

Purdue SMART Lab Highlights 2019

January 2020



Lab Overview

The Smart Machine and Assistive Robotics Technology (SMART) Lab was established by Dr. Byung-Cheol ("B.C.") Min in 2015 to research robot design & control, multi-robot systems, and human-robot interaction, with focus on applications in field robotics and assistive technology and robotics. Since the establishment of the SMART lab in 2015, 3 Postdocs, 3 MS students, 3 Undergrad students, 2 Visiting scholars, and 2 Visiting students have completed their research programs in the lab. Currently, 1 Director, 1 Postdoc, 7 PhD students, 2 MS students, and 5 Undergrad students are associated with the lab.

New Lab Space and Equipment

Lab Space

- On August 5, 2019, the SMART Lab gained a new additional lab space in Heavilon Hall (HEAV), located in Purdue University Main Campus. The additional lab's size is approximately 600 square feet, and it can serve as an office for 3 people and accommodate 1-50 mobile robot experiments. The lab is equipped with Vicon's motion capture system, enabling us to perform a high quality of experiments with mobile robots, drones, and human subjects.
- With the addition of new lab space, the SMART lab operates two physical lab spaces in POTR 141 (approx. 1200 square feet) and HEAV 101 (approx. 600 square feet). POTR 141 is used as the lab member's office and prototyping space, and HEAV 101 is used as a robot and user-study experimental space.

Equipment

- In 2019, the lab's new highlighted equipment includes Vicon's motion capture system, wearable sensors that can measure EEG, ECG and GSR, 1 laptop, and 2 desktop PCs.

Lab Media Appearances

- Our lab was featured in the Purdue University's 150 Years of Giant Leaps video celebrating the university's 150th anniversary.
- One of the lab's collaboration works was featured in the Purdue Research Foundation News – "Electronic glove offers 'humanlike' features for prosthetic hand users".
- Dr. Min and his NSF CAREER award were featured in the Purdue Polytechnic's Newsroom – "Polytechnic professor receives NSF CAREER award to advance human/robot synergy".
- Two of our PhD students who won the graduate student poster award were featured in the Purdue Polytechnic's Newsroom – "Grad research assistants present Realizing the Digital Enterprise projects".

Lab Meetings/Seminars

Lab Meetings

- A total of 31 lab group meetings were held in 2019. During the 2019 spring semester, the lab had a group meeting every Fridays from 1:30pm to 3pm in the POTR facility. During the 2019 fall semester, the lab had a group meeting every Mondays from 10am to 11:30am in the POTR facility.

Lab Seminars

- A total of 16 paper review seminars were delivered by a Postdoc, PhD students and Master students.

Lab Members

Current Members (16)

- **Byung-Cheol Min** (Director) received the NSF CAREER Award, the Purdue's Polytechnic Outstanding Faculty in Discovery Award in 2019, the Purdue's Department of Computer and Information Technology

Outstanding Faculty in Discovery Award in 2019, and the Purdue's Department of Computer and Information Technology Outstanding Graduate Mentor Award in 2019.

- **Ahreum Lee** (Postdoc) was renewed for a second term as a postdoc in 2019-20. She submitted 1 journal paper as a first author, published 1 abstract/report as a co-author, and presented 2 posters as a co-author.
- **Jun Han Bae** (PhD Student) defended his doctoral proposal in November 2019. He published 1 journal paper as a co-author and 2 conference papers as a first author and a co-author, respectively, resubmitted 1 journal paper as a first author, and presented 5 posters; 2 as a first author and 3 as a co-author. Jun Han won 3 travel grants. He served as a lab committee chair for the fall semester and mentored 2 undergrad students.
- **Sangjun Lee** (PhD Student) continued his research with the NIJ fellowship. He published 1 abstract/report as a co-author, submitted 1 conference paper as a first author, and presented 3 posters; 2 as a first author and 1 as a co-author. Sangjun won 4 travel grants. He served as a lab committee chair for the spring semester.
- **Shaocheng Luo** (PhD Student) published 1 journal paper as a first author and 3 conference papers; 2 as a first author and 1 as a co-author, resubmitted 1 journal paper as a first author, and presented 3 posters; 1 as a first author and 2 as a co-author. Shaocheng won 3 travel grants. He served as a lab committee member for the spring semester and mentored 1 visiting undergrad students.
- **Manoj Penmetcha** (PhD Student) published 1 conference paper as a first author and 1 archive paper as a first author, and presented 3 posters; 1 as a first author and 2 as a co-author. Manoj won 4 travel grants.
- **Tamzidul Mina** (PhD Student) passed his prelim exam in April 2019. He published 3 conference papers; 2 as a first author and 1 as a co-author, submitted 1 journal paper as a first author, and presented 3 posters; 1 as a first author and 2 as a co-author. Tamzidul was selected as a finalist for the 2019 OCEANS Seattle - Student Poster Competition and received a certificate in October 2019. He also won 2 travel grants. Tamzid worked as a graduate research assistant for the CAREER project in the summer. He mentored 1 MS student, 2 undergrad students, and 1 visiting K-12 student.
- **Wonse Jo** (PhD Student) passed his preliminary exam in October 2019. He published 1 journal as a first author, 1 conference paper as a first author, 1 abstract/report as a first author, submitted 3 journal papers as a co-author, and presented 9 posters; 2 as a first author and 7 as a co-author. Wonse was selected as a finalist for the 2019 OCEANS Seattle - Student Poster Competition and received a certificate in October 2019. Wonse worked as a graduate research assistant for the CAREER project in the summer and fall semester. He served as a lab committee member for the spring and the fall semester. Wonse also mentored 1 MS student and 4 undergrad students.
- **Shyam Kannan** (PhD Student) earned his MS degree in May 2019 and started his PhD in June 2019. He published 1 conference paper as a co-author and 1 archive paper as a co-author, submitted 2 journal papers as a co-author, and presented 2 posters; 1 as a first author and the other as a co-author. Shyam received the Fan Favorite Poster Award in 2019 Purdue Robotics Accelerator Showcase, Purdue University in February 2019. He served as a lab committee member for the fall semester.
- **Jee Hwan Park** (MS Student) published his first conference paper as a first author, and 2 conference papers and 1 abstract/report as a co-author. He also resubmitted 1 journal paper as a co-author and presented 3 posters as a co-author. Jee Hwan worked as a teaching assistant for Dr. Min's CNIT 355 Android Programming class in the fall semester.
- **Jeremy Pan** (MS Student) started his Masters study in August 2019. Jeremy worked on a development of a web-based adaptive human-robot teleoperation system to detect and influence the emotional state of the human.
- **Yuta Hoashi** (Undergrad Student) published 1 journal paper and 1 conference paper as a co-author, and presented 5 posters; 1 as a first author and 4 as a co-author. Yuta won the Thematic (Innovative Technology, Entrepreneurship, and Design) Award in the 2019 Purdue Undergraduate Research Conference. Yuta worked as an undergraduate research assistant for the CAREER project in the fall semester.
- **Walter Kruger** (Undergrad Student) presented 2 posters: 1 as a first author and the other as a co-author. He worked as an undergraduate research assistant for the Decentralized Multi-robot Construction project in the spring semester and for the CAREER project in the fall semester.

- **Andrew Sakai** (Undergrad Student) worked as an undergraduate research assistant for the Robotic Water Quality Monitoring Project in the summer.
- **Jaeun Kim** (Undergrad Student) worked on a study on the impact of audiovisual feedback in human-swarm interaction as part of the CAREER project.
- **Pou Hei Chan** (Undergrad Student) worked for the Robotic Water Quality Monitoring Project.

Lab Alumni (5)

- **Yogang Singh** (Postdoc) completed his postdoc training under Dr. Min in December 2019. He worked for the Robotic Water Quality Monitoring Project, published 3 conference papers as a co-author, and presented 9 posters; 2 as a first author and 7 as a co-author. Yogang won the People's Choice Poster Presentation Award in the 6th Agricultural and Biological Engineering Symposium (ABE Symposium) at Purdue University in March 2019. He will join Katholieke Universiteit (KU) Leuven, Belgium as a Postdoctoral Researcher.
- **Yuting Chen** (Postdoc) completed her postdoc training under Dr. Min in July 2019. Yuting assumed her tenure-track faculty position at the University of North Carolina at Charlotte (UNCC) in August 2019. She is an Assistant Professor in the Civil Engineering Technology & Construction Management in UNCC.
- **UC Wang** (Undergrad Student) obtained his BS degree from Mechanical Engineering at Purdue in May 2019.
- **Bumjoo Lee** (Visiting Professor) completed his visiting research and returned his home university, Myongji University in South Korea in July 2019.
- **Hanyao Yang** (Visiting Student) completed her visiting research and returned her home university, Huaqiao University, in China in September 2019.

New Lab Members (5)

- **Jeremy Pan** (MS Student) joined the lab in August 2019. Jeremy obtained his BS degree in Computer and Information Technology from Purdue. Jeremy's research interests include assistive robotics, multi-robot systems, and human-robot interaction.
- **Walter Kruger** (Undergrad Student) joined the lab in January 2019. Walter is an undergraduate student in Mechatronics & Robotics Engineering Technology at Purdue, and his research interests include decentralized multi-robot construction system.
- **Andrew Sakai** (Undergrad Student) joined the lab in July 2019. Andrew is an undergraduate student in Mechanical Engineering Technology at Purdue, and his research interests include robot design and control.
- **Jaeun Kim** (Undergrad Student) joined the lab in October 2019. Jaeun is an undergraduate student in Robotics Engineering Technology at Purdue, and her research interests include human-robot interaction, swarm intelligence and intuitive user interface.
- **Pou Hei Chan** (Undergrad Student) joined the lab in October 2019. Pou Hei is an undergraduate student in Engineering at Purdue, and his research interests include underwater robotics, autonomous robotics and multi-robot system.

Proposal Submitted (10, \$2.5M)*Awarded*

- Cybersecurity and Safety Challenges in Autonomous Vehicles: Threats Identification and Countermeasures Development, Role: PI, Sponsor: National Institute of Justice, Amount: \$47,131 (08/01/2019 – 12/31/2020).
- 18-19 Laboratory & University Core Facility Research Equipment Program: Acquisition of a Modular Robotic Walkway for Development and Testing of Soft Assistive Exoskeletons, Role: Co-PI (PI: Richard Voyles), Sponsor: Purdue University, Amount: \$169,845 (01/01/2019 – 12/31/2019).
- Polytechnic Post-Doc Support Competition Award, Role: Co-PI (PI: Sunghwan Lee), Sponsor: Purdue University, Amount: \$50,000 (08/01/2020 – 07/31/2021)

Pending

- Non-contact based Object Transport with Multi-Robot Systems, Role: PI, Sponsor: Office of Naval Research, Amount: \$510,000 (12/1/2019 – 11/30/2022).

- Package Delivery using Drone Hauling, Role: PI, Sponsor: Amazon.com, Amount: \$76,000 (01/01/2020 – 12/31/2020).
- RI: Medium: Scalable Congestion Intelligence for Autonomous Mobile Robots, Role: Co-PI (PI: Seokcheon Lee), Sponsor: National Science Foundation, Amount: \$873,594 (05/15/2020 – 05/14/2023).
- Phase II IUCRC Purdue University: Center for Robots & Sensors for the Human Well-Being, Role: Co-PI (PI: Rastgaar Mo), Sponsor: National Science Foundation, Amount: \$500,000 (11/1/2019 – 10/31/2024).
- 19-20 Laboratory & University Core Facility Research Equipment Program: Wheelchair-Mounted Robotic Manipulator for Research in Assistive Robotics, Role: Co-PI (PI: Brad Duerstock), Sponsor: Purdue University, Amount: \$39,300 (01/01/2020 – 12/31/2020).

Declined

- NRI: INT: COLLAB: A Bio-Inspired Evaluation Framework for Heterogeneous Multi-Robot Swarm Systems, Role: PI, Sponsor: National Science Foundation, Amount: \$250,000 (01/01/2020 - 12/31/2022).
- Developing a Joint Crane-Robot System to Support Automated Construction of Buildings – Phase II, Role: Co-PI (PI: Jiansong Zhang), Sponsor: Purdue Polytechnic Institute, Amount: \$8,000 (04/01/2019 – 03/31/2020).

Grants Awarded (4, \$766K)

- CAREER: Adaptive Human Multi-robot Systems, Role: PI, Sponsor: National Science Foundation, Amount: \$500,000 (02/15/2019 – 01/31/2024).
- Cybersecurity and Safety Challenges in Autonomous Vehicles: Threats Identification and Countermeasures Development, Role: PI, Sponsor: National Institute of Justice, Amount: \$47,131 (08/01/2019 – 12/31/2020).
- 18-19 Laboratory & University Core Facility Research Equipment Program: Acquisition of a Modular Robotic Walkway for Development and Testing of Soft Assistive Exoskeletons, Role: Co-PI (PI: Richard Voyles), Sponsor: Purdue University, Amount: \$169,845 (01/01/2019 – 12/31/2019).
- Polytechnic Post-Doc Support Competition Award, Role: Co-PI (PI: Sunghwan Lee), Sponsor: Purdue University, Amount: \$50,000 (08/01/2020 – 07/31/2021)

Current Funded Research Projects (7, \$3.1M)

- CAREER: Adaptive Human Multi-robot Systems, Role: PI, Sponsor: National Science Foundation, Amount: \$500,000 (02/15/2019 - 01/31/2024).
- CPS: Medium: Collaborative Research: Closed Loop Sustainable Precision Animal Agriculture, Role: Co-PI (PI: Richard Voyles), Sponsor: National Institute of Food and Agriculture, Amount: \$541,448 (09/01/2018 - 08/31/2021).
- PFI-RP: Partnerships for Innovation in Interoperable Building Information Modeling Technology for Applications in Automated Building Code Compliance Checking and Modular Construction Automation, Role: Co-PI (Jiansong Zhang), Sponsor: National Science Foundation, Amount: \$915,597 (09/15/2018 - 08/31/2021).
- Mobile Crowd Sensing for Sustainability Challenges: A Behavioral Approach to Inducing User Participation, Role: Co-PI (David J. Yu), Sponsor: Purdue Center for the Environment, Amount: \$15,000 (06/01/2018 - 06/30/2019).
- UNSA NEXUS: Robotic Water Quality Monitoring and Distribution Systems: A Pilot Study, Role: PI, Sponsor: Universidad Nacional de San Agustin, Amount: \$365,439 (01/01/2018 - 12/31/2020).
- Cybersecurity and Safety Challenges in Autonomous Vehicles: Threats Identification and Countermeasures Development, Role: PI, Sponsor: National Institute of Justice, Amount: \$147,131 (08/01/2017 - 12/31/2020).
- I/UCRC Phase I: Robots and Sensors for the Human Well-being, Role: Senior Personnel (PI: Richard Voyles), Sponsor: National Science Foundation, Amount: \$637,202 (09/15/2014 - 08/31/2020).

Publications (4 journals, 8 conferences, 1 report, 1 archive, 6 papers under review)*Journals*

- Patchara Kitjacharoenchai, Byung-Cheol Min, and Seokcheon Lee, “Two Echelon Vehicle Routing Problem with Drones in Last Mile Delivery”, *International Journal of Production Economics*, December 2019.
- Wonse Jo, Yuta Hoashi, Lizbeth Leonor Paredes Aguilar, Mauricio Postigo-Malaga, José Garcia-Bravo, and Byung-Cheol Min, “A Low-cost and Small USV Platform for Water Quality Monitoring”, *HardwareX*, Vol. 6, e00076, October 2019.
- Min Ku Kim, Ramviyas Nattanmai Parasuraman, Liu Wang, Yeonsoo Park, Bongjoong Kim, Seung Jun Lee, Nanshu Lu, Byung-Cheol Min, and Chi Hwan Lee, “Soft-packaged Sensory Glove System for Human-like Natural Interaction and Control of Prosthetic Hands”, *NPG Asia Materials*, Vol. 11, Article Number 43, August 2019.
- Shaocheng Luo, Jonghoek Kim, Ramviyas Parasuraman, Jun Han Bae, Eric T. Matson, and Byung-Cheol Min, “Multi-robot Rendezvous Based on Bearing-aided Hierarchical Tracking of Network Topology”, *Ad Hoc Networks*, Vol. 86, pp. 131-143, April 2019.

Conferences

- Tamzidul Mina, Yogang Singh, and Byung-Cheol Min, “A Novel Double Layered Weighted Potential Field Framework for Multi-USV Navigation towards Dynamic Obstacle Avoidance in a Constrained Maritime Environment”, 2019 MTS/IEEE OCEANS, Seattle, WA, USA, October 27-31, 2019.
- Shaocheng Luo, Yogang Singh, Hanyao Yang, Jun Han Bae, J. Eric Dietz, Xiumin Diao, and Byung-Cheol Min, “Image Processing and Model-Based Spill Coverage Path Planning for Unmanned Surface Vehicles”, 2019 MTS/IEEE OCEANS, Seattle, WA, USA, October 27-31, 2019.
- Jun Han Bae, Shaocheng Luo, Shyam Sundar Kannan, Yogang Singh, Bumjoo Lee, Richard M. Voyles, Mauricio Postigo-Malaga, Edgar Gonzales Zenteno, Lizbeth Paredes Aguilar, and Byung-Cheol Min, “Development of an Unmanned Surface Vehicle for Remote Sediment Sampling with a Van Veen Grab Sampler”, 2019 MTS/IEEE OCEANS, Seattle, WA, USA, October 27-31, 2019.
- Wonse Jo, Jee Hwan Park, Yuta Hoashi, and Byung-Cheol Min, “Development of an Unmanned Surface Vehicle for Harmful Algae Removal”, 2019 MTS/IEEE OCEANS, Seattle, WA, USA, October 27-31, 2019.
- Tamzidul Mina, Maliha Hossain, Jee Hwan Park, and Byung-Cheol Min, “Efficient Resource Distribution by Adaptive Inter-agent Spacing in Multi-agent Systems”, 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC), Bari, Italy, 6-9 October, 2019.
- Jee Hwan Park, Tamzidul Mina, and Byung-Cheol Min, “Grid-based Cyclic Robot Allocation for Object Carrying”, 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC), Bari, Italy, 6-9 October, 2019.
- Manoj Penmetcha, Shaocheng Luo, Arabinda Samantaray, J. Eric Dietz, Baijian Yang, and Byung-Cheol Min, “Computer Vision-based Algae Removal Planner for Multi-robot Teams”, 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC), Bari, Italy, 6-9 October, 2019.
- Yuting Chen, Jiansong Zhang, and Byung-Cheol Min, “Applications of BIM and UAV to Construction Safety”, 7th CSCE International Construction Specialty Conference, Laval, QC, Canada, June 12-15, 2019.

Abstracts/Reports

- Wonse Jo, Jee Hwan Park, Sangjun Lee, Ahreum Lee, and Byung-Cheol Min, "Design of a Human Multi-Robot Interaction Medium of Cognitive Perception", 2019 ACM/IEEE International Conference on Human-Robot Interaction - Late Breaking Reports (LBR), Daegu, South Korea, March 11-14, 2019.

Archives

- Manoj Penmetcha, Shyam Sundar Kannan, Byung-Cheol Min, “Smart Cloud: Scalable Cloud Robotic Architecture for Web-powered Multi-Robot Applications”, arXiv preprint, 2019.

Papers Under Review

- Ahreum Lee, Wonse Jo, Shyam Sundar Kannan, and Byung-Cheol Min, “Investigating the Effect of Deictic Movements of a Multi-robot”, *International Journal of Human-Computer Interaction*.

- Tamzidul Mina, Shyam Sundar Kannan, Wonse Jo, and Byung-Cheol Min, “An Adaptive Multi-human Multi-robot System Framework Based on Individual Human and Robot Condition and Performance”, IEEE Robotics and Automation Letters.
- Sangjun Lee and Byung-Cheol Min, “Distributed Switching Consensus Control of Multi-robot Systems in the Presence of Cyberattacks”, 2020 IEEE International Conference on Robotics and Automation (ICRA), Paris, France, May 31-June 4, 2020.
- Shaocheng Luo, Jonghoek Kim, and Byung-Cheol Min, “Asymptotic Boundary Shrink Control with Multi-robot Systems”, IEEE Transactions on Systems, Man, and Cybernetics: Systems. (Under minor revision)
- Ho-Young Jeong, David J. Yu, Byung-Cheol Min, and Seokcheon Lee, “The Humanitarian Flying Warehouse”, Transportation Research Part E: Logistics and Transportation Review. (Under minor revision)
- Jun Han Bae, Wonse Jo, Jee Hwan Park, Richard M. Voyles, Sara K. McMillan and Byung-Cheol Min, “Evaluation of Sampling Methods for Robotic Sediment Sampling Systems”, IEEE Journal of Oceanic Engineering. (Under minor revision)

Poster Presentations (19)

- Jaeun Kim, Wonse Jo, Ahreum Lee, and Byung-Cheol Min, “A Study on the Impact of Audiovisual Feedback in Human-Swarm Interaction”, 2019 Purdue Fall Undergraduate Research Expo, Purdue University, November 2019.
- Walter Kruger, Wonse Jo, Manoj Raj Penmetcha, and Byung-Cheol Min, “Development of an Adaptive Human-Robot Teleoperation Platform”, 2019 Purdue Fall Undergraduate Research Expo, Purdue University, November 2019.
- Yuta Hoashi, Wonse Jo, and Byung-Cheol Min, “Development of Low-Cost, Simplified Humanoid Head”, 2019 Purdue Fall Undergraduate Research Expo, Purdue University, November 2019.
- Wonse Jo, Tamzidul Mina, Jee Hwan Park, Ahreum Lee, and Byung-Cheol Min, “Human-swarm Robot Interaction Platform for STEM Education”, 2019 Next Generation Scholars Event, Purdue University, November 2019.
- Manoj Penmetcha, Wonse Jo, Walter Kruger, and Byung-Cheol Min, “You Cannot Hide Your Emotions from Us!”, 2019 Next Generation Scholars Event, Purdue University, November 2019.
- Wonse Jo, Jee Hwan Park, Yuta Hoashi, and Byung-Cheol Min “Development of environmental cleanup unmanned surface vehicle”, 2019 Center for the Environment (C4E) Mixer, Purdue University, October 2019.
- Yogang Singh, Santiago Guevara Ocana, José Garcia, Brittany Newell, Mauricio Postigo, Sara McMillan, Richard Voyles, Lisbeth Leonor Paredes Aguilar, Godofredo Pena, Edgar Gonzales Zenteno, Byung-Cheol Min, “Smart Water Irrigation for Peruvian Highlands: A Pilot Study”, 2019 Center for the Environment (C4E) Mixer, Purdue University, October 2019.
- Yogang Singh, Jun Han Bae, Shyam Sundar Kannan, Shaocheng Luo, Wonse Jo, Yuta Haoshi, José Garcia, Brittany Newell, Mauricio Postigo, Sara McMillan, Richard Voyles, Lisbeth Leonor Paredes Aguilar, Godofredo Pena, Edgar Gonzales Zenteno, and Byung-Cheol Min, “Design and Development of Unmanned Robotic Water Quality Monitoring and Sediment Sampling Systems”, 2019 Center for the Environment (C4E) Mixer, Purdue University, October 2019.
- Shaocheng Luo, Yogang Singh, Hanyao Yang, Jun Han Bae, J. Eric Dietz, Xiumin Diao, and Byung-Cheol Min, “Coverage Path Planning for Efficient Spill Cleaning in Maritime Environments”, 2019 Center for the Environment (C4E) Mixer, Purdue University, October 2019.
- Santiago Guevara Ocana, Yogang Singh, José Garcia, Brittany Newell, Mauricio Postigo, Sara McMillan, Richard Voyles, Lisbeth Leonor Paredes Aguilar, Godofredo Pena, Edgar Gonzales Zenteno, and Byung-Cheol Min, “Development of a Pilot Smart Water Irrigation System for Peruvian Highlands”, 2019 NEXUS Workshop Poster Presentation, Purdue University, July 2019.
- Jun Han Bae, Yogang Singh, Wonse Jo, Yuta Haoshi, Jose Garcia, Brittany Newell, Mauricio Postigo, Sara McMillan, Richard Voyles, Lisbeth Leonor Paredes Aguilar, Godofredo Pena, Edgar Gonzales Zenteno, and

Byung-Cheol Min, "Robotic Water Quality Monitoring and Sediment Sampling: A Pilot Study", 2019 NEXUS Workshop Poster Presentation, Purdue University, July 2019.

- Jun Han Bae, Yogang Singh, Mauricio Postigo-Malaga, Lizbeth Leonor Paredes Aguilar, Bumjoo Lee, Richard M. Voyles and Byung-Cheol Min, "Design and Development of an Unmanned Underwater Sediment Sampling System", 40th Annual IWRA Spring Symposium, Syracuse, Indiana, June 2019.
- Tamzidul Mina, Byung-Cheol Min, and Galen King, "Self-organization for Energy Sharing and Group Sustainability in Multi-robot Systems", the 26th CIRP Conference on Life Cycle Engineering, Purdue University, May 2019.
- Sangjun Lee and Byung-Cheol Min, "Secure Multi-Robot Systems: Distributed Cyber-Threat Identification using Direction of Arrival of Wireless Signals", 2019 Southern California Robotics Symposium, Caltech, April 2019.
- Santiago Guevara Ocana, Yogang Singh, José Garcia, Brittany Newell, and Byung-Cheol Min, "Development of a Pilot Smart Water Irrigation System for Peruvian Highlands", 2019 Purdue International Scholar Symposium, Purdue University, April 2019.
- Santiago Guevara Ocana, Yogang Singh, José Garcia, Brittany Newell, and Byung-Cheol Min, "Development of a Pilot Smart Water Irrigation System for Peruvian Highlands", 2019 ABE Graduate Industrial Research Symposium, Purdue University, March 2019. **[People's Choice Award]**
- Sangjun Lee and Byung-Cheol Min, "Secure Distributed Consensus Control for Multi-Robot Systems", 2019 CERIAS Poster Session, Purdue University, March 2019.
- Shyam Sundar Kannan, Jun Han Bae, Sangjun Lee, Shaocheng Luo, Manoj Penmetcha, Tamzidul Mina, Wonse Jo, Jee Hwan Park, Yuta Hoashi, Yu-Hsi Wang, Yogang Singh, and Byung-Cheol Min, "Smart Machine and Assistive Robotics Technology (SMART) Laboratory", 2019 Purdue Robotics Accelerator Showcase, Purdue University, February 2019. **[Fan Favorite Poster Award]**
- Hyeonae Jang, Manal Alduraibi, and Byung-Cheol Min, "Communication Application for People with Speech Impairment", the 2019 Health and Disease Poster Session, Purdue University, February 2019.

Invited Talks (1)

- Byung-Cheol Min, "Multi-Robot Systems and Their Applications", Chungbuk National University, Cheongju, South Korea, June 2019.

Faculty Accomplishments & Awards (4)

- Dr. Min received the NSF CAREER Award from the Cyber-Human Systems (CHS) Program to develop Adaptive Human Multi-Robot Systems in February 2019.
- Dr. Min received the 2018-19 Outstanding Graduate Faculty Mentor Award from the Department of Computer and Information Technology, Purdue University in February 2019.
- Dr. Min received the 2018-19 Outstanding Faculty Award in Discovery (Research) from the Department of Computer and Information Technology, Purdue University in February 2019.
- Dr. Min received the 2018-19 Outstanding Faculty Award in Discovery (Research) from Polytechnic Institute, Purdue University in February 2019.

Student Accomplishments & Awards (22)

Fellowships

- Sangjun Lee received an extended NIJ Fellowship in October 2019.

Poster/Paper Awards

- Wonse Jo was selected as a finalist for the 2019 OCEANS Seattle - Student Poster Competition and received a certificate in October 2019.
- Tamzidul Mina was selected as a finalist for the 2019 OCEANS Seattle - Student Poster Competition and received a certificate in October 2019.

- Yuta Hoashi won the Thematic (Innovative Technology, Entrepreneurship, and Design) Award in the 2019 Purdue Undergraduate Research Conference in April 2019.
- Yogang Singh won the People's Choice Poster Presentation Award in the 6th Agricultural and Biological Engineering Symposium (ABE Symposium) at Purdue University in March 2019.
- Shyam Sundar Kannan received Fan Favorite Poster Award in 2019 Purdue Robotics Accelerator Showcase, Purdue University in February 2019.

Travel Grant Awards

- Jun Han Bae received a Purdue Polytechnic Dean's Graduate Student Travel Grant Award in October 2019.
- Jun Han Bae received a Purdue' Computer and Information Technology Graduate Student Travel Grant Award in October 2019.
- Jun Han Bae received a Purdue Polytechnic's Office of Globalization Graduate Student Travel Grant Award in October 2019.
- Manoj Penmetcha received a Purdue Polytechnic Dean's Graduate Student Travel Grant Award in October 2019.
- Manoj Penmetcha received a Purdue' Computer and Information Technology Graduate Student Travel Grant Award in October 2019.
- Manoj Penmetcha received a Purdue Polytechnic's Office of Globalization Graduate Student Travel Grant Award in October 2019.
- Shaocheng Luo received a Purdue Polytechnic Dean's Graduate Student Travel Grant Award in October 2019.
- Shaocheng Luo received a Purdue' Computer and Information Technology Graduate Student Travel Grant Award in October 2019.
- Shaocheng Luo received a Purdue Polytechnic's Office of Globalization Graduate Student Travel Grant Award in October 2019.
- Tamzidul Mina won a Purdue College of Engineering Travel Grant Award in September 2019.
- Tamzidul Mina was selected as a Student Travel Grant Winner for the 2019 SMC conference in August 2019.
- Manoj Penmetcha was selected as a Student Travel Grant Winner for the 2019 SMC conference in August 2019.
- Sangjun Lee received a Purdue Polytechnic Dean's Graduate Student Travel Grant Award in March 2019.
- Sangjun Lee received a Purdue' Computer and Information Technology Graduate Student Travel Grant Award in March 2019.
- Sangjun Lee received a Purdue Polytechnic's Office of Globalization Graduate Student Travel Grant Award in March 2019.
- Sangjun Lee won the Purdue Graduate Student Government (PGSG) Travel Grant Award in February 2019.

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