

## **Attention-based efficiently coordinated motion planning**

MSc. Project Proposal at the Autonomous Multi-Robots Lab, Cognitive Robotics, TU Delft

**Brief description:** Exploration and surveillance tasks are at the core of search and rescue missions and structural inspections where we must obtain a map of a previously unknown environment as fast and accurately as possible. In such scenarios, distributed multi-robot systems are increasingly being deployed due to their potential efficiency and coordination in comparison to single-robot systems [1]. This is specially true in frontier exploration methods which define motion planning goals in positions that might potentially increase the obtained information on the environment when observed. However this raises the question on how these goals should be allocated within the team so that they coordinate successfully and explore the environment as fast as possible. While some methods have treated this problem before in 2D [2,3] by designing an heuristic metric on each goal, the work in [4] on unlabeled motion planning suggests the possibility of using Multi-Agent Reinforcement Learning in order to automatically assign dynamic goals to each robot in distributed systems. The aim of this project is to employ recent advancements in unlabeled multi-robot motion planning to develop a new algorithm to improve the performance of multi-robot systems in frontier-based exploration.



### **Desired qualities:**

- Motivated and independent.
- Good problem solving skills.
- Experience/interest in reinforcement learning, optimization algorithms and/or motion planning.
- Experience in C++ programming, Python and Robot Operating System (ROS).

**For further questions or to apply,** please contact A. Serra-Gomez <[a.serragomez@tudelft.nl](mailto:a.serragomez@tudelft.nl)> or Ass. Prof. Dr. J. Alonso-Mora <[j.alonsomora@tudelft.nl](mailto:j.alonsomora@tudelft.nl)>. When applying, please provide a short motivation, up to date CV, a transcript of your current degree program and intended start date.

**Group information:** <http://www.autonomousrobots.nl/>

### **References:**

- [1] B. Yamauchi. "Frontier-based exploration using multiple robots." in 1998 in *Proceedings of the International Conference on Autonomous Agents*, pp. 47-53.
- [2] N. Basilico, F. Amigoni. "Exploration strategies based on multi-criteria decision making for searching environments in rescue operations." in 2011 in *Autonomous Robots*, pp. 401-417.
- [3] W. Burgard, M. Moors, C. Stachniss and F. E. Schneider. "Coordinated multi-robot exploration." in 2005 in *IEEE Transactions on Robotics*, pp. 376-386.
- [4] A. Khan, C. Zhang, S. Li, J. Wu, B. Schlotfeldt, S. Y. Tang, A. Ribeiro, O. Bastani, and V. Kumar. "Learning safe unlabeled multi-robot planning with motion constraints." in 2019 in *ArXiv preprint arXiv:1907.05300*.