

MORTEZA LAHIJANIAN

Dept. of Smead Aerospace Engineering Sciences
University of Colorado Boulder, CO, USA, +1-303-735-5443
morteza.lahijanian@colorado.edu, <http://MortezaLahijanian.com>

RESEARCH INTERESTS

The main theme of my research is *safety* and *soundness*, and the emphasis is on *safe autonomy* through *correct-by-construction* algorithmic approaches to robotics, particularly, motion planning, strategy synthesis, model checking, hybrid systems, and human-robot interaction. My general interests include control theory, formal methods, game theory, dynamics, and systems with applications in robotics.

EDUCATION

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|---------|---|-------------------|
| 01/2013 | Ph.D. in Mechanical Engineering | Boston University |
| | <ul style="list-style-type: none">• Advisors: Sean B. Andersson & Calin Belta | |
| 05/2008 | M.S. in Mechanical Engineering | Boston University |
| | <ul style="list-style-type: none">• Emphasis: Control theory & Robotics | |
| 05/2005 | B.S. in Bioengineering | UC Berkeley |
| | <ul style="list-style-type: none">• Emphasis: Biorobotics & MEMS | |

RESEARCH EXPERIENCE

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|---------------|---|-------------|
| 11/18-present | Dept. of Aerospace Eng. Sciences, University of Colorado | Boulder, CO |
| | <ul style="list-style-type: none">• Assistant Professor: affiliated with the Research and Engineering Center for Unmanned Vehicles (RECUV). | |
| 12/15-08/18 | Dept. of Computer Science, University of Oxford | Oxford, UK |
| | <ul style="list-style-type: none">• Research Scientist: mobile autonomy - safety, trust, and integrity of autonomous mobile robots; enabling a pervasive technology of the future. Collaborators: Marta Kwiatkowska & Ingmar Posner. | |
| 09/12-08/15 | Dept. of Computer Science, Rice University | Houston, TX |
| | <ul style="list-style-type: none">• Postdoctoral Research Associate: motion planning and control synthesis for complex and uncertain systems from task-level specifications at Kavraki Lab and Computer-Aided Verification and Reasoning (CAVR) group. Collaborators: Lydia E. Kavraki & Moshe Y. Vardi. | |
| 06/08-07/12 | BU Hybrid and Networked Systems Lab | Boston, MA |
| | <ul style="list-style-type: none">• Graduate Research Assistant: formal approaches to control of stochastic dynamical systems, analysis and control of hybrid systems, finite abstraction of continuous systems. | |
| 05/07-07/12 | BU Andersson Lab | Boston, MA |
| | <ul style="list-style-type: none">• Graduate Research Assistant: symbolic control of probabilistic robots including design of feedback control primitives, finite abstraction of the motion of the robot in the environment, optimization of the probability of satisfying a task specification. | |
| 01/06-06/06 | NEU Mechanical Engineering Robotics Lab | Boston, MA |
| | <ul style="list-style-type: none">• Research Assistant: design, develop, control, and test a rehabilitation device for gait re-training of stroke or other such patients with difficulties in walking and keeping balance. | |

- 09/05-12/05 **UCSF Surgical Skills Center: Biorobotics** San Francisco, CA
- **Research Assistant:** training novice surgeons through the use of robotic manipulators; used laparoscopes for acquisition of data and performed Markov modeling of minimally invasive surgery based on tool/tissue interaction and force/torque signatures to evaluate surgical skills.
- 05/05-8/05 **Centrum Robotiky: VŠB - Technical University of Ostrava** Czech Republic
- **Intern:** Control of mobile robots; acquisition and analysis of sensor data, image processing, mapping by neural nets, programming in C++ and MATLAB.
- 01/05-05/05 **D'Esposito Lab: UCB Cognitive Neuroscience Lab** Berkeley, CA
- **Research Assistant:** understanding age-related changes in prefrontal and parietal networks: a functional study of employing multiple strategies in arithmetic problem solving. fMRI scanning of participant's brains, image processing, and data analysis.

TEACHING EXPERIENCE

- 01/19-present **Dept. of Aerospace Eng. Sciences, University of Colorado** Boulder, CO
- **Assistant Professor:** courses created and taught:
 - ASEN 6519 - Hybrid Systems: Theory, Computation, and Applications (created & taught Spring 2019)
 - ASEN 5519 - Algorithmic Motion Planning (created & taught Fall 2019)
 - ASEN 4018 - Senior Projects 1: Design Synthesis (taught Fall 2020)
 - ASEN 4028 - Senior Projects 2: Design Practicum (taught Spring 2020)
- 08/16-08/18 **Dept. of Computer Science, University of Oxford** Oxford, UK
- **Lecturer:** instructed a graduate-level course entitled, "Probabilistic Model Checking" and managed the teaching and lab assistants of the course.
- 01/13-05/13 **Dept. of Computer Science, Rice University** Houston, TX
- **Co-Instructor:** co-instructed a graduate-level seminar course entitled, "Extensive Introduction to MDPs and POMDPs."
- 10/12-11/12 **Dept. of Computer Science, Rice University** Houston, TX
- **Lecturer:** gave a series of 4 lectures on the topic of probabilistic robotics in a senior-level course titled, "Algorithmic Robotics."
- 09/09-12/09 **Mechanical Engineering, Boston University** Boston, MA
- **Graduate Teaching Fellow:** dynamics course teaching assistant – 1 semester.
- 06/07-06/08 **Chelsea High School** Chelsea, MA
- **NSF GK-12 Fellow:** taught 11th and 12th grade physics and enhanced the content of curriculum by developing new modules, designed activities, assisting with labs, and helping students with science fair projects; also provided demos of my research and organized robotic competitions to inspire students to pursue education and careers in STEM. Physics, Control, and Robotics Lesson Plans available at www.bu.edu/gk12/morteza/.
- 09/06-05/07 **Mechanical Engineering, Boston University** Boston, MA
- **Graduate Teaching Fellow:** fluid mechanics laboratory instructor and course teaching assistant – 2 semesters.

09/05-12/05

Team-Up for Youth: Coaching Corps (Outreach Program)

Oakland, CA

- **Volunteer Coach:** serving low-income young people and utilizing the potential of children of color by teaching important life lessons like teamwork, leadership, and dedication; also strengthening youth and communities through the power of sports in after school programs.

MENTORING & ADVISING EXPERIENCE

- **Mentored** three graduate students (Matthew R. Maly, Keliang He, and Min Wu) on research projects involving motion planning for robotic systems with high-level tasks and safe interaction with semi-autonomous vehicles. All projects have resulted in publication (HSCC'13, ICRA'15, IROS'17, RA-L'18).
- **Advisees**
 - John Jackson (PhD)
 - Justin Kottinger (PhD)
 - Nicholas Renninger (MS)
 - Karan Muvvala (MS)
 - Richard Moon (MS)
 - Francisco Girbal Eiras (MS)
 - thesis title: “To Err is Human: Designing Correct-by-Construction Driver Assistance Systems using Cognitive Modelling,”
 - year: 2018
 - Student: Èric Pairet Artau (MS)
 - thesis title: “Uncertainty-based Online Mapping and Motion Planning for Marine Robotics Guidance,”
 - year: 2017
 - Chak Yan Lam (MS)
 - thesis title: “Driver Assistance Using Cognitive Modelling and Strategy Synthesis”
 - year: 2017

AWARDS & HONORS

- Wadham College Research Fellow (2016-2017)
- Best Presenter at American Control Conference (2011)
- Travel Grant to American Control Conference (2011)
- NSF GRASSROOTS Fellowship (2009)
- NSF Travel Grant to IEEE International Conference on Robotics and Automation (2009)
- NSF-GK12 Fellowship (2007-2008)
- Graduate Teaching Fellowship (2006-2007)
- Federal SEOG Grant Fall (2004)
- UC Spring Grant (2004)
- Cal Grant B (2002-2003)
- Ella Mae & Lawrence R. Quarles Physical Science Achievement Award (2001)
- Arthure E. & Glaydys P. Flum Outstanding Achievement in Physical, Health Science (2001)

- Jack White Engineering Physics Award (2001)

PROFESSIONAL SERVICES

- Program committee member for Int'l Joint Conf. on Artificial Intelligence (IJCAI, 2020)
- NSF panelist for CPS program (2019)
- Editorial board member and contributor to "Inspired Research Magazine" (2016 – 2018)
- Organizing of a workshop entitled, "Robots, Morality, and Trust through the Verification Lens" as part of Federated Logic Conference and Computer Aided Verification (FLoC & CAV, 2018)
- Organized a workshop entitled, "Morality and Social Trust in Autonomous Robots" as part of Robotics: Science and Systems Conference (RSS, 2017)
- Organized a workshop entitled, "Social Trust in Autonomous Robots" as part of Robotics: Science and Systems Conference (RSS, 2016)
- Program committee member for Artificial Intelligence Conference (AAAI, 2016)
- Program committee member of Combining AI Reasoning and Cognitive Science with Robotics Workshop at the Robotics: Science and Systems Conference (RSS, 2015)
- Reviewer for the IFAC journal Automatica (2014-present)
- Co-organized ExCAPE Robotics Workshop at Rice University (ExCAPE, 2013)
- Reviewer for IEEE Transactions on Automatic Control (ITAC, 2012-present)
- Reviewer for ACM Conf. on Hybrid Systems: Computation and Control (HSCC, 2011-present)
- Reviewer for American Control Conference (ACC, 2011-present)
- Reviewer for IEEE Int. Conf. on Robotics and Automation (ICRA, 2009-present)
- Reviewer for IEEE Conf. on Decision and Control (CDC, 2009-present)
- Reviewer for IEEE Transactions on Robotics (TRO, 2013)
- Reviewer for Robotics: Science and Systems Conference (RSS, 2013)
- Reviewer for Symposium on Combinatorial Search (SoCS, 2013)

PUBLICATIONS

Peer-reviewed journal publications

- [1] M. Lahijanian, L. Laurenti, A. Abate, L. Cardelli, and M. Kwiatkowska, "Formal and Efficient Synthesis for Continuous-Time Linear Stochastic Hybrid Processes," *IEEE Transactions on Automatic Control (TAC)*, 2020. (accepted)
- [2] E. M. Hahn, V. Hashemi, H. Hermanns, M. Lahijanian, and A. Turrini, "Pareto Curves and Robust Strategies for Interval Markov Decision Processes," *invited for publication in ACM Transactions on Modeling and Computer Simulation (TOMACS)*, 2019.
- [3] K. He, M. Lahijanian, L. E. Kavraki, M. Vardi, "Automated Abstraction of Manipulation Domains for Cost-Based Reactive Synthesis," *IEEE Robotics and Automation Letters (RA-L)*, vol. 4, no. 2, pp. 285-292, Apr. 2019.
- [4] S. Edelkamp, M. Lahijanian, D. Magazzeni, and E. Plaku, "Integrating Temporal Reasoning and Sampling-Based Motion Planning for Multi-Goal Problems with Dynamics and Time Windows," *IEEE Robotics and Automation Letters (RA-L)*, vol. 3, no. 4, pp. 3473-3480, Oct. 2018. (presented in IROS 2018)
- [5] M. Lahijanian, M. Svorenova, A. Morye, B. Yeomans, D. Rao, I. Posner, P. Newman, H. Kress-Gazit, and M. Kwiatkowska, "Resource-Performance Trade-off Analysis for Mobile Robots," *IEEE Robotics and Automation Letters (RA-L)*, vol. 3, no. 3, pp. 1840-1847, July 2018.
- [6] H. Kress-Gazit and M. Lahijanian, "Synthesis for Robots: Guarantees and Feedback for Robot Behavior," *Journal of Annual Review of Control, Robotics, and Autonomous Systems*, 2018.

- [7] M. Lahijanian, M. Maly, D. Fried, L. E. Kavraki, H. Kress-Gazit, and M. Y. Vardi, "Iterative Temporal Planning in Uncertain Environments with Partial Satisfaction Guarantees," *IEEE Transactions on Robotics*, vol. 32, no. 3, pp. 583-599, May 2016.
- [8] M. Lahijanian, S. B. Andersson, and C. Belta, "Formal Verification and Synthesis for Discrete-Time Stochastic Systems," *IEEE Transactions on Automatic Control*, vol. 60, no. 8, pp. 2031-2045, Aug. 2015.
- [9] J. Wang, X. C. Ding, M. Lahijanian, I. Ch. Paschalidis, and C. Belta, "Temporal Logic Motion Control Using Actor-Critic Methods," *Int. Journal of Robotics Research*, vol. 34, no. 10, pp. 1329-1344, Aug. 2015.
- [10] M. Lahijanian, S. B. Andersson, and C. Belta, "Temporal Logic Motion Planning and Control with Probabilistic Satisfaction Guarantees," *IEEE Transactions on Robotics*, vol. 28, no. 2, pp. 396-409, 2012.
- [11] S. B. Andersson, D. Hristu-Varsakelis, and M. Lahijanian, "Observers in Language-based Control," *Communications in Information and Systems (Special Issue Dedicated to the 70th Birthday of Roger Brockett)*, vol. 8, no. 2, pp. 85-106, 2009.

Peer-reviewed conference publications

- [1] S. Almagor, and M. Lahijanian, "Explainable Multi Agent Path Finding," *Int. Conf. on Autonomous Agents and Multiagent Systems (AAMAS)*, ACM, May. 2020. (accepted)
- [2] M. Wu, T. Louw, M. Lahijanian, W. Ruan, X. Huang, N. Merat, and M. Kwiatkowska, "Gaze-based Intention Anticipation over Driving Manoeuvres in Semi-Autonomous Vehicles," *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, Oct. 2019.
- [3] F. Eiras, M. Lahijanian, and M. Kwiatkowska, "Correct-by-Construction Advanced Driver Assistance Systems based on a Cognitive Architecture," *IEEE Connected and Automated Vehicles Symposium (IEEE CAV)*, IEEE, Sep. 2019.
- [4] N. Cauchi, L. Laurenti, M. Lahijanian, A. Abate, M. and L. Cardelli, "Efficiency through Uncertainty: Scalable Formal Synthesis for Stochastic Hybrid Systems," *Hybrid Systems: Computation and Control (HSCC)*, ACM, Apr. 2019. (accepted)
- [5] E. Pairet, J. D. Hernandez, M. Lahijanian, and Marc Carreras, "Uncertainty-based Online Mapping and Motion Planning for Marine Robotics Guidance," *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, Oct. 2018.
- [6] K. He, M. Lahijanian, L. E. Kavraki, and M. Y. Vardi, "Reactive Synthesis for Finite Tasks Under Resource Constraints," *IEEE International Conference on Intelligent Robots and Systems (IROS)*, pp. 5326-5332, Vancouver, BC, Sep. 2017.
- [7] E. M. Hahn, V. Hashemi, H. Hermanns, M. Lahijanian, and A. Turrini, "Multi-objective Robust Strategy Synthesis for Interval Markov Decision Processes," *International Conference on Quantitative Evaluation of SysTems (QEST)*, pp. 207-223, Berlin, Germany, Sep. 2017.
- [8] M. Lahijanian and M. Kwiatkowska, "Specification Revision for Markov Decision Processes with Optimal Trade-off," *IEEE Conf. on Decision and Control (CDC)*, pp. 7411-7418, Las Vegas, NV, Dec. 2016.
- [9] M. Lahijanian and M. Kwiatkowska, "Social Trust: a Major Challenge for the Future of Autonomous Systems," *AAAI Fall Symposium on Cross-Disciplinary Challenges for Autonomous Systems (AAAI FSS)*, pp. 189-193, Arlington, VA, Nov. 2016.
- [10] K. He, M. Lahijanian, L. E. Kavraki, M. Y. Vardi, "Towards Manipulation Planning with Temporal Logic Specifications," *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 346-352, Seattle, WA, May, 2015.
- [11] M. Lahijanian, S. Almagor, D. Fried, L. E. Kavraki, M. Y. Vardi, "This Time the Robot Settles for a Cost: A Quantitative Approach to Temporal Logic Planning with Partial Satisfaction," *AAAI Conf. on Artificial Intelligence*, pp. 3664-3671, Austin, TX, Jan. 2015.

- [12] R. Luna, M. Lahijanian, L. E. Kavraki, M. Moll, “Asymptotically Optimal Stochastic Motion Planning with Temporal Goals,” *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, pp. 335-352, Istanbul, Turkey, Aug. 2014.
- [13] R. Luna, M. Lahijanian, L. E. Kavraki, M. Moll, “Optimal and Efficient Stochastic Motion Planning in Partially-Known Environments,” *AAAI Conference on Artificial Intelligence*, pp. 2549-2555, Quebec City, Canada, July, 2014.
- [14] M. Lahijanian, L. E. Kavraki, M. Y. Vardi, “A Sampling-Based Strategy Planner for Nondeterministic Hybrid Systems,” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 3005-3012, Hong Kong, China, May, 2014.
- [15] R. Luna, M. Lahijanian, L. E. Kavraki, M. Moll, “Fast Stochastic Motion Planning with Optimality Guarantees Using Local Policy Reconfiguration,” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 3013-3019, Hong Kong, China, May, 2014.
- [16] M. R. Maly, M. Lahijanian, L. E. Kavraki, H. Kress-Gazit, and M. Y. Vardi, “Iterative Temporal Motion Planning for Hybrid Systems in Partially Unknown Environments,” *ACM International Conference on Hybrid Systems: Computational and Control (HSCC)*, pp. 353-362, Philadelphia, PA, Apr., 2013.
- [17] M. Lahijanian, S. B. Andersson, and C. Belta, “Approximate Markovian Abstractions for Linear Stochastic Systems,” *IEEE Conference on Decision and Control (CDC)*, pp. 5966-5971, Maui, HI, Dec., 2012.
- [18] X. C. Ding, J. Wang, M. Lahijanian, I. Paschalidis, and C. Belta, “Temporal Logic Motion Control using Actor-Critic Methods,” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 4687-4692, St. Paul, MN, May, 2012.
- [19] R. Moazzez Estanjini, X. C. Ding, M. Lahijanian, C. Belta, I. Paschalidis, “Least Squares Temporal Difference Actor-Critic Methods with Applications to Robot Motion Control,” *IEEE Conference on Decision and Control (CDC)*, pp. 704-709, Orlando, FL, Dec. 2011.
- [20] Cizelj, X. C. Ding, M. Lahijanian, A. Pinto, C. Belta, “Probabilistically Safe Vehicle Control in a Hostile Environment,” *Int’l Federation of Automatic Control (IFAC) 18th World Congress*, Milan, Italy, 2011.
- [21] M. Lahijanian, S. B. Andersson, and C. Belta, “Controlling an MDP from a PCTL specification,” *American Controls Conference (ACC)*, pp. 311-316, San Francisco, CA, Jun., 2011.
- [22] M. Lahijanian, J. Wasniewski, S.B. Andersson, and C. Belta, “Motion planning and control from temporal logic specifications with probabilistic satisfaction guarantees,” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 3227-3232, Anchorage, Alaska, May, 2010.
- [23] M. Lahijanian, S. B. Andersson, and C. Belta, “A probabilistic approach for control of a stochastic system from LTL specifications,” *IEEE Conference on Decision and Control (CDC)*, pp. 2236-2241, Shanghai, China, Dec., 2009.
- [24] M. Lahijanian, M. Kloetzer, S. Itani, C. Belta, and S. B. Andersson, “Automatic deployment of autonomous cars in a robotic urban-like environment (RULE),” *IEEE International Conference on Robotics and Automation (ICRA)*, pp. 2055-2060, Kobe, Japan, May, 2009.

INVITED TALKS

- [1] Invited Talk - “Safety in Face of Complexity: An Algorithmic Approach,” Robotics: Science and System (RSS) Workshop on Robust Autonomy, Jun 2019.
- [2] Invited Talk - “Towards Safe Autonomy through Correct-by-Construction Algorithmic Approaches,” Dept. of Aerospace Engineering Sciences, University of Colorado Boulder, CO, U.S.A., 2019.
- [3] Invited Talk - “Towards Safe Autonomy through Correct-by-Construction Algorithmic Approaches,” Dept. of Aerospace Engineering Sciences, University of Colorado Boulder, CO, U.S.A., 2018.

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- [4] Invited Talk - "Towards Safe Autonomy through Correct-by-Construction Algorithmic Approaches," Dept. of Mechanical Engineering, Temple University, PA U.S.A., 2018.
 - [5] Invited Talk - "Towards Safe Autonomy through Correct-by-Construction Algorithmic Approaches," Dept. of Mechanical Engineering & Mechanics, Lehigh University, PA U.S.A., 2018.
 - [6] Invited Talk - "Towards Safe Autonomy through Correct-by-Construction Algorithmic Approaches," Dept. of Computing, Imperial College, London, U.K., 2018.
 - [7] Invited Talk - "How Much Should You Trust a Robot," Safety and Reliability Society," London, U.K., 2017.
 - [8] Invited Talk - "Bestowing Robot Autonomy Through Formal Methods," School of Electrical Engineering and Computer Science, Queen Mary University of London, U.K., 2016.
 - [9] Invited Talk - "Enabling Robot Autonomy in Complex Missions: Automatic Control Generation from Task-Level Specifications," Max Planck Institute for Informatics, Dependable Systems and Software Group, Saarland University, Germany, 2016.
 - [10] Invited Talk - "Enabling Robot Autonomy in Complex Navigational Missions," Department of Computer Science, University of Oxford, Oxford, U.K., 2015.
 - [11] Invited Talk - "Bestowing Intelligence upon Robots: Automatic Control Generation from Task-Level Specifications," Mechanical Engineering Department, University of Nevada, Reno, NV, 2015.
 - [12] Workshop Speaker - "Robot Motion Planning Under Uncertainty with Temporal Logic Tasks: from Nondeterministic Discrete Disturbances to Continuous Stochastic Noise," ExCAPE Robotics Workshop, Houston, TX, 2013.
 - [13] Invited Talk - "Automatic Deployment of Autonomous Cars with Complex Tasks in an Urban-Like Environment," University of Tokyo, Tokyo, Japan, 2009.