

Yancy Diaz-Mercado, PhD

Assistant Professor
Department of Mechanical Engineering
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Education

- May 2016 **PhD, Electrical Engineering**, *Georgia Institute of Technology*, Atlanta, GA.
- May 2014 **MS, Electrical Engineering**, *Georgia Institute of Technology*, Atlanta, GA.
- June 2011 **BS, Electrical Engineering**, *University of Puerto Rico at Mayagüez*, Mayagüez, PR.
Magna Cum Laude

Experience

Research

- Fall 2018 – Present **Assistant Professor**, *Department of Mechanical Engineering*, A. James Clark School of Engineering, University of Maryland, College Park, MD.
Research on human-swarm interactions and control of multi-agent systems.
 - Multi-robot control via time-varying coverage. (PI)
 - Results: 1 extended abstract & poster, 3 conference proceedings.
 - Characterization of control mechanisms in human-human collaborative interactions. (Co-PI)
 - Results: 1 journal, 1 grant.
 - Guaranteed capture in multi-player pursuer-evader games. (PI)
 - Results: 1 R&D grant subcontract, 1 conference proceedings.
 - Ultra-minimally invasive surgical procedures via magnetically steered needles. (Co-PI)
 - Results: 1 journal, 1 conference proceedings.
- Summer 2016 – Summer 2018 **Senior Professional Staff**, *Advanced Concepts Section*, Air and Missile Defense Sector's Guidance, Navigation and Control Group, The Johns Hopkins University Applied Physics Laboratory, Laurel, MD.
Research on
 - Generalizations of multi-vehicle interceptor problems using distributed coverage control. (PI)
 - Results: 2 R&D grant, 1 journal, 1 invention disclosure.
 - Extracting human algorithms for complex problem solving through videogamification. (Co-PI)
 - Results: 1 R&D grant.
 - Atmospheric turbulence metrology via high energy laser adaptive optics. (Co-PI)
 - Results: Runner-up for 2016 RW Hart Research Award.
 - Trajectory classification and prediction for highly kinematically capable vehicles using reproducing kernel Hilbert spaces. (Technical Lead)
 - Results: 1 invention disclosure
- Spring 2016 – Summer 2016 **Post-Doc Research Assistant**, *GRITS Lab*, *Georgia Institute of Technology*, Atlanta, GA.
Research on control of multi-robot systems. PI: Magnus Egerstedt
 - Controlling robotic swarms with low-complexity EEG brain-machine interfaces.
 - Results: 1 extended abstract & poster.
 - Remote-Access Swarm Robotics.

Fall 2011 – **Graduate Research Assistant**, *GRITS Lab*, Georgia Institute of Technology, Atlanta, GA.
Spring 2016

Research on control of multi-robot systems. Advisor: Magnus Egerstedt.

- Research on human-swarm interactions.
 - Results: 1 book chapter, 2 journal paper, 1 conference paper, 1 patent.
- Research on inter-robot interactions in multi-robot systems. Collaboration with Calin Belta from the HyNeSs Lab at Boston University.
 - Results: 1 journal paper, 3 conference papers.
- Research on online globally optimal path planners. Collaboration with Hao-Min Zhou from the School of Mathematics at Georgia Tech.
 - Results: 1 conference paper.
- Research on trajectory generation for air traffic control. Collaboration with Shih-Yih Young at Rockwell Collins, Inc.
 - Results: 1 conference paper.
- Research on heterogeneous collaboration of multi-robot systems in convoy protection scenarios. Collaboration with Shih-Yih Young at Rockwell Collins, Inc.

Summer 2010 **Summer Undergraduate Research Assistant**, *Georgia Institute of Technology*, Atlanta, GA.

Research on equalizer design for high-frequency Tx/Rx. Advisor: Kevin Kornegay.

Fall 2009 – **Undergraduate Research Assistant**, *Minds2Create Lab*, University of Puerto Rico
Spring 2011 at Mayagüez, Mayagüez, PR.

Research on power regulation of renewable source and autonomous robot design. Advisor: Eduardo Ortiz-Rivera.

- Results: 3 conference papers.

Teaching

Fall 2018 – **Assistant Professor**, *University of Maryland*, College Park, MD.

- Present
- Instructor for graduate course on Control of Multi-Robot Systems.
 - My duties include: course preparation; creating assignments, projects, and exams; grading examinations; leading recitations; and providing office hours.
 - Instructor for senior undergraduate course on Classical Controls for mechanical engineers.
 - My duties include: course preparation; creating assignments, laboratories, and exams; grading examinations; leading recitations; and providing office hours.
 - Instructor for junior undergraduate course on Vibrations for mechanical engineers.
 - My duties include: course preparation; creating assignments and exams; grading; leading recitations; and providing office hours.

Fall 2017 **Course Instructor**, *University of Maryland Baltimore County*, Baltimore, MD.

- Instructor for senior undergraduate course on Classical Controls for mechanical engineers.
 - My duties include: course preparation; creating assignments, projects, and exams; grading assignments and projects; leading recitations; and providing office hours.

Fall 2015 **Graduate Teaching Assistant**, *Georgia Institute of Technology*, Atlanta, GA.

- Head TA for “Networked Control Systems,” an advanced graduate course on the *systems and controls* technical interest area at Georgia Tech.
- My duties included: helping with course structure preparation; help creating assignments, projects, and exams; grading assignments and projects; leading 15% of lectures; and providing weekly office hours.

- Fall 2014 **Course Instructor**, *Georgia Institute of Technology*, Atlanta, GA.
- Instructor for introductory graduate course on teaching and learning for prospective teaching assistants.
 - My duties included: designing course structure; preparing and delivering weekly lectures; preparing and executing learning exercises in and outside of class; and moderating online forums and discussion boards.
- Spring 2014 **Graduate Teaching Assistant**, *Georgia Institute of Technology*, Atlanta, GA.
- Head TA for “Optimal Control,” a core graduate course on the *systems and controls* technical interest area at Georgia Tech.
 - My duties included: help creating assignments, projects, and exams; grading assignments and projects; leading 10% of lectures; and providing weekly office hours.
- Fall 2011 – **Graduate Teaching Assistant**, *Georgia Institute of Technology*, Atlanta, GA.
- Spring 2012
- TA for the “Microelectronics Laboratory,” a junior/senior course on semiconductor circuits, op-amps, and filter design.
 - My duties included: leading a section of 18 students; preparing and proctoring quizzes; grading homework assignments for 8 sections; and providing office hours.
- Fall 2007 – **Tutor**, *University of Puerto Rico at Mayagüez*, Mayagüez, PR.
- Fall 2008
- Provided private math tutoring to a dozen students as part of a special project from the dean of students.
 - Tutored in pre-basic math I-II, pre-calculus I-II, calculus I-III.

Professional

- Summer 2013 **Technical Intern**, *The Johns Hopkins University Applied Physics Laboratory*, Laurel, MD.
- Development of a six degrees of freedom terminal homing simulation environment for a generic airframe which was used to perform several advanced concept studies for the benefit of an ONR sponsored program.
- Summer 2012 **Technical Intern**, *The Johns Hopkins University Applied Physics Laboratory*, Laurel, MD.
- Development of strategies for improving robustness of fully coupled autopilot designs in flight control systems for endo-atmospheric aerodynamic vehicles.
- Summer 2011 **Technical Intern**, *The Johns Hopkins University Applied Physics Laboratory*, Laurel, MD.
- Robustness analysis of a six degrees of freedom rigid body autopilot compensation scheme for aerodynamic cross-coupling.
- Spring 2009 – **Engineering Co-op**, *Rockwell Collins, Inc.*, Cedar Rapids, IA.
- Summer 2009 Worked as part of the hardware team for the *Situational Awareness Applications* in the *Business and Regional Jets* division. My duties included:
- Development and verification of their terrain awareness and warning system.
 - Analysis of several non-working file server units to attain root-cause failure.
 - Suggested and implemented quality plan action items to improve existing designs.
- Fall 2003 – **Industrial Electronics Training**, *Antonio Lucchetti Vocational High*, Arecibo, PR.
- Spring 2006
- Over 1,200 hours completed in Industrial Electronics.

Publications

Ph.D. Dissertation

- [D1] Y. Diaz-Mercado, “Interactions in multi-robot systems,” Ph.D., Georgia Institute of Technology, May 2016. [Online]. Available: <http://hdl.handle.net/1853/55020>.

Book Chapters

- [B1] Y. Diaz-Mercado, S. G. Lee, and M. Egerstedt, “Human–swarm interactions via coverage of time-varying densities,” in *Trends in Control and Decision-Making for Human–Robot Collaboration Systems*, Springer, 2017, pp. 357–385.

Journals

- [J7] S. Honarvar, C.-S. Kim, Y. Diaz-Mercado, *et al.*, “Unveiling the neuromechanical mechanisms underlying the synergistic interactions in human sensorimotor system,” *Science Advances*, 2020, (Under Review).
- [J6] L. O. Mair, X. Liu, B. Dandamudi, *et al.*, “Magnetosuture: Tetherless manipulation of suture needles,” *IEEE Transactions on Medical Robotics and Bionics*, vol. 2, no. 2, pp. 206–215, 2020. DOI: 10.1109/TMRB.2020.2988462.
- [J5] A. Davydov and Y. Diaz-Mercado, “Sparsity structure and optimality of multi-robot coverage control,” *IEEE Control Systems Letters*, vol. 4, no. 1, pp. 13–18, Jan. 2020. DOI: 10.1109/LCSYS.2019.2921513.
- [J4] P. Rivera-Ortiz and Y. Diaz-Mercado, “On guaranteed capture in multi-player reach-avoid games via coverage control,” *Control Systems Letters (L-CSS)*, *IEEE*, vol. 2, no. 4, pp. 767–772, Oct. 2018, ISSN: 2475-1456. DOI: 10.1109/LCSYS.2018.2849582.
- [J3] M. Santos, Y. Diaz-Mercado, and M. Egerstedt, “Coverage control for multirobot teams with heterogeneous sensing capabilities,” *Robotics and Automation Letters (RA-L)*, *IEEE*, vol. 3, no. 2, pp. 919–925, Apr. 2018. DOI: 10.1109/LRA.2018.2792698.
- [J2] Y. Diaz-Mercado and M. Egerstedt, “Multirobot mixing via braid groups,” *Robotics, IEEE Transactions on*, vol. PP, no. 99, pp. 1–11, 2017, ISSN: 1552-3098. DOI: 10.1109/TR0.2017.2737636.
- [J1] S. G. Lee, Y. Diaz-Mercado, and M. Egerstedt, “Multi-Robot Control Using Time-Varying Density Functions,” *Robotics, IEEE Transactions on*, vol. 31, no. 2, pp. 489–493, Apr. 2015, ISSN: 1552-3098. DOI: 10.1109/TR0.2015.2397771.

Conference Proceedings

- [C16] X. Xu, E. J. Rodríguez-Seda, and Y. Diaz-Mercado, “Persistent awareness-based multi-robot coverage control,” *Decision and Control (CDC), IEEE 59th Annual Conference on*, 2020, (Under Review).
- [C15] M. Fan, X. Liu, K. Jain, *et al.*, “Towards autonomous control of magnetic suture needles,” in *Intelligent Robots and Systems, IEEE International Conference on*, (Under Review), Oct. 2020.
- [C14] E. J. Rodríguez-Seda and Y. Diaz-Mercado, “Decentralized persistent area coverage control with loss of awareness,” in *Control Technology and Applications (CCTA), IEEE Conference on*, (To Appear), Aug. 2020.
- [C13] A. Davydov, D. Yeo, and Y. Diaz-Mercado, “Low-mobility atmospheric sensing via multi-vehicle adaptive coverage control,” in *2020 AIAA AVIATION Forum*, (To Appear), Jun. 2020.
- [C12] X. Xu and Y. Diaz-Mercado, “Multi-Robot Control Using Coverage Over Time-Varying Non-Convex Domains,” in *2020 International Conference on Robotics and Automation (ICRA)*, (To Appear), May 2020.

- [C11] X. Xu and Y. Diaz-Mercado, “Multi-Robot Control Using Coverage Over Time-Varying Domains,” in *2020 American Controls Conference (ACC)*, (To Appear, **Keynote Presentation**), Jul. 2020.
- [C10] P. Rivera-Ortiz, Y. Diaz-Mercado, and M. Kobilarov, “Multi-Player Pursuer Coordination for Nonlinear Reach-Avoid Games in Arbitrary Dimensions via Coverage Control,” in *2020 American Controls Conference (ACC)*, (To Appear), Jul. 2020.
- [C9] Y. Diaz-Mercado, A. Jones, C. Belta, and M. Egerstedt, “Correct-by-Construction Control Synthesis for Multi-Robot Mixing,” in *Conference on Decision and Control (CDC), 2015 IEEE 54th Annual*, Dec. 2015, pp. 221–226. DOI: 10.1109/CDC.2015.7402112.
- [C8] Y. Diaz-Mercado, S. G. Lee, and M. Egerstedt, “Distributed Dynamic Density Coverage for Human-Swarm Interactions,” in *American Control Conference (ACC)*, Jul. 2015, pp. 353–358. DOI: 10.1109/ACC.2015.7170761.
- [C7] Y. Diaz-Mercado and M. Egerstedt, “Multi-Robot Mixing of Nonholonomic Mobile Robots,” in *Control Applications (CCA), IEEE Conference on*, Oct. 2014, pp. 524–529. DOI: 10.1109/CCA.2014.6981399.
- [C6] J. Lu, Y. Diaz-Mercado, M. Egerstedt, H. Zhou, and S.-N. Chow, “Shortest Paths Through 3-Dimensional Cluttered Environments,” in *Robotics and Automation (ICRA), IEEE International Conference on*, May 2014, pp. 6579–6585. DOI: 10.1109/ICRA.2014.6907830.
- [C5] Y. Diaz-Mercado and M. Egerstedt, “Multi-Robot Mixing Using Braids,” in *Decision and Control (CDC), IEEE 52nd Annual Conference on*, Dec. 2013, pp. 2001–2005. DOI: 10.1109/CDC.2013.6760175.
- [C4] Y. Diaz-Mercado, S. G. Lee, M. Egerstedt, and S.-Y. Young, “Optimal Trajectory Generation for Next Generation Flight Management Systems,” in *Digital Avionics Systems Conference (DASC), IEEE/AIAA 32nd*, Oct. 2013, pp. 3C5–1–3C5–10. DOI: 10.1109/DASC.2013.6712566.
- [C3] Y. Diaz-Mercado, J. Pabon, and E. Ortiz-Rivera, “Voltage Regulation for a Thermoelectric Generator Using a KY-Converter,” in *Center for Power Electronic Systems Annual Conference (CPES)*, 2011.
- [C2] S. Garcia-Vergara, J. Pabon, Y. Diaz-Mercado, and E. Ortiz-Rivera, “An Integrated Undergraduate Research Experience in Control, Power Electronics, and Design Using a Micromouse,” in *Frontiers in Education, IEEE*, 2010.
- [C1] Y. Diaz-Mercado, S. Garcia-Vergara, J. Pabon, and E. Ortiz-Rivera, “Maximum Power Control Based on Matching DC Motor Dynamics and Fuel Cell Dynamic Behavior,” in *Center for Power Electronic Systems Annual Conference (CPES)*, 2010.

Poster Presentation Abstracts

- [A2] X. Xu and Y. Diaz-Mercado, “Multi-robot control using coverage over time-varying domains: Extended abstract,” in *2019 International Symposium on Multi-Robot and Multi-Agent Systems (MRS)*, IEEE, 2019, pp. 179–181.
- [A1] G. Canal, Y. Diaz-Mercado, C. Rozell, and M. Egerstedt, “Controlling High-Complexity Robotic Swarms with Low-Complexity EEG Brain-Machine Interfaces,” in *Neuroscience 2017*, Program No. 147.38, Society for Neuroscience, Washington, DC, Nov. 2017.

Intellectual Property

- [P2] M. Egerstedt, S. G. Lee, Y. Diaz-Mercado, and S. Chopra, “Control of swarming robots,” US Patent US Patent 20,170,072,565, Mar. 2016. [Online]. Available: <http://www.sumobrain.com/patents/W02015171593A1.html>.
- [P1] M. Egerstedt, S. G. Lee, and Y. Diaz-Mercado, “Density-based manipulation of teams of robots,” US Provisional Patent 61/988,345, May 2014.

Awards & Honors

- 2020 Invited keynote speaker control of robots session at the 2020 American Controls Conference.
- 2019 Invited guest speaker at the U.S. Naval Academy, Annapolis, MD.
Principal investigator on Minta Martin grant for exploring guaranteed capture strategies in multi-pursuer-evader problems.
- 2018 Co-principal investigator for a Korea Institute of Machinery and Metals grant on characterizing human-human interactions.
- 2017 Principal investigator for JHU/APL independent research & development grant on generalization of multi-player pursuit-evasion problems using coverage control.
Co-principal investigator for JHU/APL independent research & development grant seedling to extract human algorithms for complex problem solving through videogamification.
RW Hart Prize for Research Award Semi-Finalist for High-Energy Laser Adaptive Optics.
- 2015 Outstanding Graduate Teaching Assistant Award.
Certificate in Higher Education, *Tech to Teaching*, Georgia Tech NSF-funded Program.
- 2014 IEEE CSS Video Clip Contest, 2nd Place.
- 2013 GEM PhD Fellow.
Alfred P. Sloan Scholar.
- 2011 GEM Masters Fellow.
Otto & Jenny Krauss Fellow.
- 2010 Inducted into the engineering honor society: *Tau Beta Pi, PR Alpha Chapter*.
Accepted into Georgia Tech’s SURE program.
- 2009 Louis Stokes Alliance Research Scholar.
- 2006 – 2011 Dean’s List, recognition for academic achievement during a semester.

Media Coverage

- 2015 **IEEE Spectrum**.
E. Ackerman. (2015). Your Finger on a Tablet Can Control Entire Swarms of Robots, [Online]. Available: <http://spectrum.ieee.org/automaton/robotics/robotics-software/georgia-tech-robot-swarm-control>.
- Science Magazine**.
(2015). How to Control a Robot Fleet Using a Smart Tablet, [Online]. Available: <http://news.sciencemag.org/sifter/2015/05/watch-how-to-control-a-robot-fleet-using-a-smart-tablet>.
- Georgia Tech News**.
J. Maderer. (2015). Controlling Swarms of Robots With a Finger, [Online]. Available: <http://www.news.gatech.edu/2015/05/12/controlling-swarms-robots-finger>.

Fox News.

(2015). Want to Control a Swarm of Robots? Georgia Tech Has the Answer, [Online]. Available: <http://www.foxnews.com/tech/2015/05/12/want-to-control-swarm-robots-georgia-tech-has-answer.html>.

WSB-TV.

C. Lucie. (2015). Georgia Tech Project Could Change How Rescuers Respond to Disasters, [Online]. Available: <http://www.wsbtv.com/news/news/local/georgia-tech-project-could-change-how-rescuers-res/nmXNC/>.

UPI.

B. Hays. (2015). Watch a Simple Tablet Control Robot Swarm, [Online]. Available: http://www.upi.com/Science_News/2015/05/12/Watch-a-simple-tablet-control-robot-swarm/7491431455304/.

Perfect Science.

J. Gibson. (2015). Engineers Program Army of Robots to Respond to Commands Issued Through Tablet, [Online]. Available: <http://perfscience.com/content/2141778-engineers-program-army-robots-respond-commands-issued-through-tablet>.

Service

Committees & Consultations

- Organization Committee **2021 Conference on Decisions and Controls, Exhibits Chair, Texas.**
- Advisory Board **MATCH Consortium, UPRM, Mayaguez, Puerto Rico.**
- Robotics Consultant **U.S. Department of Commerce, Census Division.**
- Committee Chair **Doctoral Qualifier Examination, University of Maryland, College Park, Maryland.**
- Committee Member **Doctoral Qualifier Examination, University of Maryland, College Park, Maryland.**
- Committee Member **Doctoral Dissertation Defense, University of Maryland, College Park, Maryland.**
- Committee Member **Gemstone Honors Program Senior Team Thesis Defense, University of Maryland, College Park, Maryland.**

Volunteer

- Session Chair **58th Conference on Decision and Control, Nice, France, 2020.**
- Session Chair **Missile GNC, AIAA SciTech 2018, Kissimee, Florida.**
- JHU/APL **Mentor, Advised and mentored graduate student intern, Summer 2017.**
- Lead Volunteer **Analysis and Design of Hybrid Systems, an IFAC Conference, 2015.**
- Judge **Video Clip Competition, IEEE CSS, 2015.**
- Session Chair **Multi-Conference on Systems and Control, an IEEE Conference, 2014.**
- 2010 – 2011 **Recording Secretary, Tau Beta Pi, PR Alpha Chapter, The engineering honor society.**

Journals

- Reviewer **Robotics and Automation, IEEE Letters on, 2018.**

Reviewer **Control of Network Systems**, *IEEE Transactions on*, 2018.
Reviewer **Control Systems Letters**, *IEEE*, 2018.
Reviewer **Robotics**, *IEEE Transactions on*, 2017.
Reviewer **Automatica**, *A Journal of IFAC*, 2015.
Reviewer **Aerospace and Electronic Systems**, *IEEE Transactions on*, 2015.

Conference Proceedings

Reviewer **American Controls Conference**, AACC, a member of IFAC, 2015–2020.
Reviewer **Conference on Decision and Control**, an *IEEE Control System Society International Conference*, 2016, 2019–2020.
Reviewer **Intelligent Robots and Systems**, an *IEEE/RSJ International Conference*, 2015,2020.
Reviewer **International Conference of Robotics and Controls**, *IEEE Robotics and Automation Society*, 2017–2018.
Reviewer **Multi-Robot and Multi-Agent Systems**, *IEEE International Symposium*, 2017, 2019.
Reviewer **Robotics: Science and Systems Conference**, 2016.

STEM Outreach

March 2016 **Roswell High School Career Seminar**, *Invited motivational speaker*.
October 2015 **Douglas High School**, *Organized robotic demos for student film project*.
June 2015 **Georgia Tech Summer Program**, *Held discussions and robotic demos*.
March 2015 **BEST Academy**, *Organized and led lab tours and robotic demos*.

Languages

Spanish Native language.
English Full professional proficiency.

References

Available upon request.