

# THOMAS ANTONY

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## EDUCATION

**Purdue University**, West Lafayette, IN December 2018 (expected)  
Doctor of Philosophy, Aeronautics & Astronautics GPA: 3.70  
Major: Astrodynamics, Minor: Dynamics and Control  
Advisor: Prof. Michael J. Grant

**Udacity** October 2016 – July 2017  
Self Driving Car Engineer Nano-Degree

**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

## AREAS OF INTEREST

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

## RESEARCH EXPERIENCE

**Graduate Research Assistant** August 2013–Present  
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 facilitate modular user interface design and functional pipelining

**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

## PROJECTS

### Traffic Sign Classification using Deep Learning

*Udacity Self-Driving Car Engineer Nano-Degree*

- Developed 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 for a Self-Driving Car**

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- 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.

### **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
- Solved 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

## **PUBLICATIONS & TALKS**

- "Rapid Indirect Trajectory Optimization on Highly Parallel Computing Architectures" **Antony, T.** and Grant, M.J., *Journal of Spacecraft & Rockets* [Under Review]
- "Rapid Indirect Trajectory Optimization of a Hypothetical Long Range Weapon System" Grant M.J. and **Antony, T.**, AIAA 2016-0276, *AIAA Atmospheric Flight Mechanics Conference, San Diego, CA, 4–8 Jan. 2016*

- “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*

## WORK 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, L<sup>A</sup>T<sub>E</sub>X
- **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