization Framework December 2014

- Developed a GPU-accelerated optimal control framework
- Integrated into existing MATLAB-based mission design framework
- Created a MEX library in C++ that leverages NVIDIA CUDA framework
- Developed a MATLAB library to generate C++ equation files compatible with CUDA
- Demonstrated a speed-up of 4x over MATLAB's bvp4c for a small-dimensional hypersonic trajectory optimization problem.

Aerocapture Trajectory Design April 2014
2014 Inspiration Mars International Student Design Competition (First Prize)

- Analyzed Mars-Earth return aerocapture trajectory maneuver for Purdue's Team Kanau for the 2014 Inspiration Mars Design Competition
- Used optimal control theory to minimize peak heat rate and G-loading of a direct entry trajectory for Mars-Earth return
- Demonstrated feasibility of PICA-X heat shield for hyperbolic entry velocities (14–15 km/s) with peak G-loading of under 5 Gs assuming a SpaceX Dragon class vehicle

Mission Concept Design for the Exploration of Trojan Asteroids April 2014

- Led structures and mechanical configuration design for a JPL Team-X style mission design class
- Selected instruments for achieving specific scientific exploration objectives
- Performed spacecraft sizing, instrument positioning and preliminary structural strength analysis

OTHER EXPERIENCE

Co-Founder and Chief Technology Officer December 2009–June 2012
MindHelix Technosol Pvt. Ltd, Kochi, India

- Designed and developed the first public-sector cloud-computing project in India — "Know your Police Station" for the Delhi Police Department
- Trained development teams on Android and iOS platforms
- Developed TukTukMeter that won the Indian Android Developer Contest 2011, NASSCOM AppFame 2011 Awards and the mBillionth South Asia Awards 2011

Computer Science Tutor February 2013–July 2013
HORIZONS, Purdue University, West Lafayette, IN

- Tutored undergraduate students on basic computer programming and algorithm design using Python, C and C++

SKILLS

- **Strong**: Python, MATLAB, CUDA, NumPy, SciPy, C, C++, Java, C#, Objective C, PHP/MySQL, HTML, CSS, Javascript, Git, LaTeX
- **Intermediate**: Mathematica, Solidworks, ReactJS, OpenCV, TensorFlow, Keras
- **Basic**: Scikit-Learn, Android SDK, iOS SDK, Arduino, Unity3D

COURSEWORK

- Hypersonic Performance and Design
- Guidance and Control of Aerospace Vehicles
- Optimization in Aerospace Engineering
- Multidisciplinary Design Optimization
- Design Theory and Methods for Aerospace Systems
- Principles of Dynamics
- Orbital Mechanics
- Spacecraft Attitude Dynamics