PhD Offer:

Gesture recognition and control of a mobile manipulator for a collaborative vine-surveillance task

Teams: ROMEA team at INRAE and RAP team at LAAS-CNRS

Supervisors: Nicolas TRICOT (INRAE) and Martin MUJICA (LAAS-CNRS)

Place: Clermont-Ferrand and Toulouse, France

Date of start: 01/10/2023

Duration: 36 months

Application deadline: 30/06/2023 (Please apply as soon as possible)

Figure 1: Robot Campero équipé d'un bras UR10

Context

Nowadays, several jobs consist of the combination of time-consuming, repetitive activities, as well as others, that require more experience and decision-making capabilities. Thus, the mobile manipulators are a new tool that can help and simplify these repetitive tasks. As a result, the person can focus on certain aspects that he/she considers important for the task, providing their experience and knowledge. This is the case for certain agricultural tasks where the person's experience is central to, for example, walk through and monitor different aspects of the vineyards. In this case, the mobile robot can be a partner in order to retrieve data, take pictures, locate a spot or treat the area. This presents many technological and scientific challenges as the robot must navigate the environment to follow the person, understand their intentions and allow them to interact safely.

Objective

The goal of this doctoral thesis is to explore, develop and apply methods that allow a mobile manipulator (Campero robot in Fig. 1) to interact with an agricultural operator. This interaction will consist on understanding the person's gestures and performing the corresponding task (e.g., take pictures, recover data, treat the designed area). The control of the robot plays a key role as it should be compliant in order to not harm the person standing nearby. Furthermore, as the person might need to modify or adapt the movement, the mobile manipulator should be capable of physically collaborating with the operator.

Methodology

To achieve the desirable goal, the person involved will deal with the following scientific challenges:

- Develop the algorithms to detect and recognize the operator movements based on a camera.
- Develop the control of the robot to allow the mobile platform, equipped with an arm, to safely perform the task indicated by the person.
- Allow the mobile manipulator to interact with the person based on vision and effort, to correct or customize the way the robot does the task.

These developments will be tested and evaluated experimentally on the Campero platform. However, as results should be extended to other platforms in the future as well, experimental tests on the robotic platforms at LAAS-CNRS are expected.

Requirements:

The candidate must be highly motivated, possess a Master Degree (or equivalent) in the fields of robotics and computer vision, as well as a previous research experience. The necessary qualifications for this position are:

- Strong background in robotics and computer vision
- Excellent programming skills and experience in C++ and Python
- Good skills in written and oral English
- Strong and positive problem-solving attitude
- Good communication skills, ability to work both independently and collaboratively
- Previous experience with robotic systems is desirable

How to apply:

The candidate should send an email to nicolas.tricot@inrae.fr **AND** martin.mujica@laas.fr with a single file (PDF or ZIP) containing the following elements (either in English or in French):

- Candidate's CV with studies, experience and achievements.
- A motivation letter explaining their interest for this position and the reasons that make the candidate a suitable choice for this position.
- List of marks of your master's degree (or your last two years).
- Recommendation letter and contact details of references (email and position).

References:

1. Štibinger, P., Broughton, G., Majer, F., Rozsypálek, Z., Wang, A., Jindal, K., ... & Saska, M. (2021). Mobile manipulator for autonomous localization, grasping and precise placement of construction material in a semi-structured environment. *IEEE Robotics and Automation Letters*, *6*(2), 2595-2602.
2. Lamon, E., Leonori, M., Kim, W., & Ajoudani, A. (2020, May). Towards an intelligent collaborative robotic system for mixed case palletizing. In *2020 IEEE International Conference on Robotics and Automation (ICRA)* (pp. 9128-9134).
3. Dhanaraj, N., Yoon, Y. J., Malhan, R., Bhatt, P. M., Thakar, S., & Gupta, S. K. (2022). A mobile manipulator system for accurate and efficient spraying on large surfaces. *Procedia Computer Science*, *200*, 1528-1539.
4. Mujica, M., Crespo, M., Benoussaad, M., Junco, S., & Fourquet, J. Y. (2023). Robust variable admittance control for human–robot co-manipulation of objects with unknown load. *Robotics and Computer-Integrated Manufacturing*, *79*, 102408.