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AGRITRONICS: AIDS FROM MECHATRONICS

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ABSTRACT
The precision agriculture, which comprises the agriculture as an application of mecha-tronics, enhances a new methodology (that aims at a new agricultural system) that could be the key to many current problems.
Precision agriculture components: teledetection and GPS, simulation models, support systems for decision and GIS, automatisation, robotised system, agricultural machines make possible to develop the Agricultural Mechatronics.
In the paper we present the opportunities that have favored the development of precision agriculture and the results obtained by the authors from the measurements of an important parameter of the soil: the conductivity. Dynamic measurements and GPS system, assure the simultaneous acquisition of the soil parameters. Specific data base can be obtained leading to high productivity and reduced chemical analysis cost.
Key words*:* *agritronics, soil conductivity measurements, maps on soil conductivity.*

1. INTRODUCTION
In these days the field of electronics continues to change and evolve rapidly. Electronics are increasingly being used to collect and process all types of data, transfer information, make decisions, and provide automation and control functions. Modern microcontrollers and semiconductor components offer many advantages and ease of use in designing custom measurement and control systems. The manual collection of field and laboratory data can be time- and labor-intensive. This constrains result in data often being collected at irregular or infrequent intervals. Automating the data-collection process can provide more information at regular and frequent intervals, and reduce labor requirements and costs. Advances in electronics and the availability and ease of use of electronic devices and components has made it easier and more affordable to automate many control and data-collection processes.
The Department of Fine Mechanics and Mechatronics from *Transilvania* University of Brasov in collaboration with the Research and Development Institute for Potatoes and Beetroots of Brasov - I.C.D.C.S.Z Brasov - has had intense preoccupations in the field of mechatronics applied in agriculture [1]:

• computer-aided installation for measuring the starch and dry substance content in potatoes tubers;

• installation for automated dosage of chemical liquids used as fertilizers;

• research and experiment of a mobile laboratory and of the automated system of acquisition and processing of phytoclimate data in the potatoes growing.

The precision agriculture, which comprises the agriculture as an application of mechatronics, enhances a new methodology (that aims at a new agricultural system) that could be the key to many current problems [3].

The opportunities that have favored the development of precision agriculture are [2]:

• capacity to understand the complexity of agricultural systems – systemic and holistic approach;

• capacity to monitor the phenomena and processes – computer-controlled data acquisition;

• achievements in computing techniques – hardware, software, fineware and data bases;

• improvement of interpretation and computing methods – statistics, modeling, simulation, decision support systems – DSS;

• development of geographic informational systems – GIS;

• occurrence and development of spatial analysis and statistics – Geostatistics;

• progresses of spatial technique – teledetection, GPS;

• technical achievements in automating and improving agricultural machines – agricultural mechatronics.

Improvement of crop quality and yields is a demand in modern aquaculture closed-systems. An important requirement for production costs is to be kept as low as possible to guarantee market competitiveness. The achievement of these goals implies the use of complex management and control systems to regulate, in an efficient way, a large amount of interactive physical variables. Recent developments in hardware and software tools namely microprocessors and microcontrollers, lead to the integration of complex control and management tasks in agricultural exploitations.

2. THE SYSTEM FOR THE MEASURING THE SOIL ELECTRICAL CONDUCTIVITY

Soil electrical conductivity (EC) in agriculture is a property of soil that is determined by standardized means. In order to measure soil conductivity we used four- terminal method (figure 1 –block diagram for measurements). The measuring principle consists in injecting a current with known value trough two external terminals and in measuring the voltage between the inner terminals. Taking into account the mechanical parameters, h the depth of terminals in the soil, and the distance between electrodes we can calculate soil conductivity [4].

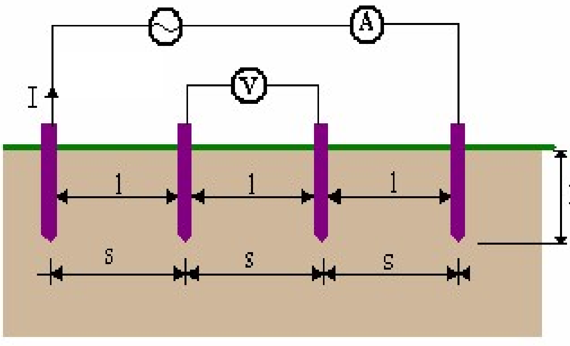

Figure 1. Block diagram for measurements

Figure 1b. Experimental setup

We designed and created a signal generator with various types of signals. Signal generator can supply three types of signals: sinusoidal, triangular and rectangle forms in three decades from 25 to 25000 Hz. The signals are amplified in a low distortion power amplifier.

3. THE EXPERIMENTAL RESULTS

Laboratory experiments (figure 1b) were made in order to obtain the influence of: distance between electrodes, temperature, signal frequency and humidity on the conductivity. In the figure 2 is presented the influence of the signal frequency at 30 cm distance between electrodes. We concluded that optimum field frequency, for which the conductivity stay almost constant is $[50 - 400]$ Hz. To avoid the 50Hz noise, in literature it is recommended 400 Hz frequency.

In the figure 3, is presented the humidity influence on soil conductivity at constant temperature (18,7 C), distance (30 cm) and signal frequency, 50 Hz.

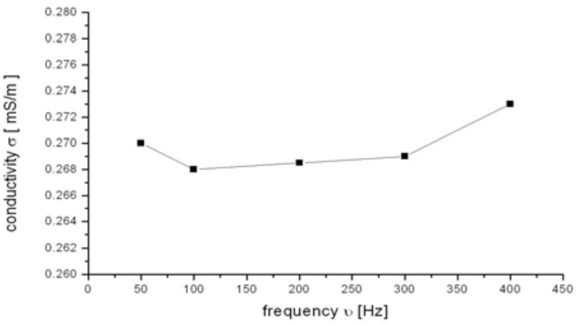

Figure 2. The influence of the signal frequency

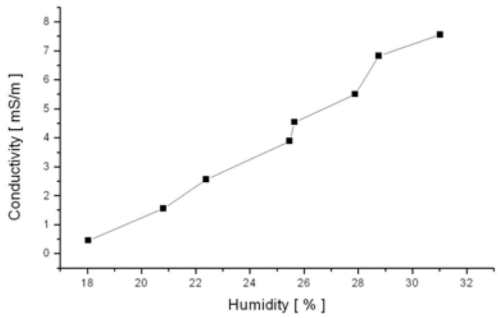

Figure 3. The influence of the humidity

The experiments were carried out on the areas belonging to I.C.D.C.S.Z Brasov on chernozemic cambic soil, characteristic of about 5% of the agricultural fields in the county and 15% of the agricultural fields in the depression of Barsa.

The depression of Barsa, where the Institute of Brasov (I.C.D.C.S.Z) is located, belongs to the intra-mountainous plain naturally drained, situated in Tara Barsei and formed through deposit, stratified and carbonated.

In the area of I.C.D.C.S.Z Brasov there are soils belonging to molic, hydromorphic and weakly developed classes. The first class is made up of chernozemic, rendzina, cambic-gley and underground soils from the class of weakly developed soils. The chernozemic, rendzina, gley soils are predominant.

4. FURTHER DEVELOPMENTS

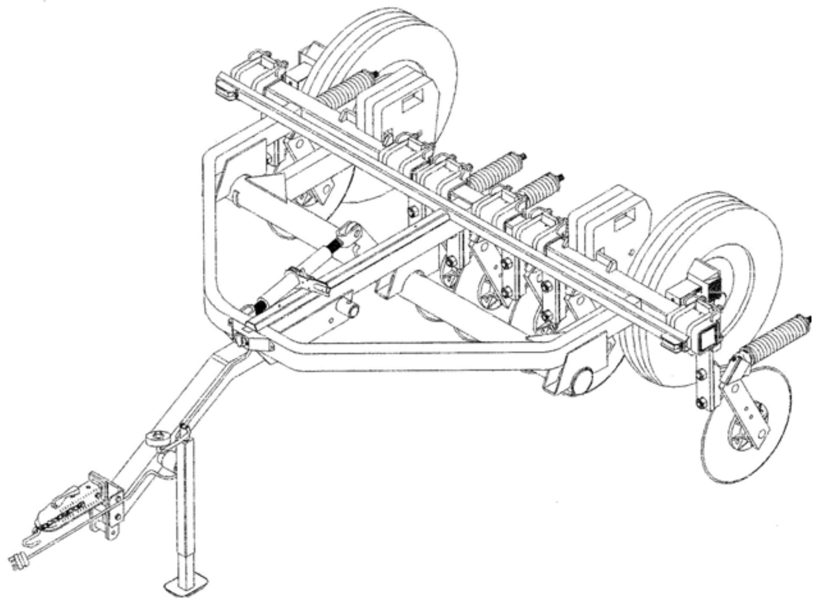

Figure 4. Continuous soil conductivity measurement device

In figure 4 there is presented the continuous soil conductivity measurement that will be further designed and realized by our team. The device will be attached to the vehicle especially designed for this purpose. Measurement electrodes, disk-shaped, assure the continuous measurement in soil. The disks are rolling at the displacement of the device. The measurement device and the computer which routes the soil conductivity map, according to the block diagram in figure 1, are placed on the vehicle. The block diagram for tracing maps on soil conductivity by using the systems of global positioning, acquisition and data processing is presented in figure 5.

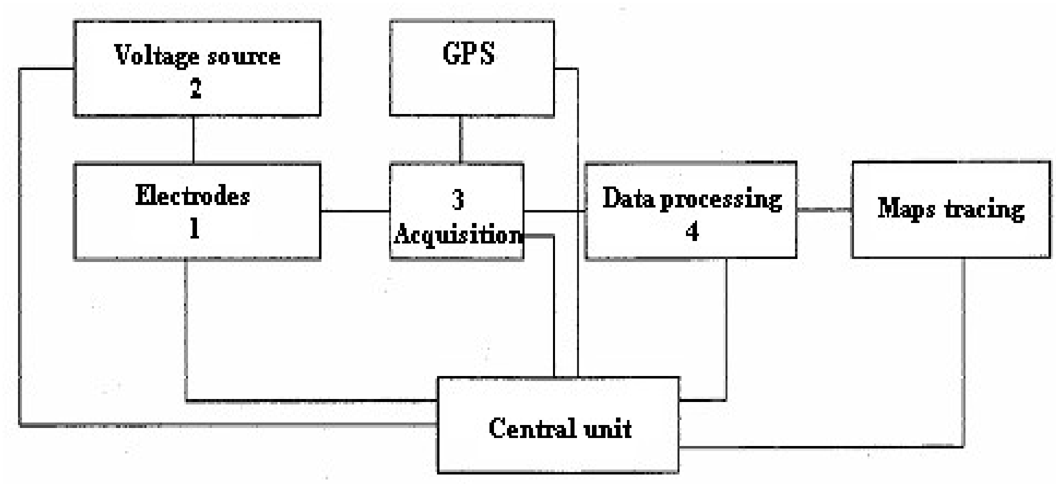

Figure5. Block diagram for tracing maps on the soil conductivity

5. CONCLUSIONS

Results of the laboratory experiments confirmed us the modality of the designing the entire system for the measurement of an important properties of the soil: conductivity. The agriculture researchers will use this data to optimum crop growth.

The final result will be an integrated system able to measure, to acquire and to map the soil conductivity chart. This will give the opportunity to agriculture engineers to plan and obtain enhanced quality and quantity yields per hectares.

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