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Community Research
SEVENTH FRAMEWORK PROGRAMME

RHEA Newsletter

Robot fleets for highly effective agriculture and forestry management

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1. 1st RHEA Workshop

The First International Workshop on Robotics and Associated High Technologies and Equipment for Agriculture (RHEA -2011) took place in Montpellier, France, on September 9, 2011. The meeting was hosted by CEMAGREF and attended by 36 participants. The program included a total 17 oral communications on various aspects related with general techniques for precision agriculture and with specific techniques for the RHEA fleet:

General Techniques for Precision Agriculture
A step by step guide for planning a site-specific weed management program for winter wheat *Fernandez-Quintanilla et al.*
Effect of thermal and mechanical weed control on garlic *Fontanelli et al.*
Effect of flaming at different LPG doses on maize plants *Frasconi et al.*
Evaluating chemometric tools to spectrally discriminate weeds in wheat *Gómez-Casero et al.*
Hyperspectral imagery to discriminate weeds in wheat *Rabatel et al.*
Software for mosaicking remote imagery from aerial mobile units *Gómez-Candón et al.*
Strategies for video sequence stabilization *Ribeiro et al.*
Effect of the spatial resolution and number of tie points in the mosaicking process. *Gómez-Candón et al.*
System geometry design for site specific treatment in precision agriculture *Guerrero et al.*
Techniques for area discretization and coverage in aerial photography for precision agriculture employing mini quadrotors *Valente et al.*
Specific Techniques for the RHEA Fleet
Analysis of engine thermal effect on electronic control units for RHEA robots *Barreiro et al.*
Path-planning of a robot fleet working in arable crops. First experiments and results *Ribeiro et al.*
Simulation of communication within the RHEA robotic fleet *Roca & Tomic*
Safety functional requirements for RHEA robots *Barreiro et al.*
Application of mechanical and thermal weed control in maize in RHEA project *Peruzzi et al.*
Wireless multi-interface management for QoS-enabled communication in the RHEA robotic fleet *Hinterhofer & Tomic*
Vehicle guidance on a single-board computer *Hoedlmoser et al.*

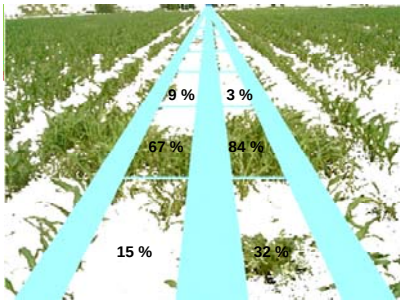
The research leading to these results has received funding from the European Union's Seventh Framework Programme [FP7/2007-2013] under Grant Agreement nº 245986

The Proceedings of this meeting, edited by P. Gonzalez de Santos and G. Rabatel are available at **http://www.rhea-project.eu**

2. CEMAGREF becomes IRSTEA

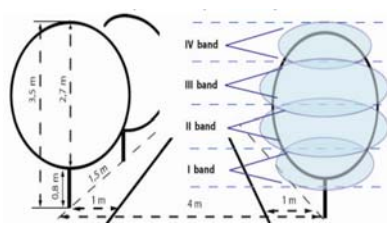
Thirty years after its creation in 1981, CEMAGREF, one major partner in the RHEA Project and host of RHEA-2011, has been renamed IRSTEA (**National Research Institute of Science and Technology for Environment and Agriculture**) to reaffirm its position at the heart of environmental research in France on the questions of water, management of environmental risks, green technologies and sustainable land management. Over the last 30 years CEMAGREF has developed a multidisciplinary approach to these topics which today gives it its strength and originality. However for more than 15 years it has suffered from a lack of public awareness and a gap between its mission and actual research topics. With its new identity, its strengths in environmental sciences on a European and international level, its research objectives, development, training and public policy support, IRSTEA will raise its profile in the political agri-environmental arena.

3. Devising new algorithms for weed detection



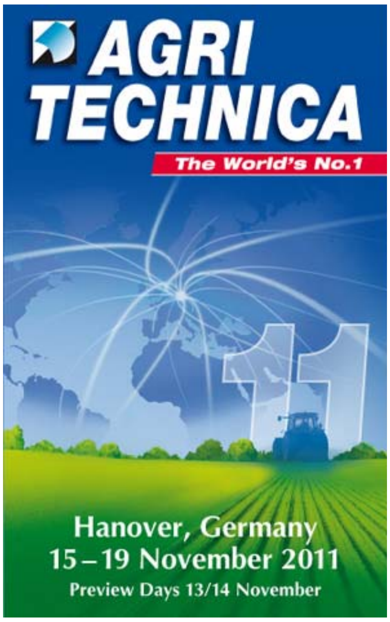
The generation of a weed map from a sequence of video images has been accomplished using a process that consists of three steps: 1. Green extraction, 2. Crop lines detection, and 3. Green pixels detection. Steps 1 and 3 are relatively simple in terms of computing time but the detection of crop lines consumes 88% of the total computing time. In order to minimize this time (without sacrificing precision) researchers from the **Universidad Complutense de Madrid** have devised and tested new mathematical algorithms that allow to quantify the proportion of weed cover present in different cells within the video image. Work in progress involves testing various adjustments of the camera (field of view, pitch angle, image resolution) and of the used parameters (green threshold, cell size, crop line margin).

4. Motorization of olive-tree implements



A research team from the **Università degli Studi di Firenze** is involved in the design and testing of an automatic unit for the application of pesticides on the canopy of woody crops. The sprayer, coupled to a small autonomous tractor, must recognize the presence, shape and thickness of the various horizontal bands of the canopy by adjusting the activation, the amount, the type of spraying and also by controlling the direction of air diffusors and the airblast flow rate in relation to the presence or thickness of the canopy. The system has been designed to control separately liquid (*dose and dropplets size*) and airblast vector (*intensity and direction*). In order to achieve this objective, several features have been introduced: a) Dose adjustment to canopy width on each band; b) Inclination adjustment of spray modules; c) Airblast flow control on each band; d) Air flow adjustment on fan manifold inlet proportional to number of spray modules opened. To reduce dose, and thus chemical flow rate o each nozzle, the opening time will be reduced with intermittent spray taking into account a balance of maximum frequency and better spray quality. This precision sprayer is expected to be tested shortly on superintensive olive crops.

5. Agritechnica sets the pace



Last November it took place in Hannover **Agritechnica 2011**. Over 2700 exhibitors and 415000 visitors (100000 of them from outside Germany) confirmed Agritechnica's leading role as a global forum for the agricultural machinery and equipment industry. It is interesting to note that numerous innovations presented in this fair were closely related with the developments of the RHEA project. At the special "*Smart Farming*" section, the concept of automation and robotics was shown with numerous examples, including an autonomous small tractor equipped with a high precision satellite system and a computer-based steering system. The tractor can follow a defined track within a field repeatably with minimum deviations and control mounted implements at predefined action points. The machine is able to recognize obstacles through laser scanners and react accordingly. A row hoe mounted at the rear of this autonomous tractor, guided precisely at a defined distance along the crop plants, was able to boosts the efficiency of weed control minimizing injury to crop plants. Two optical sensors that supply information about the nitrogen supply, crop density and weed infestation were also shown. Other exhibitors covered topics such as high-tech electronics, GPS/RTK sytems, FMIS (Farm Management Information Systems), Controlled Traffic Farming, etc

6. RHEA in the News


News from EurAgEng
Winter 2011/12

EurAgEng

EU funded research - collated by David Tinker

Agricultural Engineering and Technologies, AET, is a group that lobbies to have agricultural engineering topics included in research calls, particularly those of the FP7 research programme. AET is chaired by Prof Peter Pickel of John Deere, and himself the leader of an FP7 project 2ndVegOil (http://2ndvegoil.eu). Although the discussions and talks included very many acronyms that have to be slowly absorbed there were two talks that I thought were technically interesting and would interest EurAgEng members. In July 2010 there was an FP7 research call on *Automation and robotics for sustainable crop and forestry management*. You may remember, or even have been involved in one of the 19 proposals that were submitted. Two proposals were successfully funded, have started now and gave presentations at the AET workshop.

CROPS, Clever Robots for Crops, will develop scientific know-how for a highly configurable, modular and clever carrier platform that includes modular parallel manipulators and intelligent tools (sensors, algorithms, sprayers, grippers)

Another objective of CROPS is to develop techniques for reliable detection and classification of obstacles and other objects to enable successful autonomous navigation and operation in plantations and forests. The agricultural and forestry applications share many research areas, primarily regarding sensing and learning capabilities.

Coordinated by Wageningen UR from The Netherlands the project includes nine universities and research organisations with four commercial companies participating.

At the CROPS website www.crops-robots.eu there is plenty more information for dissemination including project workshop presentations on Sensing and Mechanical Design, and Horticultural Engineering.

The second project **RHEA**, Robot Fleets for Highly Effective Agriculture and Forestry Management, is devoted to the application of Precision Agriculture techniques. RHEA is focused on the design, development, and testing of a new

News from EurAgEng is the newsletter of the European Network for Engineering and Systems in the Rural Sector. In the last issue of this newsletter (winter 2011-2012), David Tinker, Secretary General of Agritechnica, reviews EU funded research, summarizing the two projects that were successfully funded in the last FP7 research call on *Automation and robotics for sustainable crop and forestry Management*: CROPS and RHEA. These two projects gave recently presentations at the Agricultural Engineering and Technologies (AET) Workshop. AET is a group that lobbies to have agricultural engineering topics included in research calls, particularly those of the FP7 research programme.

7. RHEA-2012, Pisa

The **First International Conference on Robotics and associated High-technologies and Equipment for Agriculture** will be held in Pisa, Italy, in September 18-21, 2012, hosted by the University of Pisa. The conference will be focused on the applications of automated systems and robotics for crop protection in sustainable precision agriculture. RHEA-2012 is divided into two main themes containing plenary and parallel sessions devoted to:

Strategies and tools for precision agriculture

- Topic 1.1: Automated machines for chemical weed control.
- Topic 1.2: Automated machines for physical weed control.
- Topic 1.3: Automated machines for tree crop protection.
- Topic 1.4: Agronomical, economical and safety impacts of automated machines use.

Automation and robotics for precision agriculture

- Topic 2.1: Design and control of autonomous agricultural vehicles and systems
- Topic 2.2: Sensing, computer vision and image analysis in agricultural processes
- Topic 2.3: ICT technologies in precision agriculture

The registration form can be downloaded from the RHEA conference website (**www.rhea-conference.eu/2012**)