ESR2

Project title: Work performance evaluation of mobile machines in earth moving tasks by using process models and sensor data.

Place of employment and planned mobility: Karlsruhe Institute of Technology, Germany: 9 months, Novatron, Tampere / Finland: 21 months, Liebherr-Werk Bischofshofen GmbH, Austria: 9 months

Supervisory team: Prof. Marcus Geimer (KIT) & MSc Antti Kolu (Novatron)

Project tasks and objectives: In order to evaluate the performance of a mobile machine, various data has to be considered, since mobile machines do have travel and working functions. For example, when only looking at the overall fuel consumption of an excavator, the fact is neglected, that the following steps in a process chain also depend on the timely fulfilment of the designated task.

For autonomous machines to work efficient, it is important that the machines are able to evaluate their own working process and its performance level, according to specified parameters. Based on the evaluation result, the machine has to derive and implement necessary changes in order to optimize its working process. Therefore, being able to process data, organise knowledge, evaluate the performance, make decisions based on results, act accordingly and learn from experience are prerequisites for intelligent and autonomous actions and systems.

The work includes:

- Research of State of the Art concerning earthmoving processes, autonomous mobile machines, process evaluation and work cycles.
- Research and Studying of applicable modelling strategies for process evaluation of a mobile machine in an earth moving process.
- Investigate earth moving processes and interview machine operators in order to gather data for the performance definition.
- Define a suitable performance vector for the target application, e.g. by using work efficiency in metric tons / hour and fuel consumption for both digging and dumping processes.
- Devise sensor concepts for an autonomous machine to acquire the necessary data during real-time operation.
- Develop the required data processing software by using both model-based computational and model-free machine learning techniques.
- Evaluate the performance of operations in the context of the target landscape given by BIM infra models.
- Define and evaluate reward functions for reinforcement learning.
- Verify / validate functionality in simulation.
- Derive a method from the results to evaluate a process of a mobile machine and get a quantitative measure of its system performance, which can be used in further machine-learning purposes and improved autonomous operations and to select the most efficient working method and tool for a given task.

The ESR will also be involved in dissemination through social media promotion of the network, such as Webropol surveys, and LinkedIn groups, YouTube video channels, Twitter and blogging.

Starting date: January 1st, 2020. Negotiable.

Duration of the work contract: 36 months/full-time contract

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Grant Agreement No. 858101.

Trial period: 6 months

Target degree: PhD degree from the department of mechanical engineering at Karlsruhe Institute of Technology (KIT), Germany

Approximate gross salary: about 3600 EUR/month plus family allowance if applicable

Eligibility: ESR shall at the date of recruitment, be in the first four years (full-time equivalent research experience) of their research careers and have not been awarded a doctoral degree. The researcher must not have resided or carried out his/her main activity (work, studies, etc.) in the country of his/her first employer (Karlsruhe Institute of Technology, Germany) for more than 12 months in the 3 years immediately prior to his/her recruitment.

The applicant must be in possession of Master of Science (MSc) diploma in Mechanical Engineering, Mechatronics, Machine Learning, Data Science, Robotics and Automation or similar.

"**English language requirements**: Proficiency in written/spoken English is mandatory. A proof is desired, such as an English certificate of level B2.

Application

Closing date: 13.11.2019

The applicant must submit the following documents through LAURA portal, only a clear copy of the documents will be considered.

1. **Certified copies of the bachelor's and master's degree certificates with the Diploma Supplement (DS)** as approved by the EU Commission for degrees completed in European universities (when applicable) Official translations into English (if the original documents are in a language other than English)
2. **Curriculum Vitae/CV** (preferably in Europass format)
3. **List of publications (if any),** your contributions in the publication
4. **References:** Contact details of 2 or more referees included in the CV
5. **Motivation letter: maximum** 1 page where you introduce yourself and present your qualifications; you may include also your previous research fields and main research results. Please emphasize your future goals career-wise
6. **Copy of the passport**
7. **Proof of residence:** statement and certificates/documents demonstrating your residence(s) in the last 4 years. A template is available on the website under *How to Apply*.

Additional information

Working and living conditions in Finland at Novatron Oy – Our headquarter is located in Pirkkala, Finland, right next to the city of Tampere that has one of the largest Universities of Finland and contributes to the young, relaxed and vibrant atmosphere of the area. Novatron develops, manufactures and supplies machine control systems for earth-moving machines and has 25+ years of experience in the field of machine control. We are a team of 120+ professionals including more than 50 full-time Engineers and Scientists in our R&D department with expertise on Research, Software Development and Embedded electronics. Novatron is part of the German MOBA group.

Working and living conditions in Germany at Karlsruhe Institute of Technology - Karlsruhe is located in the Southwest Germany. It is one hour away on a fast train from the city of Frankfurt and its international airport. Karlsruhe Institute of Technology (KIT) creates and imparts knowledge for the society and the

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environment as “The Research University in the Helmholtz Association”. It is our objective to make significant contributions to global challenges in the fields of energy, mobility, and information. KIT prepares its 25.100 students for responsible tasks in society, industry, and science by offering research-based study programs. Read more here. The city of Karlsruhe is a very young and dynamic city with big ambitions and plans for the future. A huge variety of cultural offerings can be attended, through day as well as in the late hours.

Working and living conditions in Austria at Liebherr - Situated about 45 minutes south of the city of Salzburg, Liebherr’s Bischofshofen factory is the global competence centre for the group’s wheel loaders. Surrounded by mountains of the Northern Limestone Alps, the site is specialised in the development, production and international marketing and sales of wheel loaders ranging from 4 t to well over 35 t gross weight - a product range of smart and efficient machines characterized by continuous innovation. The area offers a broad range of leisure activities in the mountains as well as cultural offerings in nearby Salzburg.

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