Matthew C. Gombolay

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Education

Ph.D., Autonomous Systems February 2017
GPA: 5.00/5.00
Dept. of Aeronautics and Astronautics, Massachusetts Institute of Technology
Committee: Julie Shah (Chair), Andrea Thomaz, Bilge Mutlu, Hamsa Balakrishnan, Peter Szolovits
Dissertation Title: "Human-Machine Collaborative Resource Optimization via Apprenticeship Scheduling."

S.M. Aeronautics and Astronautics June 2013
GPA: 5.00/5.00
Dept. of Aeronautics and Astronautics, Massachusetts Institute of Technology
Dissertation Title: "Fast Methods for Scheduling with Applications to Real-Time Systems and Large-Scale, Robotic Manufacturing of Aerospace Structures."

B.S. Mechanical Engineering May 2011
(GPA: 3.93/4.00)
Dept. of Mechanical Engineering, Johns Hopkins University

Awards

National Training and Simulation Association Modeling & Simulation Team Training Award December 2015
Award granted based upon my contribution at MIT Lincoln Laboratory applying machine learning techniques from my thesis to model human operators performing anti-ship missile defense.

NSF Graduate Research Fellowship Program Fellow September 2011- August 2016

AAAI-15 Robotics Fellowship January 2015
10 of 72 students awarded grant to travel and present their research at AAAI-15.

Best Intelligent Systems Paper August 2013
AIAA 2012 Infotech@Aerospace Conference as awarded by the AIAA Intelligent Systems Technical Committee for "Uniprocessor Scheduling Policy for Non-Preemptive Task Sets with Precedence and Temporal Constraints" (Authors: M. Gombolay and J. Shah)

Human-Robot Interaction Pioneer March 2013
HRI Pioneers Workshop identifies and empowers the world's top researchers early in their career.

Eagle Scout, *Boy Scouts of America* May 2006
National Eagle Scout Association, Member since May 2006

Research Experience

Interactive Robotics Group, CSAIL, MIT Cambridge, MA
Research Assistant with Professor Julie Shah September 2011 – present

- Formulate novel machine learning algorithm, "Apprenticeship Scheduling," to 1) learn from expert demonstration the rules-of-thumb and heuristics of domain experts who effectively solve NP-Hard scheduling problems, 2) embed these heuristics within a scalable optimization framework, and 3) scale the power of the individual expert to provide dynamic decision-support to novice users in the field.
- Design and deploy novel, autonomous robotic systems for human-subject experimentation in the research lab and professional environments (Beth Israel Deaconess Medical Center) to inform the design of and validate these robotic systems.
- Interface and collaborate with industrial partners (Boeing, BMW, Steelcase, and Beth Israel Deaconess Medical Center) to inform the design of computational methods for human-robot teaming.

Beth Israel Deaconess Medical Center Cambridge, MA
Researcher in the Department of Obstetrics and Gynecology May 2013 – present

- Observe and analyze resource management on the Labor & Delivery ward.
- Improve patient care by developing training tools for new resource nurses.

Lab for Computational Sensing and Robotics, JHU Baltimore, MD
Research Assistant with Professor Gregory Chirikjian August 2009-May 2011

- Design hybrid-dynamical, self-replicating, assembling, robotic automata and cells.

Industry Experience

MIT Lincoln Laboratory Lexington, MA
Ballistic Missile Defense Integrations Group, Summer Intern June 2015-August 2016

- Conducted machine learning and big data analytics to learn how to train warfighters in serious games.
- Briefed sponsors on data-driven techniques for improving the training of warfighters.

JHU Applied Physics Lab Laurel, MD
Space Department, Systems Engineering Group Intern June 2009-July 2010

- Developed multi-faceted scheduler algorithms for space-based sensors.
- Designed the propulsion system for a robotic mission to a Near-Earth Object.
- Developed a graphic user interface (GUI) for analysis of ballistic missile defense war games.

Mentoring

Michael Kelessoglou, Masters of Engineering Student, MIT	Summer 2015-Summer 2016
Anna Bair, Undergraduate Researcher, MIT	Fall 2015
Tania Yu, Undergraduate Researcher, MIT	Fall 2015
Samir Wadhwania, Undergraduate Researcher, MIT	Fall 2015
Zixi "Zeo" Liu, Undergraduate Researcher, MIT	Fall 2015
Cindy Huang, Undergraduate Researcher, MIT	Spring 2015
Nicole Seo, Undergraduate Researcher, MIT	Spring 2015-Fall 2015
John Peurifoy, Undergraduate Researcher, MIT	Fall 2014-Spring 2015
Eric Huppert, Undergraduate Researcher, MIT	Fall 2014
Giancarlo Sturla, Undergraduate Researcher, MIT	Spring 2014

First-Author Paper: [G. Sturla, et al.; *AIAA SciTech*, 2016].

Alex Gutierrez, Undergraduate Researcher, MIT. Fall 2013

Charlotte Kiang, Undergraduate Researcher, Wellesley College. Fall 2012

Fei Yu, Hong Kong University of Science and Technology. Summer 2012

Bryan Collazo, Undergraduate Researcher, MIT. Spring 2012

Teaching

MIT, Dept. Aeronautics and Astronautics Cambridge, MA

Real-Time Software & Systems Teaching Assistant February 2014 – May 2014

- Delivered lectures, conducted office hours, and guided students during weekly help sessions.

Leadership & Academic Service

Workshop Organizer:

- Association for the Advancement of Artificial Intelligence (AAAI) Fall Symposium Series (FSS) on Artificial Intelligence for Human-Robot Interaction (AI-HRI), November 2015.
- International Conference on Human-Robot Interaction (HRI): Workshop on Human-Robot Teaming, 2015.
- Robotics: Science and Systems (RSS): Workshop on Human-Robot Coordination in Manufacturing, 2014.

Program Committee:

- International Joint Conference on Artificial Intelligence (IJCAI), 2016.
- Robotics: Science and Systems (RSS), 2015.

Reviewer:

- Robotics: Science and Systems (RSS), 2016.
- ACM/IEEE International Conference on Human-Robot Interaction (HRI), 2016.
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2015.
- IEEE Transactions on Automation Science and Engineering, 2015-Present.
- Association for the Advancement on Artificial Intelligence (AAAI) Conference on Artificial Intelligence, 2014 (AAAI-14).
- IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN), 2014.

Invited Talks

NAO Robot Users & Developers Congress, UMass NERVE Center, Lowell, MA October 2016

Texas A&M CSCE Graduate Seminar Speaker, Texas A&M, College Station, TX September 2016

UMass Amherst MLFL Speaker, UMass Amherst, Amherst, MA May 2016

UNC-Chapel Hill CS Seminar Speaker, UNC, Chapel Hill, NC April 2016

Duke CS Seminar Speaker, Duke University, Durham, NC April 2016

Robotics Summit: The Future of Robotics, Massachusetts Technology and Leadership Council (MassTLC), Cambridge, MA December 2013

Publications

Journal Publications

[1] M. Gombolay, A. Bair, C. Huang, and J. Shah. "Computational Design of Mixed-Initiative Human-Robot Teaming that Considers Human Factors: Situational Awareness, Workload, and Workflow Preferences." To Appear in the *International Journal of Robotics Research (IJRR)*, 2017.

[2] M. Gombolay, R. Gutierrez, S. Clarke, G. Sturla, and J. Shah. "Decision-Making Authority, Team Efficiency and Human Worker Satisfaction in Mixed Human-Robot Teams." *Autonomous Robots*, 39(3): 293-312, 2015.

[3] M. Gombolay and J. Shah. "Schedulability Analysis of Task Sets with Upper and Lowerbound Temporal Constraints." *Journal of Aerospace Information Systems*, 11(12): 821-841, December 2014.

Peer-Reviewed Conference Publications

[4] M. Gombolay, R. Jensen, J. Stigile, S.H. Son, and J. Shah. "Apprenticeship Scheduling: Learning to Schedule from Human Experts." In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI),* July 2016. **[25% Acceptance Rate]**

[5] M. Gombolay, X. Yang, B. Hayes, N. Seo, Z. Liu, S. Wadhwania, T. Yu, N. Shah, T. Golen, and J. Shah. "Robotic Assistance in the Coordination of Patient Care." In *Proceedings of the Robotics: Science and Systems (RSS),* June 2016. **[24% Acceptance Rate]**

[6] M. Gombolay, R. Gutierrez, G. Sturla, and J. Shah. "Decision-Making Authority, Team Efficiency, and Human Worker Satisfaction in Mixed Human-Robot Teams." In *Proceedings of Robotics: Science and Systems (RSS),* July 2014. **[32% Acceptance Rate]**

[7] M. Gombolay, R. Wilcox, and J. Shah. "Fast Scheduling of Multi-Robot Teams with Temporospatial Constraints." In *Proceedings of Robotics: Science and System (RSS).* June 2013. **[30% Acceptance Rate]**

Conference Publications

[8] G. Sturla, M. Gombolay, and J Shah. "Incremental Scheduling with Upper and Lowerbound Temporospatial Constraints". In *Proceedings of the American Institute of Aeronautics and Astronautics (AIAA) SciTech*, 2016

[9] M. Gombolay and J. Shah. "A Uniprocessor Scheduling Policy for Task Sets with Precedence and Temporal Constraints." In *Proceedings of Infotech@Aerospace*, June 2012. **[Best Intelligent Systems Paper Award]**

[10] M. Gombolay, S. Beder, R. Boggio, J. Samsundar, P. Stadter, and P. Binning. "Scheduling of Oversubscribed Space-Based Sensors for Dynamic Objects of Interest." In *Proceedings of the U.S. Missile Defense Conference and Exhibit (SECRET)*, March 2011.

[11] T. Safko, D. Kelly, S. Guzewich, S. Bell, A. Rivkin, K. Kirby, R. Gold, A. Cheng, T. Aldridge, C. Colon, A. Colson, D. Lantukh, P. Pashai, D. Quinn, E. Yun, and the ASTERIA team. "ASTERIA: A Robotic Precursor Mission to Near-Earth Asteroid 2002 TD60." In *Proceedings of the Lunar and Planetary Science Conference*, 2011.

Doctoral Consortia

[12] M. Gombolay and J. Shah. "Increasing the Adoption of Autonomous Robotic Teammates in Collaborative Manufacturing." In *Proceedings of the Association for the Advancement of Artificial Intelligence Conference on Artificial Intelligence (AAAI-16) Doctoral Consortium*, 2016. **[39% Acceptance Rate]**

[13] M. Gombolay and J. Shah. "Increasing the Adoption of Autonomous Robotic Teammates in Collaborative Manufacturing." In *Proceedings of the ACM/IEEE International Conference on Human-Robot Interaction: Pioneers Workshop,* March 2014. **[36% Acceptance Rate]**

Workshop and Symposia Papers

[14] M. Gombolay, R. Jensen, J. Stigile, S.-H. Son, and J. Shah "Learning to Tutor from Expert Demonstration via Apprenticeship Scheduling." In *Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI) Workshop on Human-Machine Collaborative Learning (HMCL)***.** February, 2016.

[15] M. Gombolay, A. Shah "Appraisal of Statistical Practices in HRI vis-à-vis the T-Test for Likert Items/Scales." In *Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI) Fall Symposium Series (FSS) on Artificial Intelligence for Human-Robot Interaction (AI-HRI)***.** November, 2016.

[16] M. Gombolay, C. Huang, and J. Shah "Coordination of Human-Robot Teaming with Human Task Preferences." In *Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI) Fall Symposium Series (FSS) on Artificial Intelligence for Human-Robot Interaction (AI-HRI)*. November, 2015.

[17] M. Gombolay and J. Shah "Challenges in Collaborative Scheduling of Human-Robot Teams." In *Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI) Fall Symposium Series (FSS) on Artificial Intelligence for Human-Robot Interaction (AI-HRI)*. November, 2014.

[18] M. Gombolay, R. Wilcox, a. Diaz, F. Yu, and J. Shah. "Towards Successful Coordination of Human and Robotic Work using Automated Scheduling Tools: An Initial Pilot Study." In *Proceedings of Robotics: Science and Systems (RSS), Human-Robot Collaboration Workshop*, June 2013.

Patents

[19] M. Gombolay and J. Shah. 2016. Apprentice Scheduler. US Patent Application 62/318,880, filed 4/6/16. Patent Pending.

[20] J. Shah and M. Gombolay. 2013. Multiprocessor Scheduling Policy. US Patent Application 13/899,982, filed 5/22/13. Patent Pending.

[21] J. Shah and M. Gombolay. 2013. Uniprocessor Schedulability Testing for Non-Preemptive Task Sets. US Patent Application 13/873541, filed 4/30/13. Patent Pending.

Selected Press Coverage

Popular Science (US), 2016
Research Covered in "MIT's Robot Assistant Gives Nurses a Second Opinion"

CNN (US), 2016
Researched Covered in "MIT Robot Helps Deliver Babies"

International Business Times (UK), 2016
Research covered in "How MIT Robots Are Helping to Revolutionise Hospital Maternity Wards"
Qmed (US), 2016
Research covered in "How Chatty Robots Could Help Labor Ward Nurses"

Surgical Products (US), 2016
Research Covered in "Medical Robot 'Assistant' Helps Nurses with Complex Tasks"

Robotics Trends (US), 2016
Research Covered in "Medical Robot 'Assistant' Helps Nurses with Complex Tasks"

RoboHub (Switzerland), 2016
Research Covered in “MIT Robot Helps Nurses Schedule Tasks on Labor Floor”

Vice (US), 2016
Research covered in “'Medical Robot Assistants' Are Helping Nurses Schedule Tasks in the Labor Ward”

BostInno (US), 2016
Research Covered in “This MIT Robot Gives Human Coworkers Advice on Scheduling Tasks”

Boston Magazine (US), 2016
Research covered in “Beth Israel Labor Nurses Welcomed an Unusual Co-Worker”

Gizmodo (US), 2014
Research covered in “MIT Scientists Say Humans Would Rather Take Orders from Robots”

NBC (US), 2014
Research covered in “Feeling Inefficient? A Robot Boss Could Help”

CNBC (US), 2014
Research covered in “‘Robot overlords’: Coming our way soon?”

Radio New Zealand (New Zealand), 2014
Live Interview in Nine To Noon on “Why humans sometimes prefer to let robots be the boss”

TechTimes (US), 2014
Research covered in “MIT Scientists Say People Would Rather Take Orders from a Robot than Their Boss”

GotScience (US), 2014
Opinion sought for “Your Household Robot Is on the Way”