Development of a robot fleet for pest management

Participants:

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Concept:

Robotic pest management will be conducted in two different scenarios. For weed control in annual crops, initial problem diagnosis will be conducted by periodic inspection of the fields using aerial units. This information will be georeferenced in order to make possible site-specific treatments. Computer programs will be designed for the decision-making process. Each individual tactic (chemical or physical weeding) will be assessed considering its efficacy and profitability. Online decisions will be based on stored information and on current weed status information. The distribution of all the ground units of the fleet and path planning for each unit will be planned. The actuation of all the fleet vehicles will be coordinated to achieve maximum weed control effectiveness, minimal crop damage and optimal cost/benefit relationships. Aerial units will monitor the overall mission status, identifying and solving any malfunction in the fleet and informing the operator. For insect/disease control in woody crops (agricultural or forestry) online spraying will be conducted using different types of air-blast sprayers controlled by sensors. In order to achieve these goals, numerous innovations will be required in various fields: perception systems, vision systems for safety, actuation systems, communication and location,graphical user interfaces, etc.

Equipment specifications:

The Base Station is the point of interaction between the mobile units and the human operator. It consists of a cabinet located next to the mission field and equipped with a computer and software specially designed to plan and control the missions of the ground and flying units. A wireless device and a GPS antenna have been installed to allow a real time communication with each of the mobile units and to correct the signal of each mobile unit GPS receiver.

Communication antenna (FTW)
GPS antenna (SAP)
Base Station (CSIC-CAR)

The Ground Mobil Units (GMI) are based on a CNH Boomer T3050 tractor, with a length of 1.7 m and a total weight of 1.6 tn. In addition of the standard 47 hp engine, they are equipped with a fuel cell and a solar panel and carry all the required equipment for autonomous work and weed detection (laser sensor, GPS, vision camera, communication systems, etc).

Communication antenna
Vision system
Safety controller antenna
Solar panel 200W
GPS antena
Fuel cell1200 W
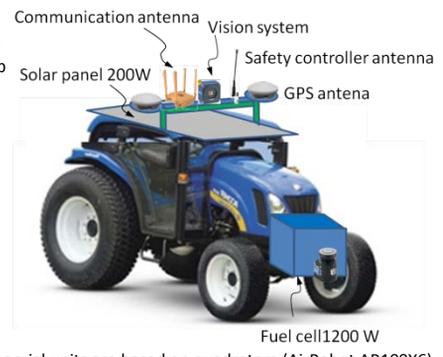
AR100-X6

The aerial units are based on quadrotors (AirRobot AR100X6) with a weight of 1.6 kg and a pay load of 680 g. They are capable to carry and control small cameras that will monitor fields in order to acquire relevant data with a high position estimation accuracy (25-100 cm).

For chemical weed control in wheat, aerial units will generate weed infestation maps. This information will be provided to a fleet of autonomous mediumsize sprayers. These vehicles will be equiped with GPS, sensors , control systems and leading edge injection systems and solenoid valves to spray diferentially various herbicides in different field areas.

For physical weed control in maize, although aerial scouting will provide basic information on extent and location of weed patches, actual weed detection will be conducted with two cameras located in the front of the vehicle. This information will be provided online to a mixed, mechanical-thermal, actuation system. For non-selective mechanical control in the inter-row area, duckfoot type elements will be used. For selective thermal control in the row, Liquified Petroleum Gas (LPG) burners will be used.

For spraying olive canopies we will use a lateral "Oktopus Sprayer". Inclination control of at least the two extreme diffusers (upper and lower) and start/stop of air (by a valve) on each pipe that give air to the diffusers will be controlled by appropriate sensors. For forestry applications we will use the "Cannon Boom" with only one big diffuser and tree different series of nozzles around the diffusers. In this sprayer the vertical pipe is telescopic to adjust height automatically and the diffuser is automatically inclinable in the vertical and horizontal planes.