SOME ASPECTS IN PREPARATION OF TRANSPORT AND FIELD OPERATIONS ON LARGE BULGARIAN FARMS BY USING GPS AND GOOGLE EARTH

Atanas Atanasov, Plamen Kangalov, Kaloyan Stoianov, Ivailo Angelov
University of Rousse, Bulgaria
aatanasov@ru.acad.bg

Abstract. Some problems in preparation of transport and field operations on large Bulgarian farms by using GPS and Google earth are discussed. The experimental investigations were carried out in experimental fields of the Institute of Agriculture and Seed Sciences (IASS) "Obraztsov chiflik" – Rousse. Hardware configuration – single Ashtec12 GPS receiver, GPS antenna, notebook computer, Garmin 205 GPS receiver; software configuration – system software GEOSURF SIZE1000 and Google earth software were used. The method of field experiment includes the next basic steps: measurement the point coordinate of 4 corners of the field, introduction of the work width of the work machine, distance between the GPS – work machine, outline of the field, work course, calculating the distance and route choice between the field and the farmyard, calculating the time for travelling and idle time. In the result of the field experiment a map for realization of transport and field operations in the IASS "Obraztsov chiflik" – Rousse is designed.

Key words: GPS, Google Earth, navigation, preparation, transport, field operations.

Introduction

Experience of the Bulgarian farmers in agricultural production, favorable natural factors and the lack of serious pollutants, predetermine the successful development of agriculture in the country. Despite the good conditions in recent years, there could some worrying trends be seen.

The continuing depopulation of rural areas and the aging population, lack of enough specialists led to a sharp increase in the demand for labor per unit of cultivated area, which has a significant impact on the quality and duration of the agricultural operations. As it is known the length and terms of employment impact on the yields of different crops and the income derived from them [1].

Conduct of agricultural operations of large areas for a short time at the appropriate time is difficult due to rapidly changing weather conditions. Because of that many farmers are forced to work long hours at the appropriate time.

The quality implementation of mechanized processes of wider areas, lack of specialists are problems, leading to demand for new solutions, such as the development and application of information technology (IT) for precise performance and control of mechanized processes and the development of simulation models WEB-based software and more.

With the introduction and implementation of new systems for precision agriculture, such as Global positioning system (GPS), Geographical information system (GIS), using infrared cameras, Google earth software etc., the implementation of transport and field processes such as plowing, fertilizing, sowing, harvesting etc. would be done very accurately and efficiently.

In contrast of most EU countries where the use of GPS in agriculture is widespread practice, in Bulgaria it is still at an early stage of implementation.

The reasons for this are attributed mainly to the lack of sufficient financial resources and limited access of Bulgarian farmers to European funds before the integration of the country in the EU, the slow pace of machine park upgrading, poorly conversance of the farmers about the benefits of these technologies, the lack of qualified specialists in this area etc.

By way of transformation into modern and competitive agriculture many farmers are facing many difficulties such as the use of existing material resources (equipment, people, warehouse), combined with modern technology entrants.

From these studies it is found that there is a lack of comprehensive research relating to the application of GPS in agriculture offering specific solutions to the needs of the Bulgarian farmers. Studies related to the application of GPS and GIS are few and have a theoretical nature [2]. The offering of GPS navigation systems and software from companies such as [3] does not take into account the real financial possibilities of the Bulgarian farmers and qualifications of the staff.

In view of the current conditions in Bulgarian agriculture, the farmers need a new integrated approach for collecting, processing and management of information that ensure sustainable interaction between the techniques involved, using the modern IT such as GPS and Google earth.

Materials and methods

The transport and field processes require executing of the work in short terms, engaging of big number of machinery, many workers etc. Complex interaction between technical means, people, natural conditions often leads to distortion of the sustainability of the operations and from there to extention of the time for work. The lengthening of the time for work leads to the diminution of the quality of agricultural operations, crop yields and income derived from them.

The development of IT and modernization of the agricultural machinery fleet are prerequisites for sustainable management of mechanized transport and technological operations.

An important step in managing of the mechanized processes is collection, processing and management of information for crops and the cultivation area, types of the operations, routes, work shape of the field, a work course etc.

The experimental investigations were carried out in experimental fields of the Institute of Agriculture and Seed Sciences (IASS) "Obraztsov chiflik" – Rousse. Hardware configuration – single Ashtec12 GPS receiver, GPS antenna, notebook computer, Garmin nuvi 205 GPS receiver shown on Figure 1; software configuration – system software GEOSURF SIZE1000 and Google Earth software were used. System software (GEOSURF SIZE1000) was installed in the notebook computer. There are three parts in the software: data recording, data estimation and graphic user interface (GUI) [4, 5]. Figure 2 shows the flow-chat of the software.

Results and discussion

This work presents two interconnected methods of collecting information through GPS and Google Earth. When using Ashtec12 GPS receiver and guidance software the method of field experiment includes the next basic steps: data recording as measurement of the point coordinate of 4 corners of the field by single Ashtec12 GPS receiver, introduction work width of the work machine, distance between the GPS – work machine, work shape of the field, a work course. Data estimation was to complete the data integrating and filtering, various data calculation, such as Kalman Filter (KF) solution, position estimation, navigation data estimation, and farm data designing was also included. By using Garmin nuvi 205 GPG the method includes measurements of the distance between the field and the farmyard, calculating the time for traveling and idle time, insert routes on Google earth map as it is shown on Figure 4 with the blue line. All collected data are input into an Excel file.

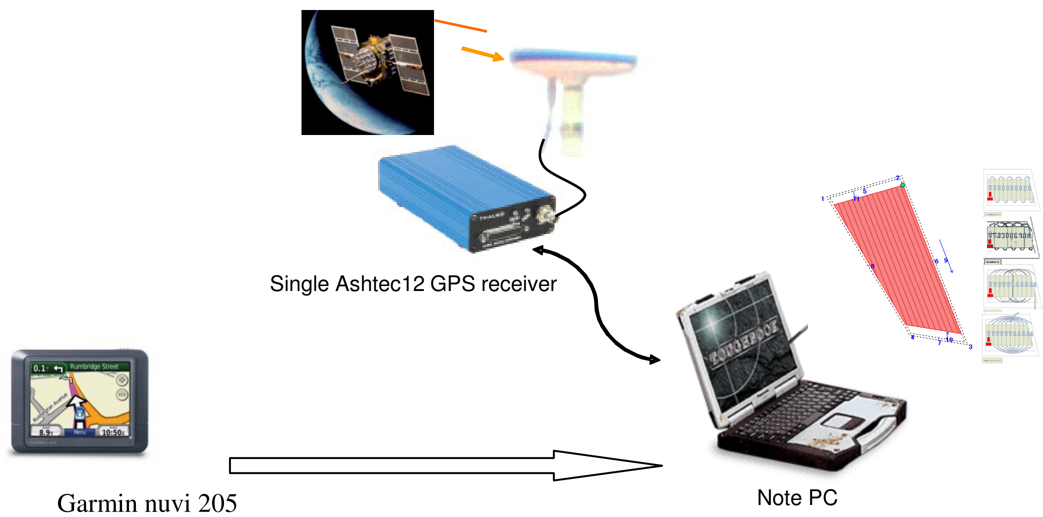

Fig. 1. **Hardware configuration**

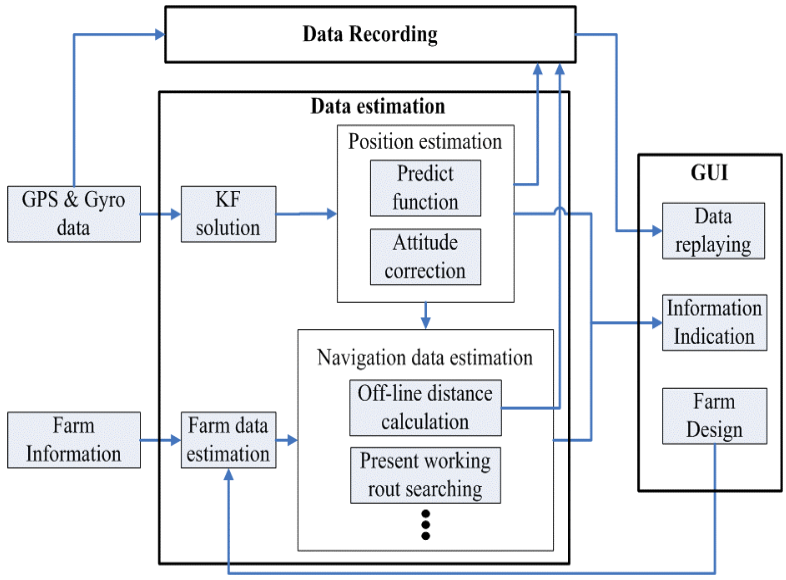

Fig. 2. **Flow-chat of the software of the guidance system**

The coordinate points of the farm are got by matching a local satellite photo of Google Earth. More than 2 correspondence points measured locally which are easy to find on a satellite photo are inserted into the map to confirm the accuracy of the map. With using Google Earth software (When unable to match with Vector map) the method includes selection of the point coordinate of 4 corners of the field, impute data in Excel file and compared difference from the points of Google Map and the measured points by Ashtec12 GPS. The average offset and collect points of Google earth are calculated. Then from the Google earth points, we can calculate correct points of the GPS coordinate. The next stage is to export the data from Excel, modify the data in GEOSURF SIZE1000 as each farm division is registered as filed points in the guidance system. The next step is drawing a cultivation area map. Some results of the method application are shown in Figures 3, 4.

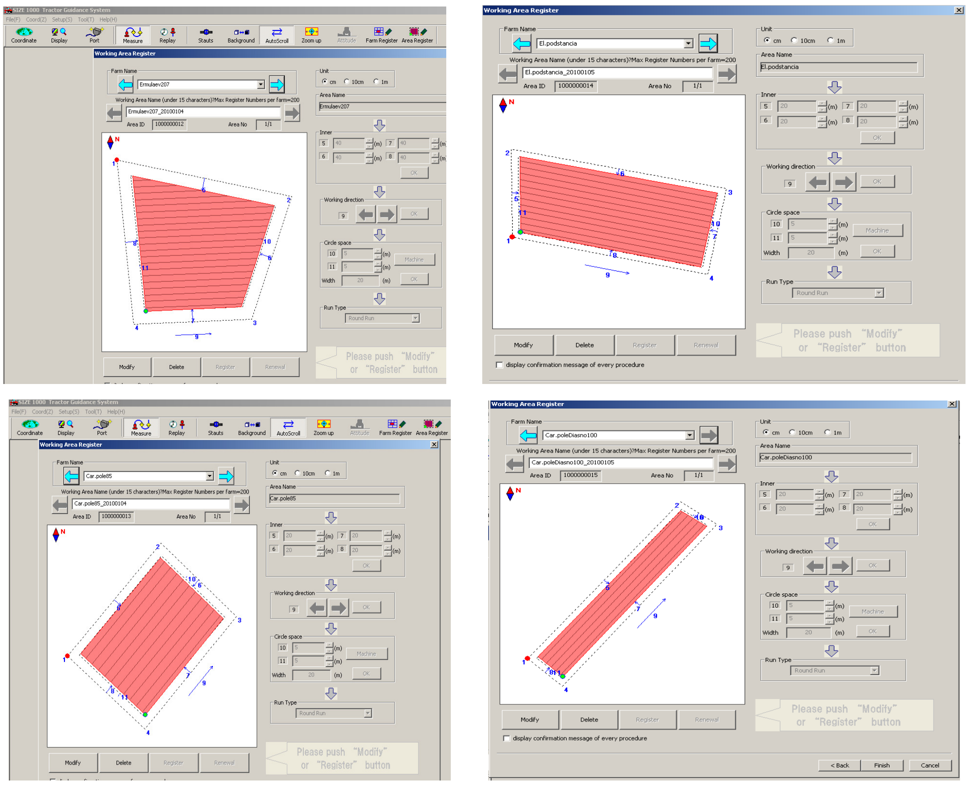

Fig. 3. **Charts of the field using system software GEOSURF SIZE1000**

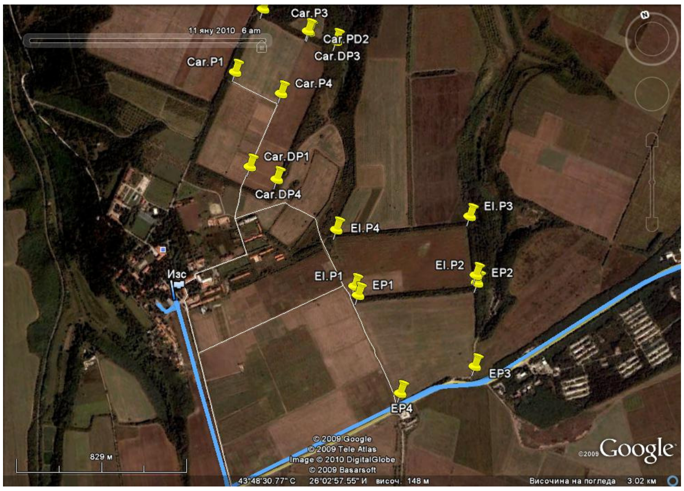

Fig. 4. **Coordinate points of the farm and field area got by matching local satellite photo of Google Earth and inserted route of Garmin**

An important step after specifying the type of the crops grown, the number and type of processing operations performed, navigational maps of individual fields, routes of movement of vehicles etc. is drawing the map showing the fields, roads, buildings shown on Figure 5.

Fig. 5. **AutoCad field map of a farm**

Conclusions

A method for preparation of mechanized transport and technology processes through the use of GPS and Google Earth is proposed. The method has the following advantages: collection of the primary data base by the use of cheaper GPS receivers and public available software, easy to understand for a broad range of users, map-making depending on the specifics of the region.

Acknowledgement

The studies were supported by the contract № BG051PO001-3.3.04/28, "Support for the development of scientific staff in the field of engineering research and innovation”. The project is funded with support from the Operational Program "Human Resources Development" 2007-2013, financed by the European Social Fund of the European Union.

The author Atanas Atanasov would acknowledge Dr. Keiichi Inoue from the National Agricultural Research Center – Region Hokkaido, Japan for discussing and help on the GPS guidance systems questions.

References

1. PROJECT 2009-AIF-Development and Investigation a New Working Organs and Applications of High Technology Systems in Agriculture Report on the research and personnel development in 2009, University of Ruse “Angel Kanchev”. (In Bulgarian).
2. NIK Ltd. [online] [22.03.2010.]. Available at: http://www.nik.bg/trimble/.
3. Inoue K., Nii K., Zhang Y., Atanasov A. Tractor guidance system for field work using GPS and GYRO. Proceedings of International Scientific Conference “Energy Efficiency&Agricultural Engineering”, October 1-3, 2009, Rousse, Bulgaria, pp. 280-295.
4. Vezirov Ch., Atanasov A., Kehayov D. Assessment stability of cereals harvesting process. Proceedings of International Scientific Conference “Energy Efficiency & Agricultural Engineering”, June 3-5, 2004, Rousse, Bulgaria, pp. 582-589.
5. Yun Y., Inoue K., Nii K., Uchiyama M. Integrating DGPS and 3D Gyro sensor in Tractor Guidance System for Precision Farming. Proceedings of 20th International Technical Meeting of the Satellite Division of the Institute of Navigation, September 25-28, 2007, Fort Worth, Texas, USA, CD-ROM.