Robotics and AI for Mapping Complex Environments

Record number : OPR-1250

Overview

RESEARCH DIRECTION

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INFORMATION

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ADMINISTRATIVE UNIT(S)

Faculté de génie
Département de génie électrique et de génie informatique
Département de génie mécanique
Institut interdisciplinaire d'innovation technologique (3IT)

LEVEL(S)

2e cycle
3e cycle
Stage postdoctoral

LOCATION(S)

3IT - Institut interdisciplinaire d'innovation technologique

Project Description

This project brings together a series of initiatives in autonomous robotics applied to exploration, navigation, mapping, and coordination among heterogeneous robots. It aims to develop and test algorithms for robust perception and mapping, intelligent decision-making, and adaptive navigation in large-scale terrestrial, aerial, and marine environments—often unknown, dynamic, or perceptually degraded. We work with various types of robots: drones (UAVs), ground vehicles (UGVs), surface watercraft (USVs), and underwater robots (UUVs), while considering constraints related to perception, communication, mobility, energy, and onboard computing.

nterested students may contribute to one or more of the following research topics (non-exhaustive list):
- Multi-modal perception and adaptive 3D mapping in natural or semi-structured environments
- Off-road or maritime autonomous navigation under uncertainty (weather conditions, degraded GPS, dynamic obstacles)
- Heterogeneous multi-robot coordination for inspection, sampling, or object search missions
- Self-supervised learning for traversability or embedded semantic segmentation
- Mission planning under resource constraints (battery, bandwidth, computing power)
- Natural language interaction for robot guidance or explanation of decisions.

This project is ideal for individuals motivated by real-world challenges in embedded AI, field robotics, and scientific exploration in harsh environments (dense forests, coastal areas, flooded zones, Arctic, etc.). The targeted applications span a wide range of fields, including environmental conservation, public safety, precision agriculture, aviation, infrastructure maintenance, and even space exploration—through missions involving surveillance, search and rescue, inspection, or automated scientific research.

The work will take place at the Institut Interdisciplinaire d'Innovation technologique (3IT), within the Sherbrooke Autonomous Field Robotics (SAFiR) Lab, and as part of the CREATEK innovation group (11 professors, 15 professionals, and 60+ graduate students). You will have access to advanced tools for simulation, design, measurement, and control. We use agile and iterative design methods, quickly building and testing prototypes in real-world, field conditions.

Required Skills and Technical Expertise:
- Strong background in mobile robotics (perception, localization, mapping, planning, and control);
- Proficiency in computer vision and multi-modal signal processing (LiDAR, RGB-D cameras, IMU, sonar, etc.);
- Knowledge of deep learning and/or reinforcement learning applied to robotics;
- Experience with distributed processing or embedded systems (real-time computing, energy management, memory, communication);
- Interest or experience in trajectory planning and constrained optimization, and/or mapping and localization (SLAM);
- Programming experience in C++ and/or Python, ideally with ROS/ROS2;
- Familiarity with robotic simulators (e.g., Gazebo, Isaac Sim, Unity) and visualization tools (e.g., RViz, Foxglove);
- Ability to work effectively in a multidisciplinary team and strong interest in field experimentation;
- Experience deploying field robotics systems (ground, aquatic, and/or aerial robots) in real-world environments (asset).

This project can accommodate one or more students in the following programs:
- Postdoctoral fellowship
- Doctoral thesis
- Research-type master's thesis
- Course-type master's essay

Discipline(s) by sector

Sciences naturelles et génie

Génie électrique et génie électronique,
Génie mécanique

Funding offered

To be discussed