Michael Vitus

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Summary

I am a self-motivated, independent researcher who excels at both developing novel algorithms and bringing these ideas into fruition on real-world systems. I have implemented and successfully demonstrated all of my theoretical contributions on robotic testbeds. My main focus during my PhD. has been on control and planning for robotics, and I also have a working knowledge of optimization, machine learning techniques, and signal processing. Lastly, I have a passion for learning and I acquire new skills quickly. I am pursuing opportunities to continue applying both my practical and analytical skills to solve challenging problems in industry.

Education

Stanford University   **Stanford, CA**

Ph.D. in Aeronautics and Astronautics   *2006–2012*
Advisor: Claire Tomlin
Thesis title: Stochastic Control via Chance Constrained Optimization and its Application to Unmanned Aerial Vehicles

Stanford University   **Stanford, CA**

M.S. in Aeronautics and Astronautics, GPA: 3.91/4.3   *2004–2005*
Coursework: linear/nonlinear control, estimation, dynamics, optimization, machine learning and artificial intelligence

Rensselaer Polytechnic Institute   **Troy, NY**

B.S. in Aeronautical and Mechanical Engineering, Minor in Computer Science, GPA: 3.97/4.0   *2000–2004*

Experience

UC Berkeley   **Berkeley, CA**

Postdoctoral Researcher   *2012–Present*
- Advising three students (2 Ph.D. and 1 undergraduate)
- Developing methods for safely integrating autonomous vehicles into everyday driving
  - Probabilistic planning for making decisions under uncertainty of other drivers' behavior
  - Probing control inputs to perform system identification of the other drivers to increase the network safety

Arc, Inc.   **Palo Alto, CA**

Cofounder/CTO   *March 2012–November 2012*
- Aerial robotics company focusing on consumer cameras
- Developed a tracking quadrotor stabilized camera for capturing life's active moments
- Designed a detailed compass model to reject large, time-varying magnetic disturbances from electric motors
- Implemented arduino based beacon for tracking user, including hardware integration and software development

Hybrid Systems Lab   **Palo Alto, CA**

Research Assistant   *January 2006–March 2012*
- Stochastic motion planning
  - Stochastic optimization with application to probabilistic motion planning in deterministic/uncertain environments
  - First successful, real-time experimental demonstration of chance constrained control with uncertain constraint parameters and variables on a quadrotor vehicle navigating through a 3D environment
  - Developed a novel risk allocation method to augment controller optimization
- Provably safe control for complex maneuvers
  - Formulated reachability based controller method to design and verify the safety of complex maneuvers
  - First demonstration of an autonomous quadrotor backflip
- Design and development of the Stanford Testbed of Autonomous Rotorcraft for Multi-Agent Control (STARMAC)
- Developed an efficient, tunable sensor selection algorithm with an analytical error bound for sensor networks
- Analyzed the interaction of collision avoidance algorithms for aircraft
- Developed an algorithm to reduce the computational complexity of optimization based path planning (MILP)

Topographik, Inc.   **Palo Alto, CA**

Cofounder/CTO   *June 2011–March 2012*
- Developed a software prototype in C++ for measuring human dimensions for custom clothing using the Kinect sensor
- Programmed algorithms for outlier rejection, smoothing, downsampling, and registration of the 3D point cloud data
- Designed and implemented a PCA based torso alignment algorithm

NASA Ames - Intelligent Robotics Group   **Mountain View, CA**
Intern on Dark Navigation Project   *January 2007–January 2008*
- Implemented hazard/obstacle avoidance methods and successfully demonstrated algorithms on over 500m of autonomous rover driving

Projects

Ongoing Projects, Spare time   *Present*
- Computational constrained scan matching for localization with LIDAR
- Recognizing user's workout routines using smartphone sensors and machine learning classification (SVM, RPCA)

Past Projects, Stanford University   *2005-2007*
- *Machine Learning for Controlled Slides of a RC Car*: developed a model of a RC car's dynamics, implemented a Q-learning controller and successfully demonstrated the desired circular trajectory while sliding
- *Nonlinear Control of Autonomous Cars*: implemented a nonlinear model predictive controller for steering control of cars
- *Carrier Phase Differential Global Positioning System*: implemented CDGPS for an aerobatic helicopter and formulated a technique to use multiple receivers while the helicopter is performing aggressive rolling/pitching maneuvers
- *Robot Localization and Navigation*: implemented local navigation, Markov localization, and a gradient based global path planner and successfully demonstrated the algorithms on a mobile robotic platform with LIDAR sensing modality

Distinguishments

2012: *YCombinator*, Startup Accelerator, 3% acceptance rate

2012: *StartX*, Startup Incubator, 10% acceptance rate

2004: Stanford University Aeronautics and Astronautics Fellowship

2004: Paul Hemke award for most outstanding Aeronautical engineer in graduating class, sponsored by AIAA

2003: Founders Award of Excellence at Rensselaer, awarded to <1% of student population

2003: 4.0 Award - Rensselaer

2000: Rensselaer Medal for Achievement in Math and Science Scholarship

Computer skills

Languages: C/C++ incl. embedded (10+ years), Python, Java, OpenGL, Javascript, PHP, CSS

Software: Matlab, Maple, SolidWorks, **Version Control**: SVN, Git, Mercurial

Libraries: ROS, PCL, OpenCV, Eigen, Boost, LAPACK

Miscellaneous: Excellent troubleshooting and debugging skills, embedded systems, **OS**: Linux, Windows

Selected Publications (23 accepted and 2 submitted)

- Michael P. Vitus and Claire J. Tomlin. A hybrid method for chance constrained control in uncertain environments. In *Proceedings of the 51th IEEE Conference on Decision and Control*, December 2012.
- Jerry Ding*, Jeremy Gillula*, Haomiao Huang*, Michael P. Vitus*, Wei Zhang*, and Claire J. Tomlin. Toward reachability-based controller design for hybrid systems in robotics. *IEEE Robotics & Automation Magazine*, September 2011.
- Michael P. Vitus, Wei Zhang, Alessandro Abate, Jianghai Hu and Claire J. Tomlin. On Sensor Scheduling of Linear Dynamical Systems with Error Bounds. In *Proceedings of the 49th IEEE Conference on Decision and Control*, December, 2010.
- Michael P. Vitus and Claire J. Tomlin. Sensor placement for improved robotic navigation. In *Proceedings of Robotics: Science and Systems*, June 2010. **17% acceptance rate**
- Jeremy Gillula*, Haomiao Huang*, Michael P. Vitus*, and Claire J. Tomlin*. Design of guaranteed safe maneuvers using reachable sets: Autonomous quadrotor aerobatics in theory and practice. In *Proceedings of the 2010 IEEE International Conference on Robotics and Automation*, May 2010.
- Liam Pedersen, Chin San Han, and Michael P. Vitus. Dark navigation: Sensing and rover navigation in permanently shadowed lunar craters. In *9th International Symposium on Artificial Intelligence, Robotics and Automation in Space*, February 2008.

*These authors contributed equally.