ESR3

Project title: Material flow coordination and optimization in construction sites

Place of employment and planned mobility*:* Örebro University, Sweden: 9 months - Novatron Oy, Finland: 21 months - Liebherr, Austria: 9 months

Supervisory team: Achim Lilienthal, Henrik Andreasson, Antti Kolu

Project tasks and objectives: In most construction sites, one important task is to move material from one place to another, where the material forms a predefined shape obtained from a BIM. This project will focus on how to do this autonomously using a single or a set of different machines in an efficient way. One envisioned usage of the system is by utilising a 3D map acquired by a drone or laser rangefinder where the user drags and drops the materials around, e.g. moves one pile from one location to the other. The differences between the two models constitute the material that needs to be moved.

The scientific objectives include (1) to investigate and develop methods to represent material, material properties and material behaviour, e.g. the slope angle of the pile using this material; (2) to investigate and develop algorithms to operate the movement of material, e.g. in what order the material should be removed and placed or if an additional structure needs to be built, such as a ramp, in order to be able to construct the desired shape; and (3) To investigate coordination strategies of multiple machines with the focus on how to move the material as quickly or as energy-efficiently as possible given a set of machines.

The ESR will acquire a broad knowledge of the state of the art in related fields, such as optimisation, constraint-based reasoning, dynamic programming and map representations.

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

Trial period: 6 months

Target degree: PhD degree from Örebro University, Sweden

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 (Örebro University, Sweden) 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 at the beginning of the employment in engineering, computer engineering, mathematics, automation, or similar.

English language requirements: Proficiency in written/spoken English is mandatory.

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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 Sweden at Örebro University - Ph.D. students in Sweden are University employees and they have all the social and financial rights of other employees. Among these: a fixed monthly salary adequate to the cost of living in Sweden, inclusion in the Swedish social security system, and at least 28 days of paid vacation each year. These conditions are guaranteed for three years as long as the requirements for the Ph.D. studies are fulfilled. Ph.D. students in Sweden have to take advanced courses during their study program. These are typically technical courses relevant to their research project, but may also be courses about other related disciplines, including scientific methodology and project management. Courses at the Centre for Applied Autonomous Sensor Systems (AASS) are meant to provide students with a unique educational background in autonomous sensor systems. Ph.D. candidates in Sweden may devote up to 20% of their time to institutional work. This work typically consists in helping with the undergraduate education. The percentage of time spent with institutional work is added to the total duration of the Ph.D. studies. In summary, the Ph.D. students at AASS will be doing four sorts of things during their Ph.D.: work on their research project; take graduate courses; contribute to undergraduate education; and participate in the scientific life of AASS and of the international community. More information about the Ph.D. studies at AASS can be found here.

The University of Örebro is a young university currently enrolling more than 14000 students. It is located in Örebro, a city with 130000 inhabitants, which is situated in central Sweden. For more information about the Universiy of Örebro click here and about the city, here.

Working and living conditions in Finland at Novatron Oy – Finland is among the most stable, free and safe countries in the world, based on prominent ratings by various agencies. It is also ranked as one of the top countries as far as social progress is concerned. Tampere is counted among the major academic hubs in the Nordic countries and offers a dynamic living environment. Tampere's region is one of the most rapidly growing urban areas in Finland and home to a vibrant knowledge-intensive entrepreneurial community. The city is an industrial powerhouse that enjoys a rich cultural scene and a reputation as a centre of Finland's information society.

Novatron's 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

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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 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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