Marcel Kaufmann, MSc

PhD Candidate in Computer Engineering

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Montreal, QC, Canada / Pasadena, CA, USA

Expertise and Competences

Experienced robotics and computer engineer with demonstrated skills in data science, data visualization, remote-sensing, computer vision, and photonics :

- Lead swarm robotics and human-robot interaction (field) experiments utilizing virtual reality and adaptive autonomy
- Implemented control algorithms and low-cognitive human-robot interfaces for UAVs, wheeled, and legged robot teams
- Developed unsupervised image processing and analysis algorithms for synthetic aperture radar [SAR] satellite-based data
- Automated characterization and calibration of new time-of-flight [ToF] 3D camera sensors utilizing 6-axis robots

Team player, able to step up in leadership and supporting roles :

- Excellent communication skills (oral, written), particularly in presenting complex data to both scientists and non-scientists
- Management of international projects and team leadership (e.g., student team lead and spokesperson of IGLUNA 2021)
- High comfort level with challenging tasks and able to pick up new skills quickly (e.g., DARPA SubT Challenge)

Select Work Experience

Mar 2020 - present — **JPL Visiting Student Researcher, NASA JPL | Caltech, CA, USA**

- Developing next-generation robots/AI for exploring space and Earth with multi-agent robotic systems
- Working for the Artificial Intelligence and Analytics (174B) and Robotic Aerial Mobility (347T) Groups
- Implemented task planning and verification tools with high levels of autonomy using **Python/ROS**
- Created and deployed assistive autonomy solutions on **real robots** and in **AWS cloud** simulations
- Developed and implemented **2D (web)** and **3D (VR/XR) user interfaces** for simulation and field operations
- Reduced operator workload and increased trust while automating health, safety, and performance monitoring

AWS Cloud Computing | Python | C++ | ROS | ROS2 | JavaScript | MongoDB | Git | Unity | Autonomy | Planning and Scheduling

Nov 2016 - Jun 2017 — **Scientific Software Engineer, Science[&]Technology, The Netherlands**

- Designed and developed complete software tools for space, science, and defense applications
- Implemented algorithms and visualization tools analyzing large satellite data sets using **Matlab/C++/Python**
- Utilized space-borne and ground-based radar systems, e.g. for research on marine vehicle signatures (NATO)

C/C++ | CMake | Python | Qt5 | Matlab | Subversion | Radar | Coherent Change Detection | Pattern Recognition | ML

Mar 2014 - Feb 2016 — **Research Assistant, Basler AG and University of Applied Sciences Darmstadt, Germany**

- Characterized the accuracy and precision of time-of-flight 3D camera prototypes
- Implemented a calibration method for exposure time- and temperature-dependent systematic errors
- Created a GenICam interface and integrated it into the open-source software MILAN in **C++**

C/C++ | CMake | Matlab | Subversion | Data Science | Model Fitting

2012 - 2016 — **Further Research & Development Student Positions, various companies and project partners, see in**

- Worked on R&D projects, e.g., for Bosch, Basler, Schott, h_da, and Orbital Eye; improved production processes
- Automated Silicon Wafer Inspection, 3D Camera Calibration, Lens Inspection, Satellite Image Processing

C/C++ | OpenCV | CMake | Subversion | Matlab | NeuroCheck | 6-axis robots | linear axle | GenICam | Time of Flight

Recent Honors and Awards

2021	DARPA SubT Challenge Finalist (Team CoSTAR ranked fifth in the finals)
2019	Natural Sciences and Engineering Research Council (NSERC) Vanier Canada Graduate Scholarship (3-year award)
2019	FRQNT Québec Merit Scholarship for Foreign Students (PBEEE), Ranked first in the Québec-wide selection
2019	Pierre Arbour Honorary Award for Outstanding Students
2018	35 under 35 Award : International Institute for Space Commerce (Astronaut Chris Hadfield in the Jury)

Languages

English	●●●●●
German	●●●●●
Dutch	●●●○○
French	●○○○○

Professional Certifications

- **Emergency Medical Technician** German Red Cross
- **Laser Safety Officer** Chamber of Commerce DA, GER
- **SCUBA Advanced Open Water Diver** PADI

Education

Sep 2017 - present — **PhD Candidate | Computer Engineering, Polytechnique Montreal, Canada**
- Thesis : Symbiotic Human and Multi-Robot Planetary Exploration Systems
- Working in the"Making Innovative Space Technologies" Laboratory, supervised by Prof. Giovanni Beltrame
- Team Lead of five graduate students for the ESA/Swiss Space Center IGLUNA 2021 Lunar Analog Field Mission
- Designed experiments and conducted validation missions in challenging analog terrain (PANGAEA, BRAILLE)

Git | C++ | Python | ROS | ROS2 | Buzz | OpenCV | Docker | Autonomous Vehicles | Adaptive Autonomy | HRI | AI/ML

Jun 2017 - Aug 2017 — **Alumnus | Space Studies Program, International Space University | CIT, Ireland**
- International, interdisciplinary, and intercultural professional summer program
- Project : "The Future of Internet of Things (IoT) and their Applicability to Space and Energy"

C | Robot Competition | International Collaboration | InDesign | Illustrator | Photoshop

Apr 2015 - Nov 2016 — **MSc in Photonics and Computer Vision (OBV Program), University of Applied Sciences Darmstadt, Germany**
- Thesis : False Alarm Reduction in Unsupervised Synthetic Aperture Radar Coherent Change Detection Systems
- Developed unsupervised classification and filtering algorithms reducing false alarms by up to 93%
- Supervised by Prof. Stephan Neser
- Volunteered in academic committees as departmental representative and examination board member

C/C++ | Matlab | IDL | OpenCV | Subversion | CMake | Unsupervised Learning

Oct 2011 - Mar 2015 — **BSc in Photonics and Computer Vision (OBV Program), University of Applied Sciences Darmstadt, Germany**
- Thesis : Characterization of Time-of-Flight Camera Prototypes, supervised by Prof. Stephan Neser
- Analyzed and reduced systematic depth errors developing multivariate correction models for 3D sensors
- Volunteered as elected student council representative for all mathematics and science students

C/C++ | Visual Studio | Subversion | OpenCV | PCL | CMake | IDL | Matlab | Zemax

Teaching and Mentoring

2019, 2021 — **GPS Denied Navigation for Quadrotors & Swarm Programming | Teaching Assistant, ISU, France**
- Teaching the swarm concepts of adaptiveness, resilience, and efficiency
- Fundamental principles and strategies to control and coordinate flying robots without GPS

2019 — **Spacecraft Computer Engineering | Teaching Assistant, Polytechnique Montreal, QC, Canada**
- Challenges of the space environment for embedded systems, including radiation effects on integrated circuits
- Analysis, sizing, and design of data handling systems for spacecraft in various mission scenarios

2013 — **United Space School | Mentor, UHCL and Johnson Space Center, TX, USA**
- Mentored 50 high-school students from 25+ countries
- Cooperated with astronauts and engineers to make this STEAM education outreach program a success

Select Publications

Please visit Google Scholar for a comprehensive overview of publications and citations

[1] **M. Kaufmann**, R. Trybula, R. Stonebraker, M. Milano, G. J. Correa, T. S. Vaquero, K. Otsu, A. Agha-mohammadi, and G. Beltrame (2022) Copiloting Autonomous Multi-Robot Missions : A Game-inspired Supervisory Control Interface (RA-L, 2nd revision)

[2] **M. Kaufmann**, T. Vaquero, G. J Correa, K. Otsu, M. F. Ginting, G. Beltrame, and A. Agha-Mohammadi (2021) Copilot MIKE : An Autonomous Assistant for Multi-Robot Operations in Cave Exploration, IEEE Aerospace Conference

[3] A. Agha-Mohammadi, K. Otsu, B. Morrell, ..., **M. Kaufmann**, et al. (2021) NeBula : Quest for Robotic Autonomy in Challenging Environments; TEAM CoSTAR at the DARPA Subterranean Challenge, in press Journal of Field Robotics (JFR)

[4] **M. Kaufmann**, K. Sheridan, and G. Beltrame (2021) Towards Human-in-the-Loop Autonomous Multi-Robot Operations, Companion Publication of the 2021 International Conference on Multimodal Interaction (ICMI)

[5] T. Vaquero, M. Saboia da Silva, K. Otsu, **M. Kaufmann**, J. A. Edlund, and A. Agha-Mohammadi (2020) Traversability-Aware Signal Coverage Planning for Communication Node Deployment in Planetary Cave Exploration, International Symposium on Artificial Intelligence, Robotics and Automation in Space (I-SAIRAS)

[6] **M. Kaufmann**, A. Zwiener, J.-F. Robin, J.-P. Gauthier, G. Beltrame, and D. St-Onge (2020) The sound settler : Spontaneous HRI in an art setting, ACM/IEEE International Conference on Human-Robot Interaction (HRI)

[7] D. St-Onge, **M. Kaufmann**, J. Panerati, B. Ramtoula, Y. Cao, E. Coffey, and G. Beltrame (2019) Planetary exploration with robot teams, IEEE Robotics and Automation Magazine (RAM)

[8] L. Siligardi, J. Panerati, **M. Kaufmann**, M. Minelli, C. Ghedini, G. Beltrame, and L. Sabattini (2019) Robust Area Coverage with Connectivity Maintenance, International Conference on Robotics and Automation (ICRA)

[9] **M. Kaufmann**, Vivek Shankar Varadharajan, and G. Beltrame (2018) A Self-Adaptive Data Handling System for Small Satellites and its Impact on Future Satellite Operations, International Astronautical Congress (IAC), Bremen, Germany

[10] M. Minelli, **M. Kaufmann**, J. Panerati, C. Ghedini, G. Beltrame, and L. Sabattini (2018) Stop, Think, Roll : online gain optimization for resilient multi-robot topologies, Proceedings of the Int. Symposium on Distributed Autonomous Robotic Systems (DARS)