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Systems Used in Precision Agriculture

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Abstract. Precision agriculture aims to exercise more control over a production system by recognizing variability and land management areas differently depending on a number of economic and environmental objectives.[1] The main objectives of the Culture Zonal Management system are: optimize production efficiency; optimizing quality of agricultural production; minimizing environmental impact of agriculture; minimize risks. To achieve objectives, precision agriculture uses several monitoring and control systems, of which one can remember: GIS (Geographical Information System) and GPS systems (Global Positioning System)

Keywords: precision agriculture, GPS, GNSS, GIS

Introduction. The term GIS refers to a database and computer programs that provide opportunities for storage, retrieval and processing of spatial data (or field). GIS software for precision farming management stores data such as soil type, nutrient levels, etc., in layers and assign that information to a named place in the field. A fully functional GIS system can be used to analyze the characteristics between different layers, to develop maps of agricultural land management, as well as other options. Coordinates of the field are stored by the receiver in the form of latitude and longitude, and usually using GPS (Global Positioning System). The software needed to create these maps is generally three types. First is the software that automatically creates maps from a given set of data, with a minimum capacity to change the default attributes of the map. It is technically only mapping software. Examples of this software include JDMap, Agleader Precision Map 2000, Micro-Trak, and FarmWorks.
The second type of software has more flexibility to change parameters of map and create maps of several features. Examples include GIS, Crop Growers Visage, Farms, and AgINFO.
The third classification of GIS software can be used for mapping agricultural areas: SSToolbox, FarmHMS, CDI AgMAPP and Aglink.

NAVSTAR GPS is a radio navigation system that provides position location information including position, direction of travel and time, to users equipped with special equipment for reception. Global Positioning System (GPS) is formed from a constellation of 24 satellites and their ground stations. GPS is using satellites as reference points to calculate positions accurate to the feet, but advanced GPS options (especially military) can be measured to an accuracy of less than one inch. In precision farming, GPS receivers are used to monitor and control the application of fertilizers, pesticides and with GIS (Geographical Information System) databases can be realized on many indicators required in the agricultural system.

GPS is used both as a manual control system for agricultural machines (soil tillage, sowing, fertilization and phytosanitary treatments) or as automated system for agricultural units.

Manual agricultural driving systems have emerged internationally since 1996, when the GPS system was declared operational. The main components of a manual GPS driving system are: a GPS receiver, a communication interface to show error in the reference position and can accept user commands (introduction of agricultural machine working width and location of the first route guidance) and a system of algorithms to apply the necessary corrections in relation to the guide line.[1]

1997 was the year in which it was first automatic driving system aggregate agricultural system marketed by the company Beeline.

The basic components of an automatic control system are agricultural unit: GPS; user interface to display errors from the reference line and the main working parameters; a system of algorithms able to calculate the error from the basic course; the automatic rotation of the steering wheel system; sensors for automatic disconnection in case of a risk situation; a process computer; sensors to compensate for errors induced by zone; other sensors needed: speed sensors, reversing sensors, etc.

In terms of the operator, automatic driving system has the following benefits: ability to perform other manager operations while driving (checking equipment and key board, working parameters of the machine); reduce driver fatigue.

In future, the agricultural aggregates will become fully autonomous and will be able to work on agricultural land, with minimal supervision. On the short term, two trends are emerging: autonomous vehicles in tandem, and multitudes of small vehicles.

For autonomous vehicles in tandem, the idea is to have one operator to control multiple vehicles. The second vehicle follows the first vehicle, at fixed working width distance and lateral, the third vehicle follows the second, etc.. This requires that vehicles have to be in communication with each other and to the person who monitors the operation of fleet vehicles. This approach could be quite well suited to combine harvesters.

Another approach is autonomous vehicles, a set of small vehicles, each vehicle with their own greater autonomy. Instead of using large vehicles, which may have a greater potential risk, the tasks are performed by a host of smaller vehicles, all of them already operating in coordination with each other. The main parameters of this autonomous vehicles: small (unmanned), lightweight, to show long-term autonomous behavior, to be able to receive instructions and to communicate information, to be capable of coordinating with other autonomous vehicles not acting dangerous, even if a failure occurs and to perform various tasks.[2]

Conclusions. In precision farming, GPS receivers are used to monitor and control the application of fertilizers, pesticides and with GIS (Geographical Information System) to create databases on many indicators for agriculture in this system.

Currently research is carried out on the opportunity, reliability and construction of fully autonomous vehicles. In the short term, two trends are emerging: autonomous vehicles in tandem, and multitudes of small vehicles.

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