Jonathan A. DeCastro

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RESEARCH INTERESTS

My research interests are in the construction of provably-correct controllers for dynamical systems, enabling complex tasks to be verified for a wide class of complex robots. I am investigating both composition of continuous controllers for verified high-level control and the automatic discovery of specification revisions for guaranteeing controller execution in dynamic environments. My work draws from a variety of technical domains, including control theory, optimization, and formal methods.

EDUCATION

Cornell University, Ithaca, NY
Ph.D., Mechanical and Aerospace Engineering   2015–*Present*
  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
M.S., Mechanical Engineering   2001–2003
B.S. (with Honors), Mechanical Engineering   1996–2001

RELEVANT COURSES

Applied Math and Optimization: Linear Systems, Probability, Mathematical Programming, Convex Optimization, Heuristic Methods for Optimization
Controls and Systems: Hybrid Systems, Robust Control, Stochastic Control, Multivariable Control
Robotics and Dynamics: Intermediate Dynamics, Robot Learning, Autonomous Mobile Robots, Robotic Manipulation

INDUSTRY AND RESEARCH EXPERIENCE

Graduate Research Assistant, Cornell University, Ithaca, NY   August 2011–*Present*
Verifiable Robotics Research Group
- Developed algorithms in C++, Python and MATLAB for automated, correct-by-construction synthesis of controllers for robots with nonlinear dynamics through application of formal methods and 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
- Authored 7 publications featured in international conference proceedings, workshops and robotics journals

Lead Engineer, Impact Technologies, LLC., Rochester, NY   July 2008–August 2011
Control and Prediction Group
- Conducted independent research on control algorithms and simulation tools for flight control and diagnostic systems and submarine navigation
- Awarded four Phase 1 and two Phase 2 Small Business Innovation Research (SBIR) grants as Principal Investigator
- Composed technical reports and conference papers, presented to customers and stakeholders, and mentored co-op students

Research Scientist, NASA Glenn Research Center, Cleveland, OH   July 2003–July 2008
Intelligent Control and Autonomy Branch
- Designed and coded Commercial Modular Aero-Propulsion System Simulation (C-MAPSS), a MATLAB-based "virtual" aircraft engine serving to extend accessibility of such models to a wide arena of researchers
- Investigated control algorithms for in-flight aircraft control reconfiguration during emergencies
- Implemented and tested various control techniques in scaled engine component test rigs

JOURNAL PUBLICATIONS	**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

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.

X. Zhang, L. Tang and **J. A. DeCastro**. Robust fault diagnosis of aircraft engines: a nonlinear adaptive estimation-based approach. *IEEE Trans. on Control Systems Technology*, 21(3):861–868, 2013. doi:10.1109/TCST.2012.2187057.

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

SELECTED CONFERENCE PUBLICATIONS

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.

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.

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.

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.

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

J. A. DeCastro, J. S. Litt, and D. K. Frederick. A modular aero-propulsion system simulation of a large commercial aircraft engine. In: *Proceedings of the 44th AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit*, Hartford, CT USA, July 21–23, 2008.

WORKSHOP PUBLICATIONS

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

TEACHING AND MENTORING EXPERIENCE

Teaching Assistant, Autonomous Mobile Robots, Cornell University   Spring 2015
- Taught lab sessions, delivered occasional lectures, graded code and reports (36 students)

Mentor, Undergraduate Research, Cornell University   Spring 2015
- Mentored seven undergraduates for two entries in the 2015 Soft Robotics Design Competition
- Earned **First Prize** (out of 82 teams) and **Honorable Mention** for outstanding project idea

Instructor, System Modeling, Rochester Institute of Technology   Winter 2010–2011
- Administered, lectured and graded a senior- and graduate-level course

SERVICE AND OUTREACH

Workshop Organizer, "Command Your Own Robot"   2014, 2015
- Organized and lead a hands-on robotics workshop as part of the **Expanding Your Horizons (EYH)** conference 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

Voting Member, **Cornell Graduate and Professional Student Assembly**   2013–2014
- Organized several events for facilitating discussion of issues of interest (e.g. student life, compensation), between graduate students and university administration

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

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 outstanding group accomplishment (C-MAPSS Team)   2009
NASA Space Act Award for an outstanding technical contribution   2007
AIAA Best Young Professional Paper awarded by the Northern Ohio Section of AIAA   2007