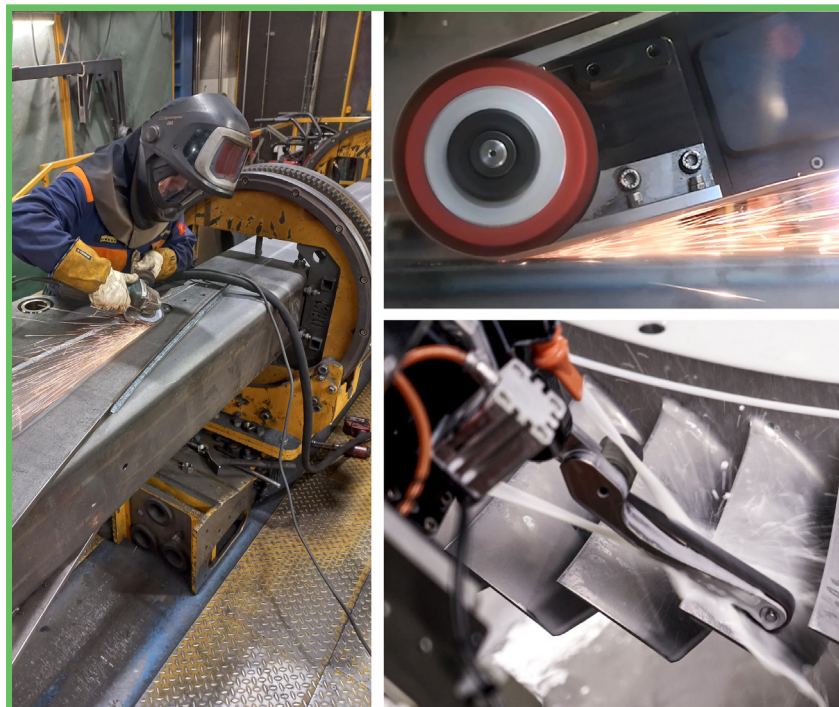


SUGAR - Sustainable Grinding with Agile Robotics

Abstract:

SUGAR project develops generic system concepts and selection processes of case-specific hardware and software block sets for flexible and intelligent robotic grinding processes. Conceptual solution demonstrators for representative industrial cases are used to verify the concepts and validate building block ensembles. Parallel to cost-effectiveness and productivity in High-Mix Low-Volume production, sustainability aspects of the grinding process are addressed through the whole project, covering not only environmental, e.g. carbon foot and handprint, waste reduction, reuse and recycling, but also economical sustainability and occupational health and safety issues for better work environment.



Countries involved



Application sectors

Capital goods, Industrial components

Research and innovation domains

Advanced manufacturing processes, Smart & adaptive manufacturing systems, Person-machine collaboration, Sustainable manufacturing

Total cost in M€ (millions)

4.250 M€

Starting date

1/10/2023

Duration (in months)

36 months

Project leader

Mika Sirén

mika.siren@vtt.fi

VTT Technical Research Centre of Finland Ltd [FI]

Project participants

VTT [FI], Mirka [FI], Ponsse [FI], Avemet [FI], Suomivalimo [FI],

Convergent Information Technologies [AT], Gachon University [KR],

KITECH Korea Institute of Industrial Technology [KR], ROAS [KR]

RATIONALE OF THE PROJECT

Manual grinding is one of the most strenuous industrial tasks. Work is heavy, working positions are often difficult and the environment harmful, including dust and noise. There are severe occupational health and safety risks related to grinding tools as well. Therefore, grinding work is unpopular, skilled workers are difficult to find and absences and medical leaves are common. Hence, grinding is a very favourable subject for automation and robotics.

The technology enabling grinding automation exists, but the potential has not been realised to the fullest. This is particularly true in sensor data utilisation: advanced sensors are not enough as such but sensor data analysis tools are needed in order to increase the process adaptivity and "intelligence". Advanced concepts have been realised but they are typically highly tailored one-off solutions – and therefore high in cost, making them unaffordable for SME's. Duplication and/or modularisation has not yet been successful.

Delivering holistic and intelligent robotic surface finishing cells is a complex task and difficult to realise by one company, therefore a strong ecosystem is needed. In SUGAR project, innovations are developed for new products and services provided along the whole manufacturing value chain by actors including end users Ponsse, Avemet and Suomivalimo; technology providers Mirka, Convergent IT and ROAS; and research centres and universities VTT, KITECH and Gachon University.

TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

SUGAR main goals and expected results are:

- 1) Create flexible and intelligent grinding concepts for various needs using existing, commercial hardware blocks. The concept possesses extreme flexibility and cost-efficiency to make it feasible and affordable to SME companies.
- 2) Demonstrate adaptability to changing conditions: fast ramp-ups, dealing with workpiece and process variations, ability to analyse and react the deviation causes using intelligent sensing and analysis.
- 3) Aim at the overall process optimum: cost efficiency, investment cost, flexibility, expandability.
- 4) Enhance sustainability as the cross-cutting theme present in all project work, including environmental, social and economic perspectives in manufacturing.

SUGAR project creates conceptual solution demonstrators for different representative industrial cases for verifying and validating the concepts and building block ensemble. Demonstrator configurations are in 2D, 3D and 3D+ (3D with critical local features to be identified and finished). The demonstrators strengthen the dissemination and enable the exploitation of developed solutions.

The regulatory environment is changing for the manufacturing industry. The GreenDeal, HSE regulations, product passports, right to repair act, etc. will all have an influence on how products are produced. This is one of the main drivers in the project, the future of surface finishing needs to be not only effective but also work with built in compliance to regulation.



MARKET POTENTIAL

Grinding is used in large industries worldwide, including automotive, precision engineering, transport and general machinery. Companies are constantly looking for new concepts and technologies to improve their operations. The grinding process can be optimised for maximum productivity by robotising and utilisation of intelligent process control. Additionally, the amount of ground material and waste will be reduced.

The market for grinding machines grows steadily: the smart industrial solutions like grinding robots are expected to grow at 6.8% CAGR. The world abrasives market of US\$ 45 bn is estimated to grow at 5% CAGR. Hence, the 5% of abrasives used in robot systems propose a substantial market growth.

The main strategy in the business is to partner with key integrators and tool producers to offer a complete solutions portfolio, and also build local robotic piloting centers to demonstrate solutions for customer use cases.

IMPACT POTENTIAL

Advanced Manufacturing Processes introduce capabilities and intelligence to adapt to varying conditions. High flexibility requirements come from the typical small series of SMEs. Systems possess fast ramp-up and capability of handling wide variety of products. The key here is easy programming integrated to adaptive process control.

SUGAR makes sustainability in grinding measurable, visible, reliable and actionable, including environmental improvements (handprint). For companies, such assessment calls for expertise from VTT.

Person-Machine Collaboration functional interfaces enable meaningful work for the employee and the robot. VTT defines the principles including safety, further brought to shop floor by the integrator. The social benefits consist of improved safety and reduction of cognitive load for staff.