Robotic Challenges in Agri-food for the First Open Call for ESMERA Experiments (ESMERA-FOCE)

Project acronym:	ESMERA
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Proposal submission deadline:	31.10.2018, at 18.00 (Brussel's time)
Proposal submission web address:	http://opencalls.esmera-project.eu
Expected duration:	9 months for experiments in Phase 1 (max 18 months for experiments advancing to Phase 2)
Total budget for the 1st Call:	€2,200,000 (maximum 16 experiments for the Phase 1 and maximum 8 experiments for the Phase 2). Maximum funding per proposal: €200,000 (€75,000 for the Phase 1, €125,000 for the Phase 2, including 25% indirect costs)
More information:	opencalls@esmera-project.eu

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Glossary/ Acronym Terms

ESMERA: European SMEs Robotics Application

SME: Small and Medium-sized enterprises form a specific target group for the experiments and the CCs in ESMERA. The term is used in the same way as defined by the EC (http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition/).

Experiment: An experiment is a small to medium sized scientific research and/or technology development project carried out by a team of at least one SME and potentially additional research institutions, robot manufacturers and robot and automation users, which typically lasts no longer than 9 months.

CC: A Competence Centre is a physical infrastructure supporting different user groups by providing state-of-the-art hardware, software components, and support in form of experienced staff.

RTD: Research and Technology Development.

HMI: Human Machine Interface

Robotic Challenges in Agri-food for the First Open Call of the ESMERA Experiments

The ESMERA project calls for contributions that propose solutions to a predefined real-life challenge in the agri-food area involving but not limited to nearly autonomous robots and demonstrate these in real-world scenarios. In the given challenge, we ask SMEs to develop a solution for an "**Autonomous Weed Control"** problem in the agriculture area with "**ESMERA-A.1**" Challenge ID. The problem description, the desired robotic technology and the supports from the Challenge Provider, Lindholm Maskiner a/s are explained in the following section.

1. ESMERA-A.1 – Autonomous Weed Control

1.1. ESMERA-A.1 challenge description

Introduction

Weed control within crop rows is one of the main problems in small to middle sized organic and traditional farming and outdoor gardening fields. For centuries, different weed removal tools have been used to reduce weeds in the crop rows. Stimulated by the demand from organic farmers, research in several European countries over the last decade has focused on mechanisation of weed removers using harrowing, torsion finger weeding etc.

The current process

Figure 1.1. An example of a currently available solution[1]

The current process is carried out with manually controlled, fuel powered tractors with mounted tools (and sprayers) (see Figure 1.1.). Most farmers and organic outdoor gardeners use tractor mounted cultivators (tillage), hoes etc., but big tractors leave a heavy impact on the CO_2 emissions, and induce soil compaction (compression of the ground by their weight). Furthermore, removal of weeds is highly manpower intensive if/when spraying with pesticides is not an option, and more and more countries have (or are about to) ban the use of pesticides. For organic outdoor gardeners, removal of weeds is one of the most labour-intensive activities in their production. In addition, some available autonomous solutions can remove weeds between the crop rows, but not in between the actual plants.

[1] Both pictures are taken from https://farmbackup.dk/machines/3590/langgaard-agro/radrensning-roer-spinat-og-majs

Thus, it is expected from the solution to remove not only weeds between the crop rows but also to remove weeds between the plants, which cannot be removed with various machines. The desired robot is aimed at small to middle sized farmers and outdoor gardeners who are usually not able to invest in big and expensive agricultural machinery and rely today on manual labour. The output for the farmer and the organic outdoor gardener is to get a much cheaper and/or a 100% ecological weed reduction. By using smaller robots with mounted tools, the soil compaction will be reduced to a minimum which will affect the outcome of the field in a positive way. By regularly use of the robot and tools, the weed will not be able to grow big.

Challenge scenario

The expected operational environment is fields with crops like beets, carrots, cabbage, leeks etc, with characteristics in the early stages of the plants' life usually easy to operate on. The weeds at that time are also fairly small and easy to remove (especially if performed regularly). Support facilities for the robot will be electricity as it will need to recharge the batteries regularly, a navigation system and a small human supervision for planning, system setup, servicing and eventually trouble shooting. The process for the robot is to remove weeds from crop rows and between plants. It would also be possible to be mounted with i.e. a cultivator and will tillage the soil around the plants. The robot does not need to interact with any other systems or humans while working.

General requirements

The following list decribes important requirements for the end user that will be evaluated positively for each proposal.

1. ***Efficiency:*** It is expected from the solution to remove same level (or less) of weeds left around the crop after the robot´s mechanical work compared to traditional tractors with mounted tools and sprayers.
2. ***Robustness:*** The robot has to be durable and water/dust/corrosion resistant.
3. ***Autonomy:*** The robot will only need limited human time, as when moved from one field to the other, servicing or troubleshooting. The reduction in human manpower could be 70-90%. It is also expected from the robot to charge itself autonomously without requiring any human interaction. A "manual override" should be available for special situations. HMI (Human-Machine-Interface) should be intuitive, simple and fast to operate by nonprofessionals.
4. ***Safety:*** It is expected from the robot to have "Detect and avoid" system as per regulations.
5. ***Manoeuvring capacity:*** The solution should be able to maneuver in tight spaces and sideways increasing flexibility and cost efficiency. It is also expected from the system to be able to maneuver in soft/wet/dry/uneven soil and on a certain degree of inclinations. All wheel drive is preferred.

Performance metrics

In addition to other metrics specified by the experiment consortium to demonstrate the efficiency/performance of the solution, the following metrics by the Challenge Provider will also be evaluated:

1. ***Operation time:*** The robot would work continuously over 8-12 hours with maximum 20% human participation.
2. ***Load capacity:*** Maximum axle load should be 250 kg.
3. ***Weed removal efficiency:*** High success weed identification and removal for a given area.

1.2. Support to the experiment

Support from the lead Competence Center

The CEA CC is responsible for the challenge and the currently available equipment list can be seen in our website. The environment and the required equipment will be provided by CEA CC and the selected proposals can test/develop their solutions in CEA CC. Other ESMERA CCs will also be available to support the development process.

Support from the Challenge Provider

The Challenge Provider will provide an access to a field around Odense in Denmark. They can also assist the solution providers providing experimental tools and provide robot experts and outdoor gardeners/farmers for solution evaluation.