Job offer
Royal Military Academy (RMA) - Patrimony

Research engineer (M/F/X)
Project "Distributed Reconnaissance And Mapping system**" (ref: DAP/22-05)**
Department MWMW
Date of publication: 18/03/2024

Job description and associated tasks

In the framework of the study "**D**istributed **Re**connaissance **A**nd **M**apping system" (ref: DAP/22-05), we are looking for a full-time researcher with a Master degree in Science or a Master degree in Engineering and a background in robotics and computer vision.

APPLICATION BY EMAIL according to the application rules hereunder (not via LinkedIn).
Incomplete applications will not be considered.

Context:
The Royal Military Academy of Belgium (RMA) is a military institution responsible for the basic academic, military and physical training of future officers, and for the continuing advanced training of officers during their active career in the Belgian Defense department (www.rma.ac.be). It is fully recognized as a university, fulfilling the same criteria as civilian universities. The Royal Military Academy is also conducting scientific research at university level for projects funded by the Belgian Defense department or external sources.
For this project you will work both within the Department of Mathematics (MWMW) and the Department of Mechanics (MECA) of the Faculty of Applied Sciences of the Royal Military Academy.

You conduct scientific research at university level on a project entitled '**D**istributed **Re**connaissance **A**nd **M**apping system'. You work within a research team and in close collaboration with the different components of the Belgian Armed Forces for defining operational requirements and setting up test campaigns.

Study:
In the last few years, we have seen AR/VR rise from a proof of concept technology to tested and validated systems improving a broad range of processes in various industries. The latest innovations allow, for example, the real-time, realistic rendering of complex scenes (e.g. with smoke and fire) and applications where security and fidelity are critical, such as people driving cars while wearing a VR headset to improve their design. At the same time, autonomous robots are being deployed in more and more complex environments (notably with the advent of legged robots). Thanks to the advances in 3D simulation and machine learning, these robots are capable of performing complex tasks with robotic arms. Distributed, multi-agent systems are also the subject of much innovation, thanks to the significant progress in micro-computers or telecommunication (5G). Moreover, 3D simulations and synthetic data have proven a valuable tool to train robots in complex environments. Together, these are unique opportunities for the Belgian Defense. Combining the innovations from these rapidly evolving fields opens up possibilities for the development of shared world representations between humans in VR and robots in real-life to perform all sorts of operations in unstructured environments.

Royal Military Academy
30 av de la Renaissance
1000 Brussels, Belgium

The goal pursued in this study is to develop a robust system made of **multiple unmanned ground robots to discover and map unknown places** and environments that are potentially dangerous for humans, while being **controlled from a VR environment**. An example of a use case scenario would be the damaged airport of Zaventem during the attacks of 2016, where structural integrity of the building or the absence of additional explosives were not guaranteed. Navigating in such places might require interacting with objects (e.g. moving debris or opening doors). Therefore, we propose to equip our platforms with a **robotic arm to allow these basic manipulations**. The multi-agent setup allows redundancy (thus robustness to failure or destruction) and an increased mapping speed and maneuverability.

In terms of applications, building this multi-agent system and evaluating it in real conditions is the main objective. However, **training the software that controls robots can be done more efficiently using a synthetic environment**, like Unreal Engine. Realizing this project will inevitably require an innovative approach in several interconnected domains such as ground robotics, computer vision, extended reality, digital twins and machine learning.

Expected outcome

This study is aimed at improving the execution of **reconnaissance and mapping operations** with a proof-of-concept system consisting of multiple **unmanned ground robots, robotic arms** that allow basic manipulations in the environment and a **VR command console**. The work will consist in integrating the robot platforms, the robotic arms and VR technology in an ensemble system for shared situational awareness that is as accurate, efficient and user-friendly as possible. To train the robots (and the operators), we will implement realistic simulations using 3D engines. **Machine learning from synthetic data** is a rapidly growing area of research, which presents a strategic interest for all activities of departments of Mathematics and Mechanics.

Developing this platform will require innovation in a multitude of domains. Therefore, significant scientific output will be produced in the form of publications, conferences or workshops. Combining the latest advances in the fields of autonomous robotics and immersive technologies, this research will strengthen Belgian Defense's knowledge and experience with these advanced systems and the Royal Military Academy's radiance in the Belgian and international research community.

Duration of the contract

The contract is foreseen to last until October 2027, with possibility of extension.

Main Tasks

Perform research activities in the frame of the study project:

1) Creation of a fully functional multi-agent SLAM simulator, which allows training our mapping agents on the go in simulation.
2) Use of the above simulator to design and train multi-agent SLAM methods. The multi-agent system should be able to map unknown places based on manually entered and pseudo-random trajectories and output 3D segmentation maps.
3) Development of a digital twin for the robotic arm and the extension of the above simulator
4) Development of a VR console, which will allow to monitor and control the robots with all of the above-proposed interactions.
5) Integration of the multi-agent robot system with the VR console, perform real-life tests and iterate.
6) Determining user requirements, analysis of the market and interaction with suppliers, integrating system components, testing of the system in controlled, training and (semi-)operational environments.

Royal Military Academy
30 av de la Renaissance
1000 Brussels, Belgium

7) Reporting of the progress results to the promotor in English.
8) Publication of the obtained results at international conferences and write scientific papers in English.

Secondary Tasks

1) Assist with the administrative aspects of purchases and field trials
2) Guidance of students during their master thesis in fields related to this study
3) Assist with the dissemination of the results of this study during PR events
4) Assist other researchers with your knowledge

Required skills

Technical skills

The applicant shall have a Master's degree (or PhD) in Science or in Engineering Sciences.
Your publications in peer reviewed journals in one of these domains should be added to your application.

- Experience in the design & implementation of AI algorithms (deep learning neural networks) is required;
- Practical experience in Computer Vision is required.
- Practical experience in Robotics is required.
- Experience in programming is required (Python is required, C/C++ is highly recommended);
- Knowledge of ROS (https://www.ros.org/) is required;
- Experience with Virtual Reality is recommended.
- Experience with complex software architectures assemblies, deployment and testing (e.g. Docker, Conda), Virtual Machines is recommended
- Proficiency in technical documents production is recommended
- Training or experience in (sensor) signal processing is recommended;
- Training or experience in Control Engineering is recommended;
- Training or experience in Sensor integration is recommended.
- Knowledge of software engineering life cycles, Agile methodologies and Scrum experience is recommended
- Experience with the organization of field trials is an added value.

Royal Military Academy
30 av de la Renaissance
1000 Brussels, Belgium

Personal skills

- You conduct scientific research in an independent and upright way within a multidisciplinary environment
- You think in an innovative and creative way.
- You communicate your results in a clear, concise and precise manner.
- You take initiative and coordinate your initiatives with the team.
- You are involved and result oriented.
- You are honest, loyal toward the institution and respect confidentiality.
- You plan and manage proactively your self-development, while being critical to your own functioning and striving to your self-improvement.
- You improve the team spirit and solve interpersonal conflicts.
- You solve problems autonomously and find alternatives or solutions.
- You behave in a respectful way toward the others, their ideas and opinions as well as toward procedures and instructions.
- You are flexible for change and adapt yourself.
- You commit yourself in your job by giving the best of your aptitudes in striving toward the highest quality standards and persevere when needed.
- You will be working very closely together with the Belgian Armed Forces and will get insight in their *modus operandi*. Confidentiality is therefore an absolute must.

Other skills

- The applicant shall have very good knowledge of English (oral / written). This will be tested during the selection process.
- The applicant shall preferably have knowledge of either French or Dutch and a minimum knowledge of the other language in order to allow collaboration with peers. This will be tested during the selection process.

Specific requirement

- The researcher may be exposed to classified information and will therefore have to obtain the required security clearance. The candidate must consent with the background check required to obtain this clearance, which will be executed by Belgian Defense.
- A driver's licence valid in Belgium is an added value.
- Working for the Patrimony requires living in Belgium for the duration of the study.

Application

You will be working in a military environment. That is why everyone is expected to undergo a security verification. A passport issued by country that is both member of the EU and NATO is required.
Please add to your application the filled out document. The form can be downloaded from: http://www.rma.ac.be/nl/aanvraag-veiligheidsverificatie

Royal Military Academy
30 av de la Renaissance
1000 Brussels, Belgium

Send by email all of the following elements:

- a motivational letter;
- a CV
- a scan of your ID card (both sides);
- the filled out security document
- your relevant publications (a link to an online open access repository is acceptable)

to Prof Dr ir Rob HAELTERMAN (rob.haelterman@mil.be), Dr ir Geert DE CUBBER (geert.de.cubber@mil.be), and to Dr ir Helena BRUYNINCKX (erm-deao-rswo@mil.be).

Please mention clearly the reference of the project in the subject line of your mail: "**DAP22/05**".
(Mails received without this reference or applications sent other than by email to all of the above addresses will not be considered. Applications that do not contain all of the above elements will also not be considered.)
Application deadline: **18/04/2024.**

The interviews will take place at the Royal Military Academy, Hobbemastraat 8, 1000 Brussels. On-line interviews can be organized under certain circumstances. The date and time of the interview will be communicated to the preselected candidates.

Miscellaneous

Contract

- Probable date of recruitment: as soon as possible, in consultation with the applicant.
- Status: Full-time employment based on an open-ended contract with the Patrimony of the Royal Military Academy (you will not be a civil servant).
- Wage scale: class A1 (holder of a Master's degree in Science or equivalent), class A2 (holder of an Ir degree or equivalent Master's in Engineering Sciences, doctor's degree in the same area of expertise). RMA-Patrimony applies a merit-based research career track, allowing researchers to advance in wage scale based upon annual evaluations.
- Holiday pay.

Extra-legal benefits

- Possibility to benefit from a bilingualism allowance (Dutch/French) following a SELOR test;
- End-of-year bonus;
- Free DKV hospitalization insurance. Possibility of additional affiliation for one or more persons living under the same roof: spouse, child(ren) (50% of the price per additional member);
- Bike allowance / Free public transport (home-work commute);
- Free access to campus sports facilities outside working hours;
- On-campus restaurant and cafeteria with democratic prices (discount on the daily menu);
- Flexible working hours within the 38-hour week;
- Teleworking possible ;
- Holidays:
    - 26 days holiday / year from the 1st year of contract (then from 45 years: +1 day holiday every 5 years)
    - + 3 extra days-off / year of "service dispensation" offered by the department

Royal Military Academy
30 av de la Renaissance
1000 Brussels, Belgium

    - + 1 week OFF every year between Christmas and New year's Eve (independent of the annual balance of holidays).
- Advantages and interesting offers thanks to the Benefits@work card (discounts, vouchers...) ;
- Entitlement to services offered by the 'Office Central d'Action Sociale et Culturelle de la Défense' (OCASC): among others holiday centres, discount on travel organised by the tour operator...;
- Possibility of benefiting from the nursery funded by Belgian Defence (subject to availability).

Workplace

- Royal Military Academy, Avenue de la Renaissance 30, 1000 Brussels;
- Occasional travels abroad for scientific conferences, etc.

Points of contact

- Concerning the research project: to Prof Dr ir Rob HAELTERMAN (rob.haelterman@mil.be)
- Concerning the recruitment modalities: Dr ir Helena Bruyninckx (erm-deao-rswo@mil.be)
- For more information about the Royal Military Academy, see http://www.rma.ac.be