USING A FLEET OF ROBOTS FOR PATCH SPRAYING

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Advanced technologies are essential for safe and efficient weed control. Using autonomous mobile platforms (both, ground and aerial) equipped with innovative perception techniques, data processing systems and tools for actuation makes possible to detect and control weeds site-specifically, reducing costs, environmental damages and risks for farmers.

From 2011 to 2014 the RHEA Project, funded by the EU 7th Framework Programme, has been involved in the configuration of a new generation of robotic systems for both chemical and physical management of weeds. This article summarizes the RHEA fleet of robots and analyzes the results achieved on the specific case of patch spraying winter wheat crops.

The project has tackled two kinds of missions: (1) an inspection mission, made by aerial units which carry the remote perception system; and (2) a treatment mission performed by ground units equipped with the spraying system. The aerial units were hex-rotor Unmanned Aerial Vehicles (UAVs or “drones”) equipped with two Sigma DP2 Merrill still cameras. In one of these cameras the NIR blocking filter was removed in order to turn it into a NIR camera. This solution was able to supply a high image quality (4704x3136 pixels) with low-price equipment. The ground mobile units (GMUs) were based on three Boomer-3050 tractors (CNHI) tuned to host the onboard computer, the communication equipment, the GPS (RTK) receiver and the GMU controller. Other elements integrated into the vehicles were a camera system, a laser and GPS and communication antennas. The GMU was carrying a sprayer with a 200L water tank and a 50L herbicide tank connected to a direct injection system to inject the chemicals into 12 solenoid nozzles activated independently and located on a 6m boom. The whole operation of the fleet (three GMUs and two UAVs) was controlled from an external Base Station equipped with a Mission Manager system and communication systems.

In January and May 2014 two assessment trials were conducted in a CSIC Experimental Farm located close to Madrid (Spain), using two artificially weed infested winter wheat fields. The assessments included the evaluation of the precision of the weed map, spraying operation, GMUs trajectories and fleet integration. Around a 95% of the weed patches were detected and over a 97% of them were accurately sprayed with herbicides. Slight delays in the opening and closing of the nozzles and some border errors were observed. The trajectory followed by the ground units barely deviated from the defined route plan pointing out high accuracy, deviating from the planned route less than 7cm (i.e., mean deviation) in the two tests performed. Regarding the performance of the fleet integration, the results showed that all three GMUs were able to work together cooperatively following pre-defined route plans.
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