

SMART LAB BY THE NUMBERS IN 2021



15

LAB MEMBERS



3,132

WEBSITE VISITS



33

LAB MEETINGS



36

LAB SEMINARS



11, \$11.3M

GRANTS PROPOSED



4, \$91K

GRANTS AWARDED



3, \$8.3M

GRANTS PENDING



9, \$3.1M

CURRENT FUNDED PROJECTS



3

JOURNAL PAPERS PUBLISHED



7

CONFERENCE PAPERS PUBLISHED



6

POSTERS & DEMOS PRESENTED



2

ARXIV PAPERS PUBLISHED



6

HONORS/AWARDS



4

MEDIA APPEARANCES

Purdue SMART Lab Highlights 2021

January 2022



Lab Overview

The Smart Machine and Assistive Robotics Technology (SMART) Lab was established by Dr. Byung-Cheol ("B.C.") Min in 2015 to research multi-robot systems, human-robot interaction, and robot design & control, with focus on applications in field robotics and assistive technology and robotics. Since the establishment of the SMART lab in 2015, 4 Postdocs, 5 PhD students, 5 MS students, 9 Undergrad students, 2 Visiting scholars, and 2 Visiting students have completed their research programs. In 2021, 1 Director, 10 PhD students, 1 MS students, 2 Undergrad students, and 1 Visiting student were associated with the lab.

New Equipment

- In 2021, the lab's new highlighted equipment includes Desktop PCs with GPU, wearable sensors, and drones.

Lab Media Appearances

- Wonse Jo, Shyam Kannan, Go-Eum Cha, Su Sun, and Dr. Min's efforts and results in the NASA Space Robotics Challenge Phase 2 Competition were featured in multiple venues including the Purdue Polytechnic's Newsroom – "Polytechnic team among finalists in NASA's Space Robotics Challenge Phase 2", and irobotnews.com.
- Jaeun Kim who won the 1st place at the 2021 Spring Purdue Undergraduate Research, and her mentors Wonse Jo and Dr. Min were featured in the Purdue Polytechnic's Newsroom – "Polytechnic students recognized at spring 2021 undergrad research conference".
- One of our sponsored research was featured in the Purdue Polytechnic's Newsroom – "SMARTBoat 5 unmanned surface vehicle removes harmful algae from waterways".
- A Memorandum of Understanding (MOU) between our lab and MCS Lab at Sungkyunkwan University (SKKU) in South Korea was featured in Korea Lecturer News at lectrenews.com.

Lab Meetings/Seminars

Lab Meetings

- 33 lab group meetings were held in 2021; 16 in-person and 17 virtual meetings. During the 2021 spring semester, the lab had a group meeting every Fridays from 2pm to 4pm via Microsoft Teams. During the 2021 fall semester, the lab had a group meeting every Fridays from 2pm to 4pm in the POTR facility.

Lab Seminars

- 17 paper review seminars were delivered by PhD students and MS students.
- 19 research update presentations were delivered by PhD students, MS students, and Undergrad students.

Lab Members

Current Members (11)

- **Byung-Cheol Min** (Director) was named a 2021 University Faculty Scholar. He received the FY21 Interdisciplinary Research Collaboration Award, and the Purdue's Department of Computer and Information Technology Outstanding Faculty in Discovery Award in 2021. Dr. Min led the Purdue-Hongik Team that placed as a finalist in the NASA Space Robotics Challenge Phase 2.
- **Wonse Jo** (PhD Student) was a RA for Dr. Min. He published 2 journal papers as a co-author and 1 conference paper as a first author, submitted 1 journal paper and 1 conference paper as a co-author, and presented 3 posters and demonstrations; 1 as a first author and 2 as a co-author. He participated in the NASA Space Robotics Challenge Phase 2 Competition where his team was selected as a finalist. He published 2 open source robot platform and ROS package via GitHub. He mentored 1 undergrad student. Wonse served as a lab committee co-chair for the fall semester.

- **Shyam Kannan** (PhD Student) was a RA for Dr. Min in the spring semester, and a GA for the Purdue's Library in the summer and fall semesters. He attempted his proposal defense in May 2021. He published 1 journal paper as a co-author and 3 conference papers; 2 as a first author and 1 as a co-author, submitted 1 journal paper as a co-author and 1 conference paper as a first author, and presented 1 poster as a co-author. He participated in the Indy Autonomous Challenge, and the NASA Space Robotics Challenge Phase 2 Competition where his team was selected as a finalist. Shyam served as a lab committee chair for the spring semester.
- **Su Sun** (PhD Student) was a TA for Dr. Min. She published 1 conference paper as a first author. Su participated in the NASA Space Robotics Challenge Phase 2 Competition where her team was selected as a finalist.
- **Go-Eum Cha** (PhD Student) was a TA for Prof. Laux. She started her PhD study in January 2021. She submitted 1 conference paper as a first author. Go-Eum participated in the NASA Space Robotics Challenge Phase 2 Competition where her team was selected as a finalist.
- **Roman Ibrahimov** (PhD Student) was a TA for Prof. Salem in the spring and fall semesters, and a RA for NASA RETH Institute at Purdue in the summer. He started his PhD study in January 2021. Roman served as a lab committee co-chair for the spring semester.
- **Vishnunandan Venkatesh** (PhD Student) was a TA for Prof. Barlow. He started his PhD study under Dr. Min's supervision in August 2021. Vishnu's research was about learning from demonstration for multi-robot systems.
- **Ruiqi Wang** (PhD Student) started his PhD study in August 2021. His research was about active preference learning for socially aware robot navigation.
- **Jeremy Pan** (MS Student) continued pursuing his MS degree. His research was about machine-learning based adaptive user interface for intuitive robot control. Jeremy served as a lab committee co-chair for the spring semester.
- **Pou Hei (Gavin) Chan** (Undergrad Student) worked as an undergraduate research assistant for the Nexus project. Gavin presented 3 posters as a first author. Gavin served as a lab committee chair for the fall semester.
- **Jong-Beom Jeong** (Visiting Student) joined the lab as a visiting student in August 2021. His research was about video coding for machines.

Lab Alumni (4)

- **Jun Han Bae** (PhD Student) completed his PhD in December 2021 and moved to the University of Illinois Urbana-Champaign (UIUC) to continue his research under Prof. Alireza Talebpour as a postdoctoral researcher. Jun Han published 1 journal paper as a first author and presented 3 posters as a co-author. Jun Han mentored 1 undergrad student. Jun Han was a TA for SoET in the fall semester.
- **Sangjun Lee** (PhD Student) completed his PhD in August 2021. He submitted 1 journal and 1 conference paper as a first author. He was nominated and gave a research presentation at the 2021 ICON Outstanding Student Research Symposium. Sangjun was a RA for Dr. Min.
- **Manoj Penmetcha** (PhD Student) completed his PhD in May 2021 and moved to NCC Limited as an Associate Director. He published 1 journal and 1 conference paper as a first author. He recognized as the Member of the Year for 2020-21 by SMART Lab. Manoj was a GA for the Purdue's Library.
- **Jaeeun Kim** (Undergrad Student) completed her BS in December 2021. She worked as an undergraduate research assistant for the CAREER project. She published 1 conference paper as a co-author and presented 2 posters and demos; 1 as a first author and 1 as a co-author. She published 2 open source robot platform and ROS package via GitHub. Jaeeun won the 1st place at the 2021 Spring Purdue Undergraduate Research.

New Lab Members (4)

- **Roman Ibrahimov** (PhD Student) joined the lab in January 2021 as a PhD student. He obtained his MS degree in Space and Engineering Systems from Skoltech. Roman's research interests include robotics, MAVs, human-drone interaction, and VR.
- **Vishnunandan Venkatesh** (PhD Student) joined the lab in August 2021 as a PhD student. He obtained his MS degree in Electrical Engineering from Rochester Institute of Technology. Before joining the SMART lab,

he worked with Prof. Richard Voyles. Vishnunandan's research interests include robot learning, human-robot interaction, machine vision, and manipulation.

- **Ruiqi Wang** (PhD Student) joined the lab in August 2021 as a direct PhD student. He obtained his BS degree in Robotics Engineering from Beijing University of Chemical Technology. Ruiqi's research interests include human-robot interaction, multi-agent system and robot learning, with focus on applications to service and assistive robots in real world.
- **Jong-Beom Jeong** (Visiting Student) joined the lab in August 2021. He is a PhD student at Sungkyunkwan University (SKKU) in South Korea. His research interests include video coding standards, virtual reality, MPEG immersive video, and video coding for machines.

Faculty Accomplishments & Awards (3)

- Dr. Min was named a 2021 University Faculty Scholar in honor of his outstanding research and scholarship, May 2021.
- Dr. Min received the FY21 Interdisciplinary Research Collaboration Award to honor his interdisciplinary and transdisciplinary work, May 2021.
- Dr. Min received the Outstanding Faculty Award in Discovery (Research) from the Department of Computer and Information Technology, February 2021.

Student Accomplishments & Awards (3)

Competitions

- Wonse Jo, Shyam Kannan, Go-Eum Cha, Su Sun, and Dr. Min, teamed up with Prof. Jongheok Kim's group at Hongik University in South Korea, and the team was selected as a finalist for the NASA Space Robotics Challenge Phase 2, January 2021.

Poster/Paper Awards

- Jaeun Kim was awarded the 1st place at the 2021 Spring Purdue Undergraduate Research Conference, in the category of Research Talks in Purdue Polytechnic Institute, May 2021.
- Sangjun Lee was nominated and gave a research presentation at the 2021 ICON Outstanding Student Research Symposium, titled "Attack Resilient Vehicle Platooning: Distributed Nonlinear Model Predictive Control Approach", May 2021.

Grant Proposals (11 submitted, 4 awarded, 3 pending, 5 declined)

Submitted (11, \$11.3M)

- Polytechnic Post-Doc Support Competition Award (Continued), Role: Co-PI (PI: Sunghwan Lee), Sponsor: Purdue Polytechnic Institute, Amount: \$50,000 (01/01/2022 – 12/31/2022).
- 2021-22 COVID-19 Research Disruption Fund, Role: PI, Sponsor: Purdue University, Amount: \$25,000 (10/05/2021 - 04/30/2022).
- Detecting Humans' Adaptive Behavior Using Deep Learning Application to Provide Active Thermal Comfort Controls in Occupancy Spaces, Role: Co-PI (PI: Kyubung Kang), Sponsor: Purdue Polytechnic Institute, Amount: \$8,000 (09/01/2021 - 06/30/2022).
- A Visual-based Force Feedback Interface for Human-robot Systems using Compliant Mechanism Design, Role: Senior Advisor (PI: Milton Aguirre), Sponsor: Purdue Polytechnic Institute, Amount: \$8,000 (09/01/2021 – 06/30/2022).
- Standard Research: Counterinterventions in Robot Assisted Therapy, Role: Co-PI (PI: Anna M. Williams), Sponsor: National Science Foundation, Amount: \$401,320 (01/01/2022 – 12/31/2023).
- A Cooperative and Proactive Situational-Awareness and Response System for In-time Adaptive Aviation Safety Management, Role: Co-PI (PI: Jin Kocsis), Sponsor: National Aeronautics and Space Administration, Amount: \$5,845,124 (02/01/2022 – 01/31/2025).
- RefleXAI: Explainable Reflexive Control, Role: Co-PI (PI: Shaoshuai Mou), Sponsor: Saab North America Inc, Amount: \$2,100,000 (03/01/2022 – 02/28/2026).

- Congestion Aware Multi-robot Navigation, Role: Co-PI (PI: Seokcheon Lee), National Science Foundation, Amount: \$501,727 (08/01/2021 – 07/31/2024).
- NRI: Short-Term Human-Robot Interaction with Adaptive Intention Expression in Public Environments, Role: PI, Sponsor: National Science Foundation, Amount: \$861,076 (01/01/2022 – 12/31/2025).
- Deep Reinforcement Learning for Damage Tolerance in Multi-robot Systems, Role: PI, Sponsor: Defense Advanced Res Projects Agency, Amount: \$742,953 (07/01/2021 – 06/30/2024).
- Advancing Student Cognition in STEM through a Hybrid AI-Powered Virtual/Physical Educational Robotic System, Role: Co-PI (PI: Jin Kocsis), Sponsor: National Science Foundation, Amount: \$850,000 (08/01/2021 – 07/31/2024).

Awarded (4, \$91K)

- Polytechnic Post-Doc Support Competition Award (Continued), Role: Co-PI (PI: Sunghwan Lee), Sponsor: Purdue Polytechnic Institute, Amount: \$50,000 (01/01/2022 – 12/31/2022).
- 2021-22 COVID-19 Research Disruption Fund, Role: PI, Sponsor: Purdue University, Amount: \$25,000 (10/05/2021 - 04/30/2022).
- Detecting Humans' Adaptive Behavior Using Deep Learning Application to Provide Active Thermal Comfort Controls in Occupancy Spaces, Role: Co-PI (PI: Kyubung Kang), Sponsor: Purdue Polytechnic Institute, Amount: \$8,000 (09/01/2021 - 06/30/2022).
- A Visual-based Force Feedback Interface for Human-robot Systems using Compliant Mechanism Design, Role: Senior Advisor (PI: Milton Aguirre), Sponsor: Purdue Polytechnic Institute, Amount: \$8,000 (09/01/2021 – 06/30/2022).

Pending (3, \$8.3M)

- Standard Research: Counterinterventions in Robot Assisted Therapy, Role: Co-PI (PI: Anna M. Williams), Sponsor: National Science Foundation, Amount: \$401,320 (01/01/2022 – 12/31/2023).
- A Cooperative and Proactive Situational-Awareness and Response System for In-time Adaptive Aviation Safety Management, Role: Co-PI (PI: Jin Kocsis), Sponsor: National Aeronautics and Space Administration, Amount: \$5,845,124 (02/01/2022 – 01/31/2025).
- RefleXAI: Explainable Reflexive Control, Role: Co-PI (PI: Shaoshuai Mou), Sponsor: Saab North America Inc, Amount: \$2,100,000 (03/01/2022 – 02/28/2026).

Declined (9, \$4.8M)

- Congestion Aware Multi-robot Navigation, Role: Co-PI (PI: Seokcheon Lee), National Science Foundation, Amount: \$501,727 (08/01/2021 – 07/31/2024).
- NRI: Short-Term Human-Robot Interaction with Adaptive Intention Expression in Public Environments, Role: PI, Sponsor: National Science Foundation, Amount: \$861,076 (01/01/2022 – 12/31/2025).
- Deep Reinforcement Learning for Damage Tolerance in Multi-robot Systems, Role: PI, Sponsor: Defense Advanced Res Projects Agency, Amount: \$742,953 (07/01/2021 – 06/30/2024).
- Advancing Student Cognition in STEM through a Hybrid AI-Powered Virtual/Physical Educational Robotic System, Role: Co-PI (PI: Jin Kocsis), Sponsor: National Science Foundation, Amount: \$850,000 (08/01/2021 – 07/31/2024).
- Empowering Delivery Robots with an Intelligent Delivery Spot Localization System, Role: PI, Sponsor: Sony, Amount: \$100,000 (05/01/2021 – 04/30/2022).
- Empowering Delivery Robots with a Human Courier Model, Role: PI, Sponsor: Amazon, Amount: \$82,000 (07/01/2021 – 06/30/2022).
- A Decentralized and Secure Situational-Awareness Architecture for Cooperative Unmanned Surface Vehicles, Role: Co-PI (PI: Jin Kocsis), Sponsor: Office of Naval Research, Amount: \$430,653 (03/01/2021 – 02/28/2024).
- Smart Campus Navigation System for Blind or Visually Impaired People, Role: PI, Sponsor: Google, Amount: \$60,000 (07/01/2021 – 06/30/2022).
- AI Institute: Institute for eXplainable Fuzzy AI (XF-AI) , Role: Co-PI (PI: Julia Rayz), Sponsor: University of Cincinnati, Amount: \$1,227,440 (07/01/2021 – 06/30/2026).

Current Funded Research Projects (9, \$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 – 08/31/2022).
- 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 – 08/31/2022).
- 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 – 02/15/2022).
- 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 – 08/31/2022).
- Polytechnic Post-Doc Support Competition Award, Role: Co-PI (PI: Sunghwan Lee), Sponsor: Purdue University, Amount: \$100,000 (7/01/2020 – 12/31/2022).
- 2021-22 COVID-19 Research Disruption Fund, Role: PI, Sponsor: Purdue University, Amount: \$25,000 (10/05/2021 - 04/30/2021).
- Detecting Humans' Adaptive Behavior Using Deep Learning Application to Provide Active Thermal Comfort Controls in Occupancy Spaces, Role: Co-PI (PI: Kyubung Kang), Sponsor: Purdue Polytechnic Institute, Amount: \$8,000 (09/01/2021 - 06/30/2022).
- A Visual-based Force Feedback Interface for Human-robot Systems using Compliant Mechanism Design, Role: Senior Advisor (PI: Milton Aguirre), Sponsor: Purdue Polytechnic Institute, Amount: \$8,000 (09/01/2021 – 06/30/2022).

Publications (3 journals, 7 conferences, 2 archives, 5 paper under review, 4 papers rejected)*Journals*

- Manoj Penmetcha and Byung-Cheol Min, “A Deep Reinforcement Learning-based Dynamic Computational Offloading Method for Cloud Robotics”, IEEE Access, Vol. 9, pp. 60265-60279, 2021.
- 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, Vol. 46, No. 2, pp. 542-554, April 2021.
- 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, Vol 37, No. 3, pp. 197-210, 2021.

Conferences

- Upinder Kaur, Haozhe Zhou, Xiixin Shen, Byung-Cheol Min, and Richard M. Voyles, “RoboMal: Malware Detection for Robot Network Systems”, 2021 IEEE Robotic Computing (IRC), Taichung, Taiwan, November 15-17, 2021.
- Shyam Sundar Kannan and Byung-Cheol Min, “Investigation on Accepted Package Delivery Location: A User Study-based Approach”, 2021 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Virtual, Melbourne, Australia, 17-20 October, 2021.
- Manoj Penmetcha, Shyam Sundar Kannan, and Byung-Cheol Min, “A Predictive Application Offloading Algorithm using Small Datasets for Cloud Robotics”, 2021 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Virtual, Melbourne, Australia, 17-20 October, 2021.
- Wonse Jo, Robert Wilson, Jaeun Kim, Steve McGuire, and Byung-Cheol Min, “Toward a Wearable Biosensor Ecosystem on ROS 2 for Real-time Human-Robot Interaction Systems”, 2021 IEEE/RISJ International Conference on Intelligent Robots and Systems (IROS), Workshop on HMRS 2021: Cognitive and Social Aspects of Human Multi-Robot Interaction, Prague, Czech Republic, Sep 27 – Oct 1, 2021.

- Su Sun and Byung-Cheol Min, “Active Tapping via Gaussian Process for Efficient Unknown Object Surface Reconstruction”, 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Workshop on RoboTac 2021: New Advances in Tactile Sensation, Interactive Perception, Control, and Learning. A Soft Robotic Perspective on Grasp, Manipulation, & HRI, Prague, Czech Republic, Sep 27 – Oct 1, 2021.
- Dongming Gan, Jiaming Fu, Mo Rastgaar, Byung-Cheol Min, and Richard M. Voyles, “Actuation-Coordinated Mobile Parallel Robots with Hybrid Mobile and Manipulation Function”, ASME 2021 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC-CIE 2021), Virtual, 17–20 August, 2021.
- Shyam Sundar Kannan, Ahreum Lee, and Byung-Cheol Min, “External Human-Machine Interface on Delivery Robots: Expression of Navigation Intent of the Robot”, 2021 30th IEEE International Conference on Robot & Human Interactive Communication (RO-MAN), Virtual, Vancouver, Canada, 8-12 August, 2021.

Archives

- Shyam Sundar Kannan and Byung-Cheol Min, “Door Delivery of Packages using Drones”, arXiv preprint, 2021.
- Sangjun Lee and Byung-Cheol Min, “Distributed Control of Multi-Robot Systems in the Presence of Deception and Denial of Service Attacks”, arXiv preprint, 2021.

Papers Under Review

- Upinder Kaur, Arunashish Datta, Haozhe Zhou, Xiixin Shen, Shreyas Sen, Byung-Cheol Min, and Richard Voyles, “Title is not displayed here due to the double blind submission policy”, ACM/IEEE 13th International Conference on Cyber-Physical Systems (ICCPS 2022), Milan, Italy, May 4-6, 2022.
- Dongming Gan, Jiaming Fu, Han Lin, Haoguang Yang, Mo Rastgaar, Byung-Cheol Min, Richard Voyles, “Actuation-Coordinated Mobile Parallel Robots with Hybrid Mobile and Manipulation Function”, Transactions of the ASME, Journal of Mechanisms and Robotics.
- Oscar Wong Chong, Jiansong Zhang, Richard M. Voyles, and Byung-Cheol Min, “A BIM-based Approach to Simulate Construction Robotics in the Assembly Process of Wood Frames to Support Offsite Construction Automation”, Automation in Construction.
- Sangjun Lee and Byung-Cheol Min, “Secure Control Strategies of Multi-Robot Systems: Deception and Denial-of-Service Attack Cases”, Journal of Intelligent and Robotic Systems.
- Tamzidul Mina, Shyam Sundar Kannan, Wonse Jo, Shaocheng Luo, Galen B. King, and Byung-Cheol Min, “Distributed Multi-robot Arbitrary Object Transportation with Pushing Surface Identification and Model-based Pushing Effort Regulation”, IEEE Transactions on Systems, Man and Cybernetics: Systems.

Papers Rejected

- Shyam Sundar Kannan and Byung-Cheol Min, “Door Delivery of Packages using Drones”, 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Prague, Czech Republic, Sep 27 – Oct 1, 2021.
- Su Sun, Wonse Jo, and Byung-Cheol Min, “Active Tapping via Gaussian Process for Efficient Unknown Object Surface Reconstruction”, 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Prague, Czech Republic, Sep 27 – Oct 1, 2021.
- Go-Eum Cha and Byung-Cheol Min, “Correlation between Unconscious Mouse Actions and Human Cognitive Workload” 2021 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Virtual, Melbourne, Australia, 17-20 October, 2021.
- Sangjun Lee and Byung-Cheol Min, “Distributed Control of Multi-Robot Systems in the Presence of Deception and Denial of Service Attacks”, 2021 IEEE International Conference on Robotics and Automation (ICRA), Xi’an, China, May 30 – June 5, 2021.

Poster & Demo Presentations (6)

- Pou hei Chan, Jun Han Bae, Yongho Kim, Richard M. Voyles, Sara K. McMillan, Jose Garcia, Brittany Newell, Edgard Gonzales Zenteno, Lizbeth Paredes Aguilar, Mauricio Postigo-Malaga, and Byung-Cheol

Min, “Unmanned Sediment Sampling System for Surface Water Sediment Collection”, 2021 Purdue Fall Undergraduate Research Expo, Purdue University, November 2021.

- Pou hei Chan, Jun Han Bae, Yongho Kim, Richard M. Voyles, Sara K. McMillan, Jose Garcia, Brittany Newell, Edgard Gonzales Zenteno, Lizbeth Paredes Aguilar, Mauricio Postigo-Malaga, and Byung-Cheol Min, “Unmanned Sediment Sampling System for Surface Water Sediment Collection”, 2021 Fall Environmental Research Expo, Purdue University, October 2021.
- Richard Voyles, Brittany Newell, Robert Nawrocki, Byung-Cheol Min, Jose Garcia, Daniel Leon-Salas, Babak Ziaie, Shreyas Sundaram, Shreyas Sen, George Chiu, Rahim Rahimi, Dennis Buckmaster, Shawn Donkin, Al Heber, Tim Gavin, Tim Filley, and Yexiang Xue, “Cyber-Animal Systems”, 2021 Fall Environmental Research Expo, Purdue University, October 2021.
- Wonse Jo, Jaeun Kim, and Byung-Cheol Min, “ROS2 Open-Source Swarm Robot Platform: SMARTmBot”, 2021 International Conference on Robotics and Automation (ICRA), Workshop on Robot Swarms in the Real World: From Design to Deployment - Live Demonstration, Xi'an, China, May 30 - June 5, 2021.
- Jaeun Kim, Wonse Jo, and Byung-Cheol Min, “Development of an Open-source Mobile Robot Platform for Multi-robot systems,” The 2021 Purdue Spring Undergraduate Research Expo, Purdue University, West Lafayette, IN, USA, April 2021.
- Pou hei Chan, Jun Han Bae, Wonse Jo, Shyam Sundar Kannan, Mauricio Postigo-Malaga, and Byung-Cheol Min, “Unmanned Core Sampling System for Surface Water Sediment Collection”, 2021 Spring Purdue Undergraduate Research Conference, Purdue University, April 2021.

GitHub Repositories (2)

- Wonse Jo, Robert Wilson, Jaeun Kim, Steve McGuire, and Byung-Cheol Min, “ROS2 Foxy Wearable Biosensors”, GitHub, September 2021.
- Wonse Jo, Jaeun Kim, and Byung-Cheol Min, “SMARTmBOT”, GitHub, June 2021.

Invited Talks (3)

- Byung-Cheol Min, “Robotic Sediment Sampling System for Surface Water Sediment Collection”, Nexus Webinar Series, November 2021.
- Byung-Cheol Min, “Robot Design, Planning, and Control for Environmental Applications”, International Conference on IT-Bio Convergence, August 2021.
- Byung-Cheol Min, ““Robotics as an Example of Sociotechnical /Interdisciplinary Research”, Purdue Polytechnic Institute Research Mentoring Lunch, January 2021.

Outreaches (2)

- Wonse Jo, Roman Ibrahimov, Jun Han Bae, and Dr. Min gave a lab tour and robot demonstrations to the delegation from the Universidad Nacional de San Agustín (UNSA) of Arequipa in Peru, October 2021.
- Wonse Jo, Jaeun Kim, and Dr. Min conducted an outreach event for K-12 students at the Purdue Polytechnic High School (PPHS) North Campus as part of the NSF CAREER project, October 2021.

Lab Social Media

YouTube Channel (14 new videos published, 4589 views, 49 new subscribers)

- “Multi-robot Control by Hand Gestures”, November 2021.
- “IROS Workshop: HMRS 2021 Presentation - Wearable Biosensor Ecosystem on ROS 2 for Real-time HRI”, September 2021.
- “A Predictive Application Offloading Algorithm using Small Datasets for Cloud Robotics”, August 2021.
- “Purdue SMART (Smart Machine and Assistive Robotics Technology) Lab Overview”, August 2021.
- “RO-MAN 2021 Presentation - External Human-Machine Interface on Delivery Robots”, August 2021.
- “External Human-Machine Interface on Delivery Robots - Supplementary video”, August 2021.

- “ROS2 Open-source Swarm Robot Platform: SMARTmBot - Video Demonstration”, June 2021.
- “Purdue SMART Lab Virtual Tour Video - POTR 141”, May 2021.
- “PhD Dissertation Defense: Secure Multi-Robot Systems -- Sangjun Lee”, May 2021.
- “A Deep Reinforcement Learning-based Dynamic Computational Offloading Method for Cloud Robotics”, April 2021.
- “Purdue SMART Lab Virtual Lab Tour Video - HEAV 101”, April 2021.
- “PhD Dissertation Defense: Application Offloading schemas for Cloud Robotics -- Manoj Penmetcha”, April 2021.
- “Door Delivery of Packages using Drones - Supplementary Video”, April 2021.
- “IROS 2020 Presentation - Material Mapping in Unknown Environments using Tapping Sound”, February 2021.

Facebook Page

- 38 new posts published.
- 745 page views and 439 post positive (like/love/wow) reactions.

Visit us at <http://www.smart-laboratory.org>