Anthony Beca

Toronto, Ontario | anthony.beca@queensu.ca | linkedin.com/in/anthonybeca | github.com/becaant

Research Interests

- Systems engineering of mobile robotic systems, particular interest in control/localization/planning of WMRs in complicated environments (prior experience in mining automation, and autonomous vehicles)
- Specialized experience:
  - Path following control of redundant WMR (kinematics, feedback linearization, PD/MPC/NMPC)
  - Full stack system design and integration of an autonomous vehicle
  - Realtime multi LiDAR-Camera fusion (incl. custom algorithm, integration, drivers, mount design, etc.)
  - Experience with ROS2, Python, Git, Linux, LaTeX, QGIS, CAN, Arduino/C++, CAD, and more

Education

Queen's University, BASc in Mechatronics and Robotics Engineering — Sept 2021 – May 2025

- **3rd year GPA:** 4.0/4.3, **Cumulative GPA:** 3.77/4.3
- **Coursework:** ELEC446 Mobile Robotics, MTHE430/MATH830 Control Theory, MREN318 Sensors & Actuators

Honours and Achievements

- **NSERC USRA** ($6,000) with Dr. Joshua Marshall; Offroad Robotics/Ingenuity Labs Research Institute
- Awarded **Dean's Scholar (3x)** for academic excellence
- Awarded **Principal's Admission Scholarship** ($4,000)

Publications and Major Reports

Academic

- **Beca, A., Marshall, J. A.**, "Feedback Linearized Path Following Control of Motor Graders." Manuscript in Preparation, Offroad Robotics — Present
- **Beca, A., Marshall, J. A.** "2D Path Following Control of Motor Graders." Abstract published in Inquiry@Queen's Undergraduate Research Conference Proceedings, September 9, 2024, Kingston, Ontario, https://doi.org/10.24908/iqurcp18056. — September 2024

Competitions

- Concept Design Report (90/100), AutoDrive Challenge II Year 3 — May 2024
- Project Leadership Report (4th of 10), AutoDrive Challenge II Year 3 — May 2024
- MREN303: Mechatronics Design III Final Prototype Report (A+) — April 2024

Presentations

- Towards Autonomous Path Following for Motor Graders, presented for Robotics Cluster at Ingenuity Labs Research Institute — August 2024
- Path Following Control of Motor Graders, presented for MacLean Engineering — July 2024
- Concept Design Event (87/100), AutoDrive Challenge II Year 3 — June 2024
- Project Leadership Event (4th of 10), AutoDrive Challenge II Year 3 — June 2024
- Design Reviews (I, II, III), Queen's AutoDrive Year 3 — October 2023 - March 2024
- MREN318: Sensors and Actuators Final Project Demonstration (A) — March 2024
- Mobility Innovation 0-0-0 Challenge (4th of 10), AutoDrive Challenge II Year 3 — February 2024
- Concept Design Event, AutoDrive Challenge II Year 2 — June 2023

Conferences and Seminars Attended

- Canadian Conference on Electrical and Computer Engineering, Kingston, Ontario — August 2024
- Robotics and AI Symposium (RAIS), Ingenuity Labs, Kingston, Ontario — August 2024
- AutoDrive Challenge Series II Workshops (4x), Ann Arbor Michigan — October 2023 - May 2024
- "Let It Snow! Teaching Self-Driving Cars to Handle Adverse Weather and Know Their Perception Limitations." Guest lecture by Dr. Steven Waslander, hosted by Queen's School of Computing, Kingston, Ontario — May 2023

Professional Experience

Undergraduate Researcher, Offroad Robotics, Kingston, ON — May 2024 - August 2024
- NSERC USRA under supervision of Dr. Joshua Marshall, Offroad Robotics @ Ingenuity Labs Research Institute
- Derived vehicle kinematics and feedback linearization scheme for an overactuated WMR
- Proposed two control methodologies to manage redundancy: Rear Offset Control, and Single Track Control
- Implemented FBL+PD, FBL+MPC, and NMPC path following control, simulated with Python
- Presented insights to MacLean Engineering, to be included in future grader autonomy efforts (GR5, GR8 models)

Autonomous Vehicle Intern, GM-AutoDrive/Queen's University, Kingston, ON — May 2023 - August 2023
- Designed and mentored 3 capstone proposals, addressing specific weaknesses in the AV stack
- Secured $25,000 in investments; managed a portfolio of 15 sponsors cumulatively valued at $250,000
- Expanded outreach, and instituted a novel team structure, resulting in 196 new applications

Teaching Assistant, APSC143, Queen's FEAS — Sept. 2022 - Dec. 2022
- Supervised lab sessions, graded 50+ assignments and midterms
- APSC143: Intro. to Programming for Engineers provided an introduction to algorithms and data structures in C

Robotics Summer Research Intern, CADMech Inc, Markham, ON — May 2022 - August 2022
- Designed and implemented a mobile robot to autonomously navigate a mapped indoor facility
- Implemented custom electronics, 3D-printed chassis, and P control
- Fused IMU, ultrasonics and map to execute waypoint following with Arduino

Associations and Affiliations

Mentor, Queen's AutoDrive — July 2024 - Present

Team Captain, Queen's AutoDrive — June 2023 - June 2024
- Led 93-member team developing an SAE-Level 4 AV as part of a 5-year international competition sponsored by GM, SAE, Intel, Komatsu, and more. Undertook complete overhaul of culture and personnel (14 h+/wk)
- Placed 3rd of 10 teams in the Intersection (self-driving) Challenge; all systems from scratch
- Primary author for Concept Design, Software Design Specifications, Project Leadership Reports (all top 5)
- Implemented novel approach for 3-LiDAR, 4-Camera fusion (±15 cm at 40 m) and 3x speed (90 Hz)
- Developed Global Planner with Python, ROS2, QGIS, worked first try on the AV
- Consultation for system design and implementation of all systems (Perception, Planning, Controls, Integration)

Technical Lead, Queen's AutoDrive — October 2022 - June 2023
- Responsible for system design and integration of (all) 11 points of failure with ROS2, Python (10+ h/wk)
- Configured and modified ROS2 (C++) drivers for LiDAR, camera, and GNSS
- Developed Autonomous Mode indicator via CAN with Arduino microcontroller
- Developed projection-based 3-LiDAR, 4-Camera fusion to obtain 3D position of detected classes

General Member, Queen's AutoDrive — March 2022 - October 2022
- Collected and annotated approximately 5,000 images for dataset manually; designed UI for Mobility Innovation

Athlete, Queen's Men's Tennis Team (3x) — October 2021 - March 2023
- Played at the collegiate level; 4 h/wk practice commitment;

Mechatronics Specialist, Queen's Vertical Farming Team — October 2021 - March 2022

- Designed and implemented sensor suite (temperature, pressure, etc.) with Arduino
- Broadcast data via ESP8266 to web server for live dashboard

Relevant Skills

- **Software:** Python, ROS2, Linux, Git, LaTeX, MATLAB, Arduino/C++
- **Control Theory:** WMR Kinematics, Feedback Linearization, Path Following, Theory (MTHE430/MATH830)
- **Computer Vision:** LiDAR-Camera Fusion, CNNs

References

References available upon request.