

Lantao Liu

Assistant Professor

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Research Interests

Fields: artificial intelligence, algorithmic robotics, machine learning, operations research, distributed robotic systems

Platforms: underwater drones, autonomous boats, aerial drones, multi-robot systems, sensor networks

Methods: planning (deterministic, stochastic, data-driven), decision-making, reinforcement learning, deep learning, Gaussian Process, vehicles routing, data routing, task/resource allocation, distributed coordination

Applications: life-long autonomy, aquatic/atmosphere environment monitoring, adaptive sampling, environmental exploration & mapping, smart vehicles/transportation, drones formation, warehouse robots

Education

2008–2013 **Doctor of Philosophy**¹, *Texas A&M University*.
Dept. of Computer Science and Engineering

2003–2007 **Bachelor of Engineering**², *Beijing Institute of Technology*.
Dept. of Automatic Control

Academic Positions

2017– **Assistant Professor**, *Indiana University–Bloomington*.
Dept. of Intelligent Systems Engineering

2015–2017 **Research Associate**, *University of Southern California*.
Dept. of Computer Science

2013–2015 **Postdoc Fellow**, *Carnegie Mellon University*.
Robotics Institute

2008–2013 **Research Assistant**, *Texas A& M University*.
Dept. of Computer Science and Engineering

¹University Dissertation Fellow

²Silver Medal Graduate

Major Publications

(Authors marked with * are my students)

Preprints Kai-Chieh Ma*, Lantao Liu, Hordur K. Heidarsson, Gaurav Sukhatme. *Data-Driven Planning and Learning for Environmental Sampling*. (arXived, Journal of Field Robotics (**JFR**)). 2017)

Shoubhik Debnath*, Lantao Liu, Gaurav Sukhatme. *Markov Decision Processes Solutions with Mean First Passage Time Reachability Characterization*. (arXived, under review.)

Lantao Liu, Gaurav Sukhatme. *Making Decisions with Spatially and Temporally Uncertain Data*. (arXived, under review.)

Shoubhik Debnath*, Lantao Liu, Gaurav Sukhatme. *Reachability and Differential based Heuristics for Solving Markov Decision Processes*. International Symposium on Robotics Research (**ISRR**). Chile, 2017.

Zhibei Ma*, Kai Yin, Lantao Liu, Gaurav Sukhatme. *A Spatio-Temporal Representation for the Orienteering Problem with Time-Varying Profits*. IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**). Vancouver, Canada, Sept, 2017

Kai-Chieh Ma*, Lantao Liu, Gaurav Sukhatme. *Informative Planning and Online Learning with Sparse Gaussian Processes*. IEEE International Conference on Robotics and Automation (**ICRA**), Singapore, 2017.

2016 Kai-Chieh Ma*, Zhibei Ma*, Lantao Liu, Gaurav Sukhatme. *Multi-Robot Informative and Adaptive Planning for Persistent Environmental Monitoring*. International Symposium on Distributed Autonomous Robotic Systems (**DARS**). London, UK, Nov, 2016

Kai-Chieh Ma*, Lantao Liu, Gaurav Sukhatme. *An Information-Driven and Disturbance-Aware Planning Method for Long-Term Ocean Monitoring*³. IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**). Korea, Oct, 2016

Zhibei Ma*, Lantao Liu, Gaurav Sukhatme. *An Adaptive k-opt Method for Solving Traveling Salesman Problem*. IEEE Conference on Decision and Control (**CDC**). Las Vegas, Dec, 2016

Lantao Liu, Nathan Michael. *An MDP-based Approximation Method for Goal Constrained Multi-MAV Planning under Action Uncertainty*. IEEE International Conference on Robotics and Automation (**ICRA**), Stockholm, Sweden, 2016. [acceptance rate = 34%]

³Best Application Paper Award Finalist (one of four, IROS 2016)
Best Student Paper Award Finalist (one of six, IROS 2016)

Kai-Chieh Ma*, Lantao Liu, Gaurav Sukhatme. *Multi-robot Informative Planning for Long-Term Ocean Monitoring*. IEEE International Conference on Robotics and Automation **ICRA Workshop: AI for Long-term Autonomy**, Stockholm, Sweden, 2016

2015 Lantao Liu, Nathan Michael, Dylan Shell. *Communication Constrained Task Allocation with Optimized Local Task Swaps*. *Autonomous Robots (AURO)*. vol. 39, no. 3, pp. 429-444, 2015. [2014 Impact factor 2.06]

2014 Vishnu R. Desaraju, Lantao Liu, Nathan Michael. *Multi-Vehicle Adaptive Planning with Online Estimated Cost due to Disturbances*. International Conference on Intelligent Autonomous Systems (**IAS**). Padova, Italy. July 2014.

Lantao Liu, Nathan Michael, Dylan Shell. *Fully Decentralized Task Swaps with Optimized Local Searching*⁴. Robotics: Science and Systems Conference (**RSS**). Berkeley, California. July 2014. [acceptance rate = 30%.]

Lantao Liu, Nathan Michael. *Energy-Aware Aerial Vehicle Deployment via Bipartite Graph Matching*. International Conference on Unmanned Aircraft Systems (**ICUAS**). Orlando, Florida. May 2014.

Lantao Liu, Dylan Shell, Nathan Michael. *From Selfish Auctioning to Incentivized Marketing*. *Autonomous Robots (AURO)*. vol. 37, no. 4, pp. 417-430, 2014. [2013 Impact factor 1.8]

2013 Lantao Liu, Dylan Shell. *Physically Routing Robots in a Multi-robot Network: Flexibility through a Three Dimensional Matching Graph*. International Journal of Robotics Research (**IJRR**). vol. 32, no. 12, pp. 1475-1494, 2013. [2012 Impact factor 2.9]

Lantao Liu, Dylan Shell. *An Anytime Assignment Algorithm: From Local Task Swapping to Global Optimality*. *Autonomous Robots (AURO)*. vol. 35, no. 4, pp. 271-286, 2013. [2012 Impact factor 1.9]

Lantao Liu, Dylan Shell. *Optimal Market-based Multi-Robot Task Allocation via Strategic Pricing*⁵. Robotics: Science and Systems Conference (**RSS**). Berlin, Germany. June 2013.

Weibing Shi, Shangxian Xie, Su Sun, Xueyan Chen, Xin Zhou, Lantao Liu, Peng Gao, Nikos C. Kyprides, En-Gyu No, Joshua S. Yuan. *Comparative Genomic Analysis of the Endosymbionts of Herbivorous Insects Reveals Eco-Environmental Adaptations: Biotechnology Applications*. **PLoS Genetics**. vol. 9, no. 1. 2012.

⁴Among 10 selected/invited for AAAI robotics-track talks (RSS 2014)

⁵Among 5 selected for long talks (RSS 2013)

Lantao Liu. *Toward the Desired Performance for Multi-robot Task Allocation*. IEEE International Symposium on Safety, Security, and Rescue Robotics (**SSRR**). Sweden. Oct 2013.

Yixiang Zhang, Peng Gao, Zhuo Xing, Shumei Jin, Zhide Chen, Lantao Liu, Nasie Constantino, Xin-wang Wang, Weibin Shi, Joshua S. Yuan, Susie Y. Dai. *Application of an Improved Proteomics Method for Abundant Protein Cleanup: Molecular and Genomic Mechanisms Study in Plant Defense*. Molecular & Cellular Proteomics (**MCP**). vol. 12, no. 11, pp. 3431-3442, 2013.

2012 Lantao Liu, Dylan Shell. *Multi-robot Formation Morphing through Matching Graph*⁶. International Symposium on Distributed Autonomous Robotic Systems (**DARS**). Baltimore, MD. Nov 2012.

Lantao Liu, Dylan Shell. *Large-Scale Multi-Robot Task Allocation via Dynamic Partitioning and Distribution*. Autonomous Robots (**AURO**). vol. 33, no. 3, pp. 291-307, 2012. [2011 Impact factor 2.0]

Lantao Liu, Dylan Shell. *Tackling Task Allocation Uncertainty via a Combinatorial Method*. IEEE International Symposium on Safety, Security, and Rescue Robotics (**SSRR**). College Station, TX. Nov 2012.

Lantao Liu, Dylan Shell. *An Efficient Distributed Topo-Geometric Spatial Density Estimation Method for Multi-Robot Systems*. IEEE/RSJ International Conference on Intelligent Robots and Systems (**IROS**). Algarve, Portugal. Oct 2012.

Lantao Liu, Dylan Shell. *A Distributable and Computation-Flexible Assignment Algorithm: From Local Task Swapping to Global Optimality*. Robotics: Science and Systems Conference (**RSS**). Sydney, Australia. July 2012. [acceptance rate = 30%]

Lantao Liu, Dylan Shell. *Tunable Routing Solutions for Multi-Robot Navigation via the Assignment Problem: A 3D Representation of the Matching Graph*. IEEE International Conference on Robotics and Automation (**ICRA**). Saint Paul, Minnesota. May 2012.

2011 Lantao Liu, Dylan Shell. *Assessing Optimal Assignment under Uncertainty: An Interval-based Algorithm*. International Journal of Robotics Research (**IJRR**). vol. 30, no. 7, pp. 936-953, 2011. [2010 Impact factor 4.2]

⁶Best Student Paper Runner-up Award (DARS 2012)

Lantao Liu, Dylan Shell. *Multi-level Partitioning and Distribution of the Assignment Problem for Large-scale Multi-robot Task Allocation*⁷. Robotics: Science and Systems Conference (**RSS**). Los Angeles, California. Jun 2011. [acceptance rate = 25%]

Lantao Liu, Benjamin Fine, Dylan Shell, Andreas Klappenecker. *Approximate Characterization of Multi-Robot Swarm ‘Shape’ in Sublinear-Time*. IEEE International Conference on Robotics and Automation (**ICRA**). Shanghai, China. May 2011.

Lantao Liu, Sanmin Liu (co-first), Ugur Uzunner, Xin Zhou, Manxi Gu, Weibing Shi, Yixiang Zhang, Susie Y. Dai, Joshua S. Yuan. *HDX-Analyzer: A Novel Package for Statistical Analysis of Protein Structure Dynamics*. Journal of BMC Bioinformatics. 12(S1):S43, 2011.

Sanmin Liu, Lantao Liu, Ugur Uzunner, Xin Zhou, Manxi Gu, Weibing Shi, Yixiang Zhang, Susie Dai, Joshua Yuan. *HDX-Analyzer: A Novel Package for Statistical Analysis of Protein Structure Dynamics*. The 9th Asia Pacific Bioinformatics Conference (APBC). Incheon, Korea. Jan 2011.

2010 Lantao Liu, Dylan Shell. *Assessing Optimal Assignment under Uncertainty: An Interval-based Algorithm*⁸. Robotics: Science and Systems Conference (**RSS**). Zaragoza, Spain. Jun 2010. [acceptance rate = 16%]

Lantao Liu, Dylan Shell. *Task Insertion and Reassignment in Networked Robots for Topological Morphing*. **ICRA** Workshop of Network Science and Systems. Anchorage, AK. May 2010.

Ugur Uzuner, Weibing Shi, Lantao Liu, Sanmin Liu, Susie Y. Dai, Joshua S. Yuan. *Enzyme Structure Dynamics of Xylanase I from *Trichoderma longibrachiatum**. Journal of BMC Bioinformatics 11(S6):S12, 2010. [2009 Impact factor 3.4]

Other Refereed Contributions

2011-2016 Kai-Chieh Ma, Lantao Liu, Gaurav S. Sukhatme. *A Hierarchical Informative Path Planning Method for Ocean Monitoring*. The 1st Southern California Robotics Symposium (SCR). San Diego, CA. Apr 2016. (2-page abstract)

Lantao Liu, Dylan Shell. *Distribute the Task Swapping Assignment Method under Communication Constraints*. The 2012 Symposium on Emerging Topics in Control and Modeling: Networked Systems (CMNS). Urbana- Champaign, IL. Oct 2012. (1-page abstract)

⁷Among 20 selected for long talks (RSS 2011)

⁸Among 10 selected/recommended to IJRR (RSS 2010)

Lantao Liu, Xin Zhou, Ugur Uzuner, Susie Dai, Joshua Yuan. *Novel Software Package for HDX Mass Spectrometry Analysis*. The 7th Annual MidSouth Computational Biology and Bioinformatics Society (MCBIOS) Conference. Jonesboro, AR. Feb 2010. (1-page abstract)

Ugur Uzuner, Weibing Shi, Lantao Liu, Susie Dai, Joshua Yuan. *Structure Dynamics Analysis of Xylanases*. The 7th Annual MidSouth Computational Biology and Bioinformatics Society (MCBIOS) Conference. Jonesboro, AR. Feb 2010. (1-page abstract)

Weibing Shi, Yingxiang Zhang, Lantao Liu, Susie Dai, Joshua Yuan. *Structure Dynamics Analysis of Cellulase Enzymes*. The 7th Annual MidSouth Computational Biology and Bioinformatics Society (MCBIOS) Conference. Jonesboro, AR. Feb 2010. (1-page abstract)

Invited Talks

- 2017 *From Single Robot Planning to Multi-Robot Collective Decision Making:*
- Dept. of Applied Ocean Physics & Engineering, Woods Hole Oceanographic Institution, Apr 2017
 - Dept. of Intelligent System Engineering, Indiana University - Bloomington, Apr 2017
 - Dept. of Electrical and Computer Engineering, Ohio State University, Mar 2017
 - School of Computing, Informatics, and Decision Systems Engineering, Arizona State University, Mar 2017
 - Dept. of Electrical and Computer Engineering, University of Rochester, Feb 2017
 - Dept. of Computer Science and Operations Research, University of Montreal, Jan 2017
- 2015 *Coordinating Multi-Robot Systems: From Task Allocation to Cooperative Planning and Decision-Making:*
- Dept. of Computer Science, University of Southern California, Jun 2015
 - Dept. of Computer Science and Engineering, Lehigh University, Mar 2015
 - Dept. of Computer Science and Engineering, University of Nevada Reno, Feb 2015
- Fully Decentralized Task Swaps with Optimized Local Searching:*
- AAI Conference, Robotics Track. Austin, Texas, Feb, 2015

- 2013 *Coordinating Multi-Robot Systems: Improvements in Task Allocation:*
- Dept. of Computer Science, University of Hong Kong, May 2013. Cancelled
 - Dept. of Computer Science and Engineering, University of South Carolina, Apr 2013

Teaching Experiences

Courses Taught.

- Special Topics in Robotics Planning and Learning, Fall 2017
- Introduction to Intelligent Systems Engineering, Fall 2017 (Co-Instructor)

Student Advising.

- Malintha Fernando (PhD student at IU, 2017-)
- Zhengyi Li (PhD student at IU, 2017-)
- Grace Li (PhD student at IU, 2017-)
- Shoubhik Debnath (Master student at USC, 2016-)
- Chen Huang (Master student at USC, 2016-)
- Yezhen Zhao (Master student at USC, 2016-)

Student Advised.

- Kai-Chieh Ma (Master student at USC, 2015-2017. First position: TuSimple self-driving car company)
- Steven Ly (Master student at USC, 2016-2017. First position: Internship at Lawrence Livermore National Laboratory)
- Zhibei Ma (Master student at USC, 2015-2017. First position: TuSimple self-driving car company)
- Heseng Zhang (Master student at USC, 2015-2016. First position: Affirmed Networks)
- Laila Lo (Master student at CMU, 2014-2015. First position: PhD student at UT-Austin)
- Pramod Kulkarni (Master student at CMU. 2013-2014. First position: Air Force Materiel Command)

Grant Proposal Experiences

- NSF Robust Intelligence (funded)
Drafted “Decision Making with Spatially and Temporally Uncertain Data”
- NSF Cyber-Physical Systems (funded)
Drafted part of “Collaborative Research: Adaptive Water Quality Sampling with Autonomous Vehicles with Applications to Nitrate Deposition”
- ARL Collaborative Technology Alliance White Paper (funded)
Drafted “Dynamic Goal Assignment and Trajectory Generation for Cooperative Teams of Micro Air Vehicles Exploring Complex 3D Environments”

Honors, Awards, Distinctions

- 2016 Best Application Paper Finalist and Best Student Paper Finalist of IEEE/RSJ International Conference on Intelligent Robots and Systems
- 2013 Chinese Government Award for Outstanding Self-Financed Students Abroad (500 / Chinese Worldwide, 1 / TAMU)
- 2012–2013 Texas A&M University Dissertation Fellowship (10 / TAMU)
- 2012 Best Student Paper Runner-up Award of Distributed Autonomous Robotic Systems symposium
- 2011 Outstanding Student Research Award for TAMU National Robotics Week
- 2009–2010 Industrial Affiliate Program scholarship & CSE Ambassador Honor
- 2007 Silver Medal (highest distinction 3 / College)
- 2003–2007 Renmin Scholarship (top 10%) 4 years
- 2007 Honors of Beijing Excellent Graduate (top 5%) and BIT Excellent Graduate (top 10%)
- 2007 Outstanding Thesis Award
- 2007 College Star Honor (1 / College)
- 2007 Department Star Honor for undergrad research (1 / Dept)
- 2004, 2006 BIT Excellent Student Honor (top 2%) twice

Travel Grants, Competitions

- 2015 AAAI 2015 AI-Robotics Session Invited Talk (travel supported by AAAI and NSF)
- 2012 Travel Grant of International Symposium on Distributed Autonomous Robotic Systems
- 2012 National ICT Australia (NICTA) Student Fellowship of Robotics: Science and Systems
- 2012 Travel Grant of 4th Symposium on Emerging Topics in Control and Modeling: Networked Systems
- 2007 Competition: 8th out 78 teams in 2007 FIRA China robot soccer championship (Simulation)
- 2006 Competition: 7th out 30+ international teams in 2006 RoboCup China-open (Simulation)
- 2003 Competition: First class prize of 2003 BIT Art Contest (Chinese painting)

Professional Service

- Symposium Co-organizer Second Southern California Robotics Symposium (SCR17), Los Angeles, April 2017. We had over 300 attendees. There were 15 speakers, 25 accepted posters (50% acceptance rate), and 16 exhibition booths, from both academia and industry.
- Symposium Founding Co-organizer Inaugural Southern California Robotics Symposium (SCR16), San Diego, April 2016, with a total number of 300 participants from both academia and industry. We got an amazing line-up of 16 speakers, 20 posters, and 16 exhibition booths.
- Associate Editor IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2014, 2015, 2016
- Conf. Session Chairing IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2017
- Program Committee ACM Symposium on Applied Computing, Intelligent Robotics & Multi-Agent Systems (IRMAS) 2015, 2016
- International Joint Conference on Artificial Intelligence (IJCAI), 2015
- Robotics: Science and Systems (RSS) Workshop on Distributed Control and Estimation for Robotic Vehicle Networks. 2014.
- IEEE International Symposium on Safety, Security and Rescue Robotics (SSRR) 2013, 2014, 2015
- University Service Software Committee Member CMU Field Robotics Center, Robotics Institute (2013-2015).
- Research Presentation Judge (2012) TAMU Student Research Week.
- Roles of toastmaster, presenter, presentation evaluator TAMU Distributed AI and robotics seminar (2010-2011, weekly).
- Team organizer and leader, BIT-Laser robot soccer team (2005-2007).
- Paper Reviewer T-RO, T-ASE, AURO, ICRA, IROS, RSS, ISRR, IJCAI, JAAMAS, RA-L, NIPS, CDC, ACC, SSRR, DARS, ICUAS, IAVS, SAC, Physics Letters, and many other symposium and workshop venues.