Job description: Research Engineer/Scientist (M/F)
for the Patrimony of the Royal Military Academy,
Department of Mechanics,
project "Artificial Intelligence for Detection of Explosive Devices" (AIDED)

1. Job description and associated tasks

Within the context of a collaboration project with multiple partners from within the European Union, the Patrimony of the Royal Military Academy is looking for a full-time research scientist / engineer with a master degree in Industrial Engineering or master's degree in Applied Sciences / Engineering / Physics / Computer Science in the field of Robotics & Artificial Intelligence (AI).
In one sentence, the task of the applicant will be to integrate new sensors (Ground Penetrating Radar, Electromagnetic Induction Array, Spectrometer) on an existing unmanned ground vehicle (http://mecatron.rma.ac.be/wp-content/uploads/2020/02/tiramisu-robot.jpg) and pursue field tests with the Belgian demining team in order to validate the system performance.

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.
You work within the research cell 'Robotics & Autonomous Systems' (http://mecatron.rma.ac.be/) of the department of Mechanical Engineering. You conduct scientific research at university level on a project entitled 'Artificial Intelligence for Detection of Explosive Devices'. You work within the context of an international research project within the framework of a Preparatory Action on Defense Research (PADR) project. You will also interact often with the Belgian Demining team DOVO / SEDEE for defining requirements and setting up measurement and test campaigns.

Study

Recent armed conflicts (Afghanistan, Iraq, Syria) have seen a dramatic rise in the use of EOs (Explosive Ordnance), specifically IEDs (Improvised Explosive Devices) and landmines by adversaries, often resulting in casualties from EU and NATO member states. In modern warfare operations, consistently 50% of all soldier deaths in action are directly related to IEDs.
The disruptive vision of AIDED will be realized using a set of state of the art Artificial Intelligence (AI) algorithms able to (i) identify unconventional (IEDs) and conventional (Buried Mines) explosive devices (ii) autonomously plan offline and run-time missions plans and (iii) provide positioning, navigation and mapping to control a fleet of robots that cooperate quickly to identify a safe passage in a high risk area.
AI-Machine Learning techniques such as deep learning will be designed & trained using simulated & outdoor data sets for the detection of EOs using sensor data from GPR (Ground Penetrating Radar), EM (Electromagnetic Array) array IR (Infrared) or thermal cameras & LIBS (Laser Induced Breakdown Spectroscopy) & fusing them to improve the confidence of detection and classification of EOs by removing outliers and false detection. AI techniques will ensure robustness to changing environments & composition of EOs.
AIDED will also develop AI based Centralized & decentralized mission planning to coordinate a swarm of small and medium heterogeneous robots (land and aerial) that are capable of working cooperatively towards the goal of detecting EOs that are on the surface, buried or hidden. The Positioning Navigation and Mapping will also be based on AI-machine learning techniques for robustness and standalone operation in GNSS denied environments.

Within this collaborative research project, RMA is mostly responsible for the development of the unmanned ground vehicles for IED detection. Your main responsibilities will thus revolve around the development of this unmanned ground vehicle system.

The research will be performed at the MECA (Mechanics) department of the Royal Military Academy (RMA). The candidate will be supervised by Dr. Ir. Geert DE CUBBER.

The contract will be for 2 years, with possibility of extension.

<u>Main Tasks</u>

- Perform research activities in the frame of the study project:
    - Mapping end-user requirements with AI solutions for the detection of explosive ordnance
    - Sensor Data collection for Machine Learning for training and evaluating the AI components of AIDED on the military test sites of Meerdaal and Leopoldsburg
    - Analog and mock IED design for testing and demonstration in collaboration with DOVO
    - Adaptation of an existing Unmanned Ground Vehicle, system integration of a Ground Penetrating Radar (GPR), Spectrometer and Electromagnetic Induction (EMI) array
    - Integration of sensors on unmanned ground vehicle
    - Integration of communications tools on the robot
    - Develop a testing and demonstration in coordination with DOVO
    - Preparation for validation and demonstration using unit and integrated test cases and system level testing
    - Validation of the AIDED system in an outdoor field analog
    - Reporting of final test results from simulation and field demonstration
    - Design of the AIDED website and social media accounts
    - Report the progress results to the promotor and research team in English.
    - Report the obtained results at international conferences and write scientific papers in English

<u>More information :</u>
Geert DE CUBBER & Daniela DOROFTEI:geert.de.cubber@rma.ac.be& daniela.doroftei@rma.ac.be

2. Required skills	
Technical skills:	The applicant shall have a master degree in Industrial Engineering or a master's degree in Applied Sciences / Engineering / Physics / Computer Science. This is a multi-disciplinary study, requiring a mix of practical skills (development of electronic circuits and CAD/CAM design of new components for the robot) and more theoretical skills (requirements engineering, system validation, scientific reporting). - Experience in programming is highly recommended. - Experience in robotics is highly recommended. - Training or experience in Unmanned Ground Vehicles is recommended; - Training or experience in Control Engineering is an added value; - Training or experience in Sensor integration is an added value; - Training or experience in Perception is an added value; - Knowledge of ROS (https://www.ros.org/) is an added value; - Training or experience in applied research and or design is an added value; - Knowledge of AI and deep learning algorithms (within this project developed by other partners) is an added value in order to enhance the mutual comprehension within the team.

Job description

Specific requirement:	The researcher will be working within the context of an EU Preparatory Action for Defense Research project, which is a project managed by the European Defense Agency (EDA). Due to this project framework, this position is only open for NATO / EU citizens. The researcher will be exposed to classified information up to the level "EU RESTRICTED" 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.
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 initiatives. • You are involved and results 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 commit yourself in your job by giving the best of your aptitudes in striving toward the highest quality standards and persevere when needed. • 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 are capable of writing qualitative technical reports on your work • You are capable to manage, direct and assist with the composition of deliverables towards the funding authority • You are capable to write and present scientific papers about your work • You will be responsible as work package leader for the validation campaign. This means that you will have to manage the 5 partners which are involved in this work package, manage the resources and budget, organize the logistics of the field trials, present the progress and results of the work package towards the European Defense Agency, etc. This means that you need to have management skills. • You will be working very closely together with multiple project partners from across Europe and with the Belgian Demining team DOVO. The ability to work well in a team is therefore an absolute must. • This study calls for both theoretical and practical developments. You will need to integrate new sensors and perform field validation campaigns on different locations in Belgium (Meerdaal and Leopoldsburg) in order to account for different types of soil conditions. A practical attitude and willingness to bring novel scientific innovations into practice is therefore certainly required.
Other skills:	• The applicant shall have excellent knowledge of English (oral and written) • Minimum knowledge of French or Dutch is an added value for collaboration with peers

Job description

3. Application	
	• Send a motivational letter, a CV and a scan of your ID card (both sides) to Geert DE CUBBER (geert.de.cubber@rma.ac.be), Daniela DOROFTEI (daniela.doroftei@rma.ac.be) and to Thierry DEPREZ (erm-deao-rswo@mil.be) • You will be working in a military environment. That is why everyone is expected to undergo a security verification. Please add to your application the filled out document that is attached to the job description: http://www.rma.ac.be/nl/aanvraag-veiligheidsverificatie • Please mention clearly the reference of the project: **MECA-AIDED** • Application deadline: **August 1**, 2020 • The interviews will take place at the Royal Military Academy, Hobbemastraat 8, 1000 Brussels. Taking into consideration the COVID-measures, remote / tele-interviews are likely. The date and time of the interview will be communicated to the preselected candidates.

4. Miscellaneous	

Points of contact	• Concerning the research project:
	    • Geert DE CUBBER (geert.de.cubber@rma.ac.be)
	    • Daniela DOROFTEI (daniela.doroftei@rma.ac.be)
	 • Concerning the recruitment modalities:
	    • Thierry Deprez erm-deao-rswo@mil.be
	 • For more information about the Royal Military Academy, see
	    http://www.rma.ac.be
	 • For more information about the 'Robotics & Autonomous Systems' research unit: http://mecatron.rma.ac.be/

Others	• **Probable date of recruitment**: From September 1 2020, in consultation with the applicant. (Applicants graduating in June / July 2020 are accepted).
	
	 • **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**:
	    • A11 (holders of a Master Degree)
	    • A21 (Ir or holders of a Master Degree in Engineering Sciences (Applied Sciences))
	
	 • **Extra-legal benefits:**
	    • Possibility to obtain a bonus for bilingualism (Dutch/French);
	    • Holiday pay;
	    • End-of-year bonus;
	    • Hospitalization insurance;
	    • Free public transport (home-work commute);
	    • Free access to the on-campus sport infrastructure;
	    • On-campus restaurant and cafeteria with discount on the daily menu.
	
	 • **Workplace:**
	    • Royal Military Academy, Avenue de la Renaissance 30, 1000 Brussels;
	    • Field tests will need to be executed at the premises of DOVO (Meerdaal) and in Leopoldsburg
	    • Occasional travels abroad for scientific conferences, etc.
	    • Stimulating work environment.