Zachary Manchester

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Research Interests:

- Small Spacecraft
- Unmanned Aircraft
- Robotics
- Optimization
- Control Systems
- Nonlinear Dynamics
- Estimation and Filtering
- Low-Power Radio Communication and Navigation

Education:

2015 ***Ph.D.*** ***Aerospace Engineering*** ***Cornell University***
- Cumulative GPA: 3.79

2010 ***M.Eng.*** ***Aerospace Engineering*** ***Cornell University***
- Cumulative GPA: 3.75

2009 ***B.S.*** ***Engineering Physics*** ***Cornell University***
- Cumulative GPA: 3.34

Research Experience:

Oct. 2015-Present ***Harvard University***
- Developing optimization-based algorithms for control and system identification of small wing-morphing aircraft

2009-Present ***Cornell University***
- Pioneered the development of centimeter-scale (ChipSat) spacecraft
- Founded the KickSat project to launch and deploy over 100 centimeter-scale spacecraft from a CubeSat "mothership" in low Earth orbit
- Raised $74,586 through crowd-funding website Kickstarter
- Awarded launch through NASA's CubeSat Launch Initiative
- Developed long-range, low-power radio communication protocol
- Developed novel attitude control and inertia estimation algorithms
- Led a small team to design, build, test, and fly a 3U CubeSat

2012-2013 ***NASA Ames Research Center***
- Developed attitude determination and control algorithms for small satellite missions
- Experimented with rapid prototyping techniques for fabrication of spacecraft components
- Performed integration and environmental testing for CubeSats

2009 ***Sandia National Laboratories***
- Used semiconductor fabrication techniques to build prototype satellite-on-chip devices at Sandia's Center for Integrated Nanotechnology

2006-2007 ***CU-24 Unmanned Arial Vehicle Team***
- Integrated onboard computer, autopilot, and communication systems for a UAV
- Developed a linux-based software stack for video and flight data communication

Teaching Experience:

Spring 2016 ***Teaching Assistant – Optimization Algorithms for Robotics – Harvard***

- Held office hours and gave several guest lectures for a graduate course in optimal control and optimization-based motion planning for robotic systems

Spring 2012 ***Lecturer – Spacecraft Engineering – Cornell***

- Taught a junior-level undergraduate course (73 students) covering spacecraft orbital and attitude dynamics and space mission design

Fall 2010 ***Teaching Assistant – Feedback Control Lab – Cornell***

- Ran the lab portion of a senior-level undergraduate course on feedback control systems where controllers were designed and implemented on electromechanical laboratory systems

Work Experience:

2010 ***Sentinel IC Technologies, Inc.***

- Developed high performance mixed-integer optimization code in C for semiconductor design applications

2007-2010 ***Analytical Graphics, Inc.***

- Developed astrodynamics (orbital and attitude dynamics) simulation software
- Developed an algorithm for calculating rhumb lines on oblate and prolate spheroids that is now part of the Systems Tool Kit (STK) software
- Developed an automated C# to Java source code translator

Academic Awards:

2010 ***Thomas J. and Joan T. Kelley Prize***

- Awarded for the top Master of Engineering project in Aerospace Engineering at Cornell

Journal Publications:

1. Z. Manchester and M. Peck. "Quaternion Variational Integrators for Spacecraft Dynamics," *AIAA Journal of Guidance, Control, and Dynamics*, Vol. 39, No. 1, 2016, pp. 69–76.
2. Z. Manchester and M. Peck. "Recursive Spacecraft Inertia Estimation with Semidefinite Programming," *AIAA Journal of Guidance, Control, and Dynamics* (in review).

Conference Publications:

1. Z. Manchester. "Lyapunov-Based Control for Flat-Spin Recovery and Spin Inversion of Spin-Stabilized Spacecraft," AIAA/AAS Astrodynamics Specialist Conference, Long Beach, California, September 13-16, 2016.
2. Z. Manchester, M. Peck, and A. Filo. "KickSat: A Crowd-Funded Mission To Demonstrate The World's Smallest Spacecraft," AIAA/USU Conference on Small Satellites, Logan, Utah, August 12-16, 2013.
3. Z. Manchester and M. Peck. "Stochastic Space Exploration with Microscale Spacecraft," AIAA Guidance, Navigation, and Control Conference, Portland, OR, August 8-11, 2011.
4. J. Atchison, Z. Manchester, and M. Peck. "Microscale Atmospheric Reentry Sensors," 7th International Planetary Probe Workshop, Barcelona, Spain, June 14-18, 2010.

Other Publications:

1. Z. Manchester. "Centimeter-Scale Spacecraft: Design, Fabrication, and Deployment," PhD Thesis, Sibley School of Mechanical and Aerospace Engineering, Cornell University, August 2015.
2. Z. Manchester. "KickSat: Bringing Space to the Masses," *CQ VHF Magazine*. Vol. 17, no. 3, pp. 32-38, 2013.

Invited Talks:

1. "Aerospace Generations: Lessons Learned from a Half Century of Innovation in Aerospace Technology." AIAA SciTech Conference Plenary, San Diego, January 5, 2016.
2. "CubeSat Constellations for Wildlife Tracking and Monitoring." National Science Foundation Workshop on Engineering and Biology at the Frontier of Environmental and Organismal Sensing, Washington, D.C., October 16, 2014.
3. "KickSat: The World's Smallest Spacecraft." Texas Instruments, Dallas, TX, May 30, 2014.
4. "KickSat: Crowd-Funding Space." Technology for Bootstrapped Entrepreneurship, Cornell University School of Hotel Administration, May 5, 2014.
5. "ChipSats: Centimeter-Scale Spacecraft and How They Will Change Atmospheric Science." NASA Ames Research Center, October 24, 2012.
6. "KickSat: Kick Starting the Personal Space Age." AIAA San Francisco Chapter Small Payloads Tech Talks, October 15, 2012.
7. "The Sprite Project: Satellite on a Chip." NASA Goddard Spaceflight Center, December 12, 2011.
8. "Demonstration of a Prototype 'Sprite' ChipSat." ChipSat Workshop, Brown University, Providence, RI, February 18, 2010.

Selected Popular Press Coverage:

1. BBC World News: Interviewed as part of a segment on low-cost space exploration, September 24, 2014.
2. The Science Channel, *Man vs. The Universe*. Episode 2, August 2014.
3. G. Fleishmann. "Nanosats are go!" *The Economist*. June 7, 2014.
4. C. Seidler. "SpaceX-Flug: Mein Haus, mein Auto, mein Mini-Satellit." *Der Spiegel*. April 14, 2014.
5. S. Clark. "Crowd-funded stowaway to deploy 104 tiny satellites." *Spaceflight Now*. April 13, 2014. http://spaceflightnow.com/falcon9/009/140413kicksat
6. N. Hurst. "Q&A: KickSat's Zac Manchester and Andy Filo." *Make Magazine*. April 11, 2014. http://makezine.com/2014/04/11/how-to-kick-a-sat/
7. Q. Hardy. "Space Chips for the Common Man." *The New York Times Bits Blog*. April 5, 2014. http://bits.blogs.nytimes.com/2014/04/05/space-chips-for-the-common-man
8. R. Hollingham. "How to get to space on the cheap." *BBC Future*. April 16, 2012. http://www.bbc.com/future/story/20120412-how-to-get-to-space-on-the-cheap
9. BBC Radio 4: Interviewed about the KickSat project, October 13, 2011.

References:

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