MIHIR VINAY KULKARNI

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EDUCATION

Ph.D. Engineering Cybernetics *January 2022 - Present*
Norwegian University of Science and Technology *Expected Graduation: May 2025*
Department of Engineering Cybernetics

M.S. Computer Science and Engineering August 2020 - December 2021
University of Nevada, Reno
Department of Computer Science and Engineering
(Cumulative GPA: 3.875/4.0)

B.E. Mechanical Engineering August 2016 - July 2020
Birla Institute of Technology and Science, Pilani (Goa Campus)
Department of Mechanical Engineering
(Cumulative GPA: 8.66/10)

JOURNAL PUBLICATION

- Marco Tranzatto, Mihir Dharmadhikari, Lukas Bernreiter, Marco Camurri, Shehryar Khattak, Frank Mascarich, Patrick Pfreundschuh, David Wisth, Samuel Zimmermann, **Mihir Kulkarni**, Victor Reijgwart, Benoit Casseau, Timon Homberger, Paolo De Petris, Lionel Ott, Wayne Tubby, Gabriel Waibel, Huan Nguyen, Cesar Cadena, Russell Buchanan, Lorenz Wellhausen, Nikhil Khedekar, Olov Andersson, Lintong Zhang, Takahiro Miki, Tung Dang, Matias Mattamala, Markus Montenegro, Konrad Meyer, Xiangyu Wu, Adrien Briod, Mark Mueller, Maurice Fallon, Roland Siegwart, Marco Hutter, Kostas Alexis, **"Team CERBERUS Wins the DARPA Subterranean Challenge: Technical Overview and Lessons Learned"**, Field Robotics. Available at `https://doi.org/10.48550/arXiv.2207.04914`.

- Marco Tranzatto, Takahiro Miki, Mihir Dharmadhikari, Lukas Bernreiter, **Mihir Kulkarni**, Frank Mascarich, Olov Andersson, Shehryar Khattak, Marco Hutter, Roland Siegwart, Kostas Alexis, **"CERBERUS in the DARPA Subterranean Challenge"** Science Robotics. Available at `https://www.science.org/doi/abs/10.1126/scirobotics.abp9742`.

- Frank Mascarich, **Mihir Kulkarni**, Paolo de Petris, Taylor Wilson, Kostas Alexis, **"Autonomous Mapping and Spectroscopic Analysis of Distributed Radiation Fields using Aerial Robots"**, Autonomous Robots. Available at `https://doi.org/10.1007/s10514-022-10064-7`.

- M. Tranzatto, F. Mascarich, L. Bernreiter, C. Godinho, M. Camurri, S. Khattak, T. Dang, V. Reijgwart, J. Loje, D. Wisth, S. Zimmermann, H. Nguyen, M. Fehr, L. Solanka, R. Buchanan, M. Bjelonic, N. Khedekar, M. Valceschini, F. Jenelten, M. Dharmadhikari, T. Homberger, P. De Petris, L. Wellhausen, **M. Kulkarni**, T. Miki, S. Hirsch, M. Montenegro, C. Papachristos, F. Tresoldi, J. Carius, G. Valsecchi, J. Lee, K. Meyer, X. Wu, J. Nieto, A. Smith, M. Hutter, R. Siegwart, M. Mueller, Ma. Fallon, K. Alexis, **"CERBERUS: Autonomous Legged and Aerial Robotic Exploration in the Tunnel and Urban Circuits of the DARPA Subterranean Challenge"**, Field Robotics. Available at `https://doi.org/10.55417/fr.2022011`.

CONFERENCE PUBLICATIONS

- Dharmadhikari, Mihir, Paolo De Petris, **Mihir Kulkarni**, Nikhil Khedekar, Huan Nguyen, Arnt Erik Stene, Eivind Sjøvold, Kristian Solheim, Bente Gussiaas, and Kostas Alexis. **"Autonomous Exploration and General Visual Inspection of Ship Ballast Water Tanks using Aerial**

Robots.", IEEE International Conference on Advanced Robotics (ICAR) 2023. ***Winner - Best Paper Award***. Available at https://doi.org/10.48550/arXiv.2311.03838.

- **Mihir Kulkarni** and Kostas Alexis, **"Reinforcement Learning for Collision-free Flight Exploiting Deep Collision Encoding"**. (Under Review).
- **Mihir Kulkarni** and Kostas Alexis, **"Task-driven Compression for Collision Encoding based on Depth Images"**. International Symposium on Visual Computing (ISVC) 2023. Available at https://doi.org/10.48550/arXiv.2309.05289.
- **Mihir Kulkarni**, Huan Nguyen, and Kostas Alexis. **"Semantically-enhanced Deep Collision Prediction for Autonomous Navigation using Aerial Robots"**. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2023. Available at https://doi.org/10.48550/arXiv.2307.11522.
- M. Dharmadhikari, P. De Petris, H. Nguyen, **M. Kulkarni**, N. Khedekar and K. Alexis, **"Manhole Detection and Traversal for Exploration of Ballast Water Tanks using Micro Aerial Vehicles"**, International Conference on Unmanned Aircraft Systems (ICUAS) 2023, Available at https://doi.org/10.1109/ICUAS57906.2023.10156214.
- Nikhil Khedekar, **Mihir Kulkarni**, Kostas Alexis, **"MIMOSA: A Multi-Modal SLAM Framework for Resilient Autonomy against Sensor Degradation"**, IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2022.
- De Petris, Paolo, Huan Nguyen, Mihir Dharmadhikari, **Mihir Kulkarni**, Nikhil Khedekar, Frank Mascarich, and Kostas Alexis. **"RMF-Owl: A Collision-Tolerant Flying Robot for Autonomous Subterranean Exploration."**, International Conference on Unmanned Aircraft Systems (ICUAS) 2022. Available at https://arxiv.org/pdf/2202.11055.pdf.
- **Mihir Kulkarni**, Mihir Dharmadhikari, Marco Tranzatto, Samuel Zimmermann, Victor Reijgwart, Paolo De Petris, Huan Nguyen, Nikhil Khedekar, Christos Papachristos, Lionel Ott, Roland Siegwart, Marco Hutter, and Kostas Alexis, **"Autonomous Teamed Exploration of Subterranean Environments using Legged and Aerial Robots"**, IEEE International Conference on Robotics and Automation (ICRA) 2022. Available at https://doi.org/10.1109/ICRA46639.2022.9812401. ***Winner - Outstanding Deployed Systems Paper Award***.
- P. D. Petris, H. Nguyen, **M. Kulkarni**, F. Mascarich and K. Alexis, **"Resilient Collision-tolerant Navigation in Confined Environments"**, 2021 IEEE International Conference on Robotics and Automation (ICRA), 2021. Available at https://doi.org/10.1109/ICRA48506.2021.9561999.
- **Kulkarni, M.**, Nguyen, H., and Alexis, K. (2020). **"The Reconfigurable Aerial Robotic Chain: Shape and Motion Planning"**. IFAC World Congress, 2020. Available at https://doi.org/10.1016/j.ifacol.2020.12.2383.

BOOK CHAPTERS

- **Mihir Kulkarni**, Brady Moon, Sebastian Scherer, Kostas Alexis, **"Aerial Field Robotics"**, Encyclopedia of Robotics. Available at https://doi.org/10.1007/978-3-642-41610-1_221-1.

AWARDS AND ACHIEVEMENTS

- Best Paper Award — IEEE ICAR 2023
- Outstanding Deployed Systems Paper Award — IEEE ICRA 2022
- Certificate of Special Recognition — United States Senate (2021)
- Winner - Prize Round — DARPA Subterranean Challenge (2021)

OPEN SOURCE CONTRIBUTIONS

- Aerial Gym Simulator - massively parallelized aerial robot simulator based on NVIDIA Isaac Gym.
- Graph-based Exploration Path Planner - exploration planner for aerial and ground robots used in the DARPA Subterranean Challenge. `https://github.com/ntnu-arl/gbplanner_ros`
- GSOC 2020: Sensor Data Visualisation - Open Robotics. `https://community.gazebosim.org/t/gsoc-2020-sensor-data-visualization/638`
- Simulation Models - Team CERBERUS Aerial Robots. DARPA Subterranean Challenge Simulator. `https://github.com/osrf/subt/tree/final_event/submitted_models`
- SuperMegaBot Simulator - Team CERBERUS Roving Robot `https://github.com/ntnu-arl/smb_simulator`

INTERNSHIPS AND EXPERIENCE

Google Summer of Code 2020, OpenRobotics. *May 2020 - September 2020*
Visiting Scholar, Autonomous Robots Lab, University of Nevada, Reno. *June 2019 - January 2020*
Summer Research Intern, CSIR-CEERI Pilani, India. *May 2018 - July 2018*

TECHNICAL SKILLS

Programming Languages - C, C++, Python, MATLAB
Mechanical Design - SOLIDWORKS, PTC Creo, Autodesk Fusion 360
Proficient in ROS, ROS 2, Gazebo Classic and (Ignition) Gazebo
Experienced in mechanical design, hardware and sensor integration for high-performance multirotor and wheeled platforms.

PRINT AND DIGITAL MEDIA PRESENCE

- Multiple features in IEEE Spectrum - Video Friday
  - Reinforcement Learning for Collision-free Flight Exploiting Deep Collision Encoding. `https://www.youtube.com/watch?v=gPrT21sbpTY`
  - Autonomous Teamed Exploration of Subterranean Environments using Legged and Aerial Robots. `https://spectrum.ieee.org/video-friday-perseverance-autonomy`
  - Semantically-enahnced Deep Collision Prediction for Autonomous Navigation using Aerial Robots. `https://spectrum.ieee.org/video-friday-resilient-bugbots`.
- Featured in The Washington Post Magazine "The Pentagon's $82 Million Super Bowl of Robots" `https://www.washingtonpost.com/magazine/2021/11/10/darpa-robot-competition/`.
- Featured in Teknisk Ukeblad article "Seier for NTNU-basert robotmiljø: Bedre enn både Nasa og MIT" `https://www.tu.no/artikler/seier-for-ntnu-basert-robotmiljo-bedre-enn-bade-nasa-og-mit/513808`.
- GazeboSim Community: GSOC 2020: Sensor Data Visualisation `https://community.gazebosim.org/t/gsoc-2020-sensor-data-visualization/638`.
- BITS R&D Post: Thesis at The University of Nevada, Reno `https://bitsrnd.wordpress.com/2020/04/21/mihir-kulkarnis-thesis-at-university-of-nevada-reno/`.

KEY PROJECTS

Team CERBERUS - DARPA Subterranean Challenge - Winning Team
I am a part of Team CERBERUS, participating in the DARPA Subterranean Challenge. The challenge focuses on performing search and rescue missions using autonomous robots in underground settings, in GPS-denied, degraded environment and sensing conditions. I worked on our team's ground robot, equipped with multiple LIDAR sensors, thermal cameras, depth and colour cameras and multiple network interfaces. I worked on the motion planning and controls of the skid-steer drive robot and further designed a robust sensor head to accommodate all the above sensors on the robot. I have also worked on the artifact detection pipeline for the team that included the training and deploying the inference pipeline of the team's object detector using YOLO-v3. Team CERBERUS won the first position during the Final Event of the DARPA Subterreanean Challenge. Please see following links for more information - **Team Website**.

Hyperloop India - SpaceX Hyperloop Pod Competition 2019
Team Lead for the Electronics Team in Hyperloop India. Worked on the electronic subsystem for the hyperloop pod, system design, selection and interfacing of electronics components. Coordinated with the mechanical design team for integration. Gained major learning during The SpaceX - Hyperloop Pod competition.

JOURNALS AND CONFERENCES REFEREED

Journals: IEEE Transactions on Robotics, IEEE Robotics and Automation Letters
Conferences: IEEE ICRA, IEEE/RSJ IROS

POSITIONS OF RESPONSIBILITY

Chief Coordinator, Aerodynamics Club, BITS Pilani *March 2018 - May 2019*
Sub-Coordinator, Electronics and Robotics Club, BITS Pilani *April 2018 - May 2019*
Electronics Team Lead, Hyperloop India *March 2018 - January 2019*

TEACHING AND RESEARCH EXPERIENCE

Graduate Research Assistant - Department of CSE, UNR *Jan 2021 - Dec 2021*
Teaching Assistant - Computer Programming (Department of CSE, BITS Pilani) *Jan 2020 - May 2020*
Instructor - Intermediate Robotics (Center for Technical Education, BITS Pilani) *Jan 2019 - May 2019*
Instructor - Introduction to Robotics (Center for Technical Education, BITS Pilani) *Aug 2018 - Dec 2018*