Short Communication Journal of Electrical and Electronic Systems 2020
Vol.9 No.3

Robotics 2019: Robotics for a sustainable precision agriculture - Gerassimos Peteinatos - University of Hohenheim

Gerassimos Peteinatos
University of Hohenheim, Germany

The irruption of Information and Communication Technologies in agriculture has provided new tools, enabling the more regular and rational distribution of efforts and inputs. This leaded into the current farm management systems and crop management strategies that take into account the temporal and spatial variability of the crop. This irruption of new digital technologies, known as Agriculture 4.0 incorporated within Precision Agriculture, can revolutionize agriculture and herald the dawn of a more autonomous and stable agricultural world. A pallet of different applications can utilize this novel technology, for example in plant breeding, nutritional assistance or pest management. A pest monitoring system and the equivalent localized treatment applicator can be conceived as a complex artificial system consisting of (1) perception (sensors) for detection and 3D modeling of natural structures, focusing on values of importance and interest. (2) Decision making (processing) for the elaboration of an action plan that monetizes the parameters of interest extracted from the models into treatment decisions, always taking into consideration the perceived and established objectives. (3) Actuation (actuators): implementation of the treatment plan, closing the perception-decision - actuation loop through the control and development of intelligent tools. The integration of perception systems for the detection and control of action devices for treatment on autonomous mobile platforms will allow a more exhaustive, and therefore effective, pest treatment, as well as being more precise and safe both for the agri-food chain and the environment. This general approach is the basis for agricultural robotics.

There have been major developments in the world related to food safety and traceability. Some of the initiatives come from governments to protect the health of the citizens, the other are private initiatives by growers and retailers in order to meet the expectations of their customers with respect to food safety and environmental sustainability. Everyone in the food chain assumes that these expectations can be satisfied if production is done in line with good agricultural practices (GAP). It appears also that the origin and destination of animal feed, materials and food in all stages of production and distribution must be known and as information available to the qualified authorities or to food safety departments at manufacturers or retailers. Global G.A.P. is an example of a standard for primary agricultural production. A partnership between retailers, food traders and growers administers and maintains this standard that is being used worldwide. The aim is to ensure integrity, transparency and harmonization of global agricultural standards since sourcing of food, either fresh produce or processed farm products, has become a global activity. Precision agriculture technologies and robotics share the underlying ideas of GAP and may become important tools for complying with the regulations and for documentation of the production conditions as a proof of compliance.

The Scheme covers the whole agricultural production process of the certified product, from before the plant is in the ground (seed and nursery control points) to non-processed end products (Produce Handling control points). In response to the challenges posed by fast changing crop protection product legislation, the Global G.A.P. organization developed guidance notes to help farmers and growers to become more fully aware of the maximum residue limits (MRLs) in operation in the markets where the product will be sold.

Precision Farming and the use of Global Positioning Systems (GPS) on agricultural machinery, provide location and time information of all treatments. This is of course very important for automation like navigation during the different treatments or the collection of data on crop status, diseases and yields. After harvest, the GPS data may be added to the shipping documents such that the origin of the product (the region, the farmer, the field) can be traced and the consumer can be assured about the origin claims. It is also possible in mixed final products to state where the different component of such a mixture originated. For retailers or stores that claim to sell locally produced food and for their clients, it offers the possibility to trace the product and verify the claims as long as the system is fool proof.

Good agricultural practice implies that the correct dose of fertilizer is applied at the correct moment and in the correct way. The correct dose depends on the soil condition or the crop condition. Numerous efforts have been done for automation of the measurement of nutrient availability in the soils. They include automation of soil sampling for laboratory chemical analysis. The time delay for getting the results can be reduced by using near field chemical analysis using optical VIS/NIR techniques or electrochemical sensors on prepared samples or even on. The latter can be direct measurement ion-selective field effect transistors (ISFETs) with flow injection analysis or the measurement of ion activity using ion-selective electrodes. At this moment they are only for pH reliable. Although the electrochemical measurements can be geo-referenced, the time lag between sample collection and sensor output precludes on-the-go control of variable rate lime and fertilizer applications.

This work is partly presented at 2nd International Conference on Robotics and Artificial Intelligence May on 23-24, 2019 held at Vienna, Austria