Jonathan A. DeCastro

CONTACT INFORMATION

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RESEARCH INTERESTS

I am interested in high-level control of robots featuring complex, nonlinear dynamics. My work draws from a variety of technical domains, including robotics, control theory, optimization, and formal methods.

EDUCATION

Cornell University, Ithaca, NY

Ph.D., Mechanical and Aerospace Engineering 2015–*Present*

Thesis Topic: *Automated Reactive Synthesis for Dynamical Systems*
Advisor: Prof. Hadas Kress-Gazit
Graduate Minors: Computer Science, Computational Science and Engineering

M.S., Mechanical and Aerospace Engineering 2011–2014

Virginia Tech, Blacksburg, VA

B.S./M.S. (with Honors), Mechanical Engineering 1996–2003

Advisor: Prof. William R. Saunders

HONORS AND AWARDS

Travel Grant to ICRA in Seattle, WA; sponsored by IEEE RAS and NSF 2015
Cornell MAE Fellowship, a merit-based award to incoming Ph.D. students 2011–2012
ASME Propulsion Best Paper Award 2009
NASA Group Achievement Award for an outstanding group accomplishment developing the software tool C-MAPSS 2009
NASA Space Act Award for an outstanding technical contribution: novel control algorithms for aircraft engines 2007
AIAA Best Young Professional Paper awarded by the Northern Ohio Section of AIAA 2007

PROFESSIONAL EXPERIENCE

Graduate Research Assistant, Cornell University, Ithaca, NY 2011–*Present*
Verifiable Robotics Research Group Advisor: *Prof. Hadas Kress-Gazit*

- Developed an algorithm for automated, correct-by-construction synthesis of controllers for robots with nonlinear dynamics through application of formal methods and sums-of-squares optimization.
- Developed a novel approach to automatically synthesize revisions to robot mission specifications that cannot be realized and explain these revisions to the user via auto-generated feedback.
- Supported by NSF Expeditions in Computer-Augmented Program Engineering (ExCAPE).

Lead Engineer, Impact Technologies, LLC., Rochester, NY 2008–2011
Control and Prediction Group Supervisor: *Carl Byington*

- Developed control algorithms and simulation tools for application to flight control and diagnostic systems and submarine navigation. DoD- and NASA-sponsored research.
- Responsible for authoring proposals and mentoring co-op students.

Research Scientist, NASA Glenn Research Center, Cleveland, OH 2003–2008
Intelligent Control and Autonomy Branch Supervisor: *Dr. Sanjay Garg*

- Developed Commercial Modular Aero-Propulsion System Simulation (C-MAPSS), a publicly-available "virtual" aircraft engine serving to extend accessibility of such models to a wide arena of researchers. The C-MAPSS team was the recipient of a NASA Group Achievement Award.
- Investigated control algorithms for in-flight aircraft control reconfiguration during emergencies. Responsible for implementing and testing various control techniques in scaled engine component test rigs.

Journal Publications

[1] **J. A. DeCastro** and H. Kress-Gazit. Synthesis of nonlinear continuous controllers for verifiably-correct high-level, reactive behaviors. *International Journal of Robotics Research*, 34(3): 378–394, 2015. doi:10.1177/0278364914557736

[2] **J. A. DeCastro**, R. Ehlers, M. Rungger, A. Balkan, P. Tabuada, and H. Kress-Gazit. Dynamics-based reactive synthesis and automated revisions for high-level robot control. (submitted) *CoRR*, abs/1410.6375, 2014. arXiv:http://arxiv.org/abs/1410.6375.

[3] **J. A. DeCastro**. Rate-based model predictive control of turbofan engine clearance. *AIAA Journal of Propulsion and Power*. 23(4):804–813, 2007. doi:10.2514/1.25846
AIAA NOS Best Young Professional Paper

Refereed Conference Publications

[4] **J. A. DeCastro**, J. Alonso-Mora, V. Raman, D. Rus and H. Kress-Gazit. Collision-free reactive mission and motion planning for multi-robot systems. To appear in: *Proceedings of the 17th International Symposium on Robotics Research (ISRR)*, Sestri Levante, Italy, September 12–15, 2015.

[5] **J. A. DeCastro**, V. Raman and H. Kress-Gazit. Dynamics-driven adaptive abstraction for reactive high-level mission and motion planning. In: *Proceedings of the IEEE/RSJ International Conference on Robotics and Automation (ICRA 2015)*, Seattle, WA, USA, May 26–30, 2015.

[6] **J. A. DeCastro** and H. Kress-Gazit. Guaranteeing reactive high-level behaviors for robots with complex dynamics. In: *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2013)*, Tokyo, Japan, November 3–8, 2013.

[7] **J. A. DeCastro**, L. Tang, B. Zhang and G. Vachtsevanos. A safety verification approach to fault-tolerant aircraft supervisory control. In: *Proceedings of the AIAA Guidance, Navigation, and Control Conference*, Portland, OR, USA, August 8–11, 2011.

[8] **J. A. DeCastro**, L. Tang, C. S. Byington and D. E. Culley. Analysis of fault-tolerance and decentralization concepts for distributed engine control. In: *Proceedings of the 45th AIAA Joint Propulsion Conference & Exhibit*, Denver, CO, USA, August 2–5, 2009.
ASME Propulsion Best Paper

Workshop Publications

[9] **J. A. DeCastro**. Mission possible: guaranteeing reactive missions for complex robots. In: *ICRA 2015 Ph.D. Forum*, Seattle, WA, USA, May 26, 2015.

Invited Talks

Generalized Collision-free reactive mission and motion planning for multi-robot systems, NSF ExCAPE Annual Meeting, MIT, June 20–21, 2015.

Abstractions and revisions for synthesis for non-linear robots, NSF ExCAPE Annual Meeting, U. C. Berkeley, March 10–11, 2014.

Reactive high-level robot controller synthesis: optimality, environment, and dynamics, NSF ExCAPE Robotics Workshop, Rice University, November 20–22, 2013.

Automated contingency management for flight control, Aerospace Control and Guidance Systems Committee Meeting 106, San Diego, CA, October 2010.

Teaching Experience

Cornell University

Teaching Assistant, Autonomous Mobile Robots — Spring 2015

Responsible for administering lab sessions, grading and occasional lectures (36 students). Instructor: Hadas Kress-Gazit

Mentor, Undergraduate Research — Spring 2015

Mentoring a team of four undergraduates for an entry in the 2015 Soft Robotics Design Competition, with Hadas Kress-Gazit and Robert Shepherd serving as faculty advisors.

Rochester Institute of Technology

Instructor, System Modeling — Winter 2010–2011

Responsible for administering, lecturing and grading a senior- and graduate-level course.

Outreach and Service

Expanding Your Horizons (EYH)

Workshop Organizer: "Command Your Own Robot" — 2014, 2015

Responsible for organizing and leading a hands-on robotics workshop for middle-school girls interested in math and science. Supervised a team of four to lead the activities and introduce students to opportunities for further education and careers in STEM fields.

Cornell Graduate and Professional Student Assembly, Voting Member — 2013–2014

Reviewer:

IEEE Conf. on Event-Based Control, Communication, and Signal Processing (EBCCSP)	2015
International Conference on Robotics and Automation (ICRA)	2014, 2015
American Control Conference (ACC)	2014
IEEE Transactions on Industrial Electronics	2011, 2012, 2013
ASME Turbo Expo	2005, 2007, 2010

Courses

Linear Systems, Probability, Intermediate Dynamics, Introduction to Stochastic Control, Robust Control, Hybrid Systems, Convex Optimization, Heuristic Methods for Optimization, Robot Learning, Autonomous Mobile Robots, Robotic Manipulation.

Hardware and Software Skills

Programming Languages: C, C++, Python, MATLAB

Libraries and Tools: ROS, Simulink, Microsoft Visual Studio, gcc, LaTeX

OS: Linux, Windows