Welcome to the first issue of the Flourish Newsletter!

This biannual newsletter will keep you updated on the project progress, results, events and activities undertaken by Flourish in precision agriculture and will be available in our project website: http://flourish-project.eu/

Newsletter contents

In this issue you will find a general description of the Flourish project, all the activities related to the dissemination of the main Flourish progress and results and finally all the opportunities for project partners and relevant stakeholders to exchange knowledge, experiences and technologies within the consortium or with external audience.
**The Flourish Project**

**Summary**

This section provides an introduction to the Flourish project and presents its main goals. The Flourish team is currently carrying out experimentations and tests on two main crops in order to design an efficient robotic agriculture system for precision agriculture. The main features, functionalities and applications of the Flourish robotic system are detailed below. So far several progress toward the development of system sub-components have already been achieved.

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**What is Flourish?**

Flourish is a three-year project on precision farming started on March 2015 and funded by the European Community Horizon 2020 Programme under grant agreement no 644227 and from the Swiss State Secretariat for Education, Research and Innovation (SERI) under contract number 15.0029.

The FLOURISH project is carried out by a consortium made up of seven partners from four European countries (Switzerland, Germany, France and Italy), with highly specialized know-how ranging from robot design to crop management. Read more

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**Project goals**

The aim of the Flourish project is to develop a robotic agriculture system that helps increasing yields to reach the growing food demand and, at the same time, to reduce the amount of applied agro-chemicals pesticides to meet the future pesticide usage requirements of a sustainable and safe food production on the field. Furthermore, the Flourish solutions are expected to contribute to more efficient use of human resources in crop development and to reduce farms emissions.
Mission scenarios

The Flourish project develops a robotic system combining aerial survey capabilities of a small autonomous multi-copter, Unmanned Aerial Vehicle (UAV), with a multi-purpose agricultural Unmanned Ground Vehicle (UGV). Both the UAV and the UGV aim at evaluating the crop growth performance, nutritional condition, weed infestation and health status non-destructively.

Data collected by the Flourish robotic system can be sent to a server (for storage, handling, processing and map building) and eventually to a farmer device (i.e. Mission Control Interface). Management recommendations are derived on the basis of maps produced by the system, then the need for ground intervention by the UGV is prioritized and the UGV missions are scheduled accordingly. Hence, management recommendations are sent back to the UGV, so that it can autonomously fertilize or control weeds with its ground intervention tools.

For this purpose the UAV and the UGV continuously collect a rich set of data (e.g. position, temperature, 3D-information, as well as visual and spectral imagery) over the field. The UAV can also detect the presence of problem areas in the field needing for intervention. When detected, problem areas are communicated by the UAV to the UGV analysis module and higher resolution imagery of the critical area is captured by the system.
The Flourish robotic system can be adapted to a wide range of farm management activities and different crops by choosing different sensors, status indicators and ground treatment packages. All the developed components and technologies can work together or can be exploited individually. While the UAV allows the survey of large fields to identify critical areas on a macroscopic scale, the UGV works on a single plant level both for data collection and intervention.

The Flourish robotic system is highly collaborative as the UGV may act as a mobile docking and charging station for the UAV. During the missions, the UAV automatically lands and starts from the UGV to recharge its batteries. Moreover the UAV can upload data on the UGV data analysis module.

![The UGV and the UAV communicate to coordinate their actions and send data to the analysis module and to the farm operator. In this picture the UAV located a weed and reports the position to the UGV.](image1)

![The UGV is used as a mobile docking and charging station for the UAV, allowing it to survey large areas.](image2)

![In response to commands from the data analysis module or farm operator, the UGV enters the field.](image3)

![After entering the field, the UGV applies treatment to a targeted area.](image4)

**Progress so far**

In order to develop the Flourish robotic system, several project sub-components have been developed so far. Each of them contributes to the projects goals and can be exploited on the market individually.
**Navigation**

The UAV avoids local obstacles and plans its missions. The UGV has advanced technologies allowing own localization and terrain assessment. Overall, the UGV automated path planning uses information of UAV perception and spot detection, field data, weed treatment strategies and other additional information.

**Perception**

The UAV is able to carry out multi-spectral mapping and to estimate the spatial distribution of crop health and field status from the captured aerial images. Thus, it can conduct multi-spectral and multi-resolution environment analysis highlighting the problematic areas of the field. The UGV can map and classify crops and weeds, on the basis of its sensor data, to support automated ground intervention.

**Ground intervention**

The UGV perception capabilities allow the functioning of the UGV precision placement tool and of the ground intervention systems. The main ground intervention systems developed so far are: a selective spraying system specifically targeting areas infested by weeds and a mechanical weed treatment system able to remove weeds (with the stamping technique) without the usage of pesticides and without damaging the crop plants.
Use cases

**Sugar beet**

For Flourish, the primary crop use case chosen is sugar beet (*Beta vulgaris ssp. vulgaris var. altissima*).

Sugar beet is a high value/m², cash crop, and the planted acreage across Europe is relatively large. It is very sensitive to weeds, thus plant protection presents significant monetary and time costs to its cultivation. Furthermore, sugar beets are planted in clearly separated rows, allowing a robot to drive between them and providing a basis for effective mechanical weed treatment. Finally, due to changes in legislation, the European sugar industry is trying to reduce the amount of herbicides, at the same time as ensuring competitiveness to sugar cane-based products.

**Sunflower**

The second use case is represented by sunflower, which can benefit in various ways from the Flourish system: first, sunflower yield is also negatively affected by the presence of weeds. Secondly, various types of epidemics can drastically reduce the yield. Both weed protection and treatment of epidemics are two of the main applications targeted by the Flourish framework.
Flourish results are disseminated towards several stakeholders such as scientific experts, agriculture operators and organizations, business sector and policy makers.

This section presents the Flourish main dissemination channels and events.

### Summary

- Latest news
- Presentations
- Publications
- Social media

### Latest news

**ICRA Best Paper Award in Automation**

The Flourish paper "UAV-Based Crop and Weed Classification for Smart Farming" won the Best Paper Award in Automation of the IEEE Robotics and Automation Society at ICRA 2017.

Read all the Flourish news at: [http://www.flourish-project.eu/news/](http://www.flourish-project.eu/news/)

### Presentations

Flourish project has been presented during many public events, commercial and scientific conferences, workshops and fairs. Bosch is actively discussing Flourish with relevant business units inside the company as well as with other companies along the value chain including supplier, OEMs and end-users.
A presentation highlight was the grand opening of the new Bosch research site in Renningen, hosting Germany's chancellor Merkel obviously attracting the interest of the media. An article of this event has been published on the Germany's largest tabloid “Bild”.

**Publications**

From 2015 to August 2017, the Flourish team has published around 30 scientific papers, many of them have been published in two of the most prestigious conferences ICRA (International conference on robotics and automation) and IROS (International conference on robotic systems).

Please find Flourish publications at:

http://flourish-project.eu/documents/

**Social media**

A YouTube channel, a Facebook and a Twitter account have been set up. Videos, activities and results of the projects are available on these media.

https://www.youtube.com/channel/UC_1Jm_IpTwDJITPlcUCNVy

https://www.facebook.com/flourishproject/

https://twitter.com/flourishrobots

**ResearchGate project space**

A Flourish project space has been set up in the scientific social networking site “ResearchGate”. The space contains a description of the project, project log, references, and a space for questions. This allows interested people to follow the project and to stay up to date, especially with respect to scientific achievements within the project.

Please visit Flourish ResearchGate space at:

https://www.researchgate.net/project/Flourish-Aerial-Data-Collection-and-Analysis-and-Automated-Ground-Intervention-for-Precision-Farming
Get together!

SECTION #3

Summary

This section presents the main opportunities for project partners to exchange knowledge and experiences and to present the project results and potentialities to the public.

Meetings

From the beginning of the project three integration weeks have been organized to ensure integration of all the individual modules to a working subsystem.

In March 2017, the consortium met in Eschikon (Switzerland) for the third successful Integration Week. Preparations for a large scale data collection took place.

Next events

A fourth integration week is planned for the period 18-22 September 2017 in Rheinbach, Germany, followed by the second review meeting on the 12th of October 2017.

The Flourish team will be present at Agritechnica 2017 the leading trade fair for agricultural machinery that will be held from 12th to 18th November 2017 in Hanover, Germany. https://www.agritechnica.com
The Flourish consortium, led by ETHZ, consists of Universities, a leading technology supplier (BOSCH group), a scientific research center and a regional agency for agro-food sector services. For further details on Flourish Consortium please visit: http://flourish-project.eu/consortium/

Eidgenössische Technische Hochschule Zurich - Autonomous Systems Lab and Crop Science Lab

Rheinische Friedrich-Wilhelms Universität Bonn - Department for Photogrammetry

Albert Ludwigs University of Freiburg - Autonomous Intelligent Systems Lab

Robert Bosch GmbH

 Centre National de la Recherche Scientifique - Dream lab

Sapienza Università di Roma - Lab for Cooperative Cognitive Robots

ASSAM - Agency for Agro-food Sector Services of the Marche Region