

# JORDAN MARR

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## *Skills Overview*

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- **Computer Vision** – For Master’s thesis, extensive experience with ORB-SLAM, LSD-SLAM as part of camera to lidar calibration routine. Interface with and help to debug object and landmark detection modules as part of Autonomous Vehicles SW org at Nvidia.
- **C++ and CUDA** – For Nvidia DriveAV, wrote modular, reusable C++ library to implement localization algorithm within larger DriveAV software stack. CUDA development for parallelization of vehicle pose optimization. Further C++ library design experience during Master’s thesis.
- **Localization and Sensor Fusion** – For Nvidia DriveAV software stack, contributed to algorithm design for localization of a self-driving vehicle to HD semantic maps. The system localizes from egomotion sensors, plus one or more camera/radar/lidar sensors. Estimates from each sensor modality are fused to achieve robust vehicle pose estimate.
- **Interpreted Programming (Matlab, Python and NodeJS)** – Extensive work with Python for CI tests and internal tools at Nvidia. Further work with Python in academic context (including TensorFlow for deep-learning projects). Experience with NodeJS for Queen’s Space Engineering Team.
- **CI with Docker** – Work with Docker based CI tools at Nvidia to ensure code portability between Linux development environment and target embedded environments.
- **Numerical Optimization** – For Master’s thesis, used a modified Bayesian optimization (a.k.a. “Global optimization”) algorithm in a novel routine which solves for camera to lidar calibration parameters in highly nonlinear search space.
- **Kalman Filtering & Batch Optimizers** – Extensive work with EKFs, Batch Optimizers and Sliding Window Filters at Nvidia and in Master’s course work.

## *Engineering and Research Experience*

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Oct 2018 – Present: **Software Engineer – Autonomous Vehicles Localization** – Nvidia – Santa Clara, CA

- Research and adapt cutting edge localization algorithms to the specific problem of localizing a vehicle using mass market sensors such as GPS, IMU, odometry, and camera.
- Develop functional, high-performance software modules in C++ as part of a larger embedded self-driving software stack.
- Development, profiling, and optimization (for time / compute resources) of highly parallelized CUDA kernels for computing vehicle pose estimate which optimizes novel cost function.
- Use of GTest and Python for CI tests ensuring consistent performance,
- Work with integrated Docker based CI tools to ensure code portability between Linux development environment and target embedded environments (QNX and embedded linux).
- Automatic nightly KPI reporting to ensure reliability and safety in car.
- Maintenance of developer tools such as debug mode GUI application, and map generation executable, requiring interfacing of external libraries such as OpenGL with proprietary C++ application code.

Sept 2016 – Sept 2018: **Research Assistant / Master Student** – University of Toronto Institute for Aerospace Studies - Toronto, ON

- Developed an automatic calibration routine for monocular camera + 2D lidar handheld system.
- In addition to 6DOF spatial transform, the calibration requires estimating 1) camera scale parameter to allow use of camera as egomotion sensor, and 2) time delay between sensor internal clocks.
- Using point cloud entropy as an objective function, I adapted an existing algorithm known as Bayesian optimization to solve for the function optimum in a highly nonlinear search space.
- The calibration routine works without any specific calibration targets, allowing a “power-on-and-go” system for handheld scanning and point cloud creation.
- Developed a set of modular C++ APIs to allow for calibration parameter determination using various open source solvers such as BayesOpt and NLOpt.
- Published in ISER 2018.

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## **Project Management Experience**

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April 2014 – May 2015: **Captain** - Queen's Space Engineering Team (QSET) - Kingston, ON

- Implemented a finance tracking system and team wiki to instill better project management practices.
- Set up hands-on mechanical and electrical tutorials to aid team members' professional development.
- Worked with Outreach team to obtain greater funding than any previous year, through mix of grants, sponsorship, and in-kind donations.
- The increased financial support and improved management brought the team out of deficit and led to the construction of the team's prototype Mars rover.

Sept 2014 – April 2015: **First Year Engineering Project Manager** - Queen's University Faculty of Applied Science and Engineering - Kingston, ON

- Coordinated a group of fifteen first year students, including oversight of meeting times, client constraints and meetings with university faculty mentors.
- Responsibilities included facilitating team dynamics and providing tutorials on MATLAB and C++ libraries required for the project.
- Served as an academic mentor for students, supplementing university resources with personal experience and time-management advice.

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## **Education/certification**

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- **Master of Applied Science – Aerospace Engineering (Robotics Specialization)** – University of Toronto, Toronto ON. Attended Sept 2016 to Sept 2018. Degree conferred 2018.
- **Bachelor of Science in Engineering - Electrical Engineering** – Queen's University, Kingston ON. Attended Sept 2012 to Apr 2016. Degree conferred 2016. 4.1 cumulative GPA (4.3 scale).
- Bilingual in English and French

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## **Publications**

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- **Marr J., Kelly J. (2020)** *Unified Spatiotemporal Calibration of Monocular Cameras and Planar Lidars*. In: Xiao J., Kröger T., Khatib O. (eds) *Proceedings of the 2018 International Symposium on Experimental Robotics*. ISER 2018. Springer Proceedings in Advanced Robotics, vol 11. Springer, Cham. [https://doi.org/10.1007/978-3-030-33950-0\\_67](https://doi.org/10.1007/978-3-030-33950-0_67)