THE USE OF THE VIRTUAL INSTRUMENTATION FOR THE FARMING MANAGEMENT

Catalina Turcu
„TRANSILVANIA" University of Brasov
Brasov Rozelor, no. 37, Brasov
Romania

Ciprian Olteanu
„TRANSILVANIA" University of Brasov
Grivitei, no. 54, ap. 36, Brasov,
Romania

Braun Barbu
„TRANSILVANIA" University of Brasov
Griviței, no 91, ap 9, Brasov
Romania

Corneliu Drugă
„TRANSILVANIA" University of Brasov
Al. Vlahuta, no 32, ap 12, Brasov
Romania

ABSTRACT

In the precision agriculture, the portable sensors were used for the first time as a method for evidencing the soil electrical conductivity, in order to deliver some indirect measuring of some soil properties, who is subjected to the research.

As a solution for the soil resistivity measuring the four electrodes method was proposed. The soil electrical conductivity measuring equipment was made for small depth determining, and, as a classic way, there were used two multimeters for the applied to the internal electrodes voltage level measuring and also for the external electrodes current intensity reading. The two measured values permit the electrical conductivity values calculation, in each soil measured point.

Afterwards there was created a virtual instrument for the displaying of the soil electrical conductivity values and also for the 3 – D graphic representation of these values, using the Lab VIEW graphical programming software. The coordinates of the points in which the measuring is made, are deliver on the serial port, by a Garmin portable GPS system.

Key words: virtual instrumentation, precision agriculture, soil electrical conductivity, GPS mapping.

1. THE PRECISION AGRICULTURE MANAGEMENT

The researches carried out in the area of precision agriculture demonstrated the connection among soil's chemical and physical properties and its electrical conductivity. The electrical conductivity of soil is practical produced in the water layer that fills the pits among the particles of soils, and ca be influenced by a proprietary series ale of the soil porosity, water content, salinity level, cations exchange capacity and temperature

The precision agriculture aims to optimize the use of soil resources, water and chemical inputs resources (fertilizers and pesticides) on local specific bases. Some major objectives of precision agriculture are obtaining quality and important productions, optimizing the economic profits, achieving the environment protection and increasing the sustainability of agricultural systems.

There have been develop two methods for measuring electrical conductivity of soil, one without contact, using electromagnetic sensors, and another, with contact between electrodes and soil. The direct method has as principle of measuring the four terminals method that consists in injecting a current with known value through two external terminals and measuring the voltage between the inner terminals. Taking into account the mechanical parameters, h the depth of terminals in the soil, and l the distance between electrodes we can compute the soil electrical conductivity.

In these paper, the research team want to share the results obtained in measuring the electrical conductivity of soil using the direct method, in order to relate them whit some properties of the soil.

As first stage investigatory we developed the activity of building the portable pick-up sensor. The electrical conductivity sensor were conceived for determinations to little depths, These two measured values allow to compute electrical conductivity value in the point of measurement.

2. THE USE OF THE VIRTUAL INSTRUMENTATION IN MEASURING AND 3D PLOTTING OF THE ELECTRICAL CONDUCTIVITY

The real instruments of measure gives us the values of the voltage and the amperage, which can be registered in the virtual instrument that calculate the values of the electric conductivity of the soil in the point of measurement. Subsequently, these dates should be represented in 3D, the coordinates of the points of the measurement should be delivered by a portable GPS Garmin.

The panel of virtual instrument was built so that we could set up the distance among electrodes (mm) and the previous values determinates for the **voltage**(V) at the internal electrodes 2 and 3 and the values determinate for the **electric amperage**(mA) at the exterior electrodes 1 and 4. You can also validate the registration by using the **mark up** button. The program get on with the registration of valuable sets concerning electrical conductivity until the number of measurements is achieved. The number of measurement result by multiplying the value in the **number of rows** control with the value in the **number of measurement point per row** control. The panel shows up the values of the voltage, electric amperage and the electric conductivity in three vectors called so far.
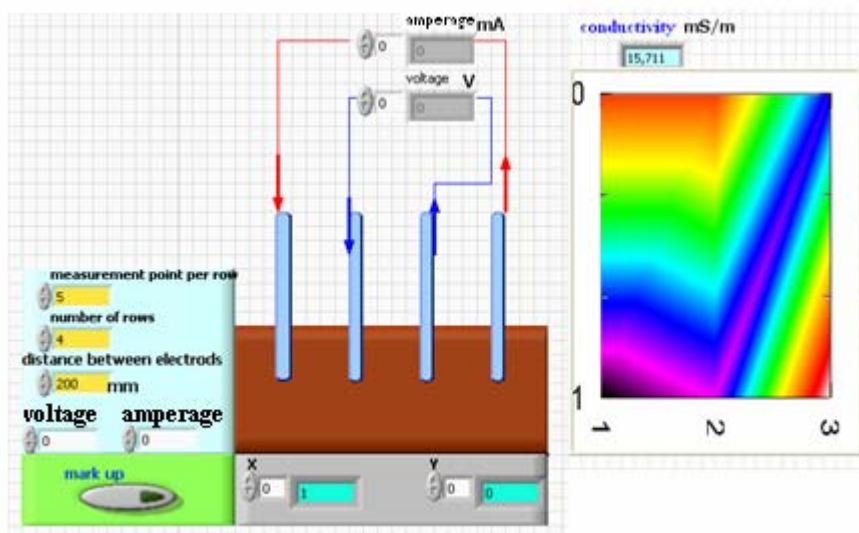

Figure 1 The front panel for the mapping of the electrical conductivity of the soil

The field on which were done the measurements had been split in a number of rows, to a certain distance, and on each row there had been accomplished a number of measurements. In figure 2 it can be seen the split of the field in four rows, from 1 to 4, on each row there are a number of three measurements, 0, 1, 2. The technique of measurement require the generation of the couples of numbers (1, 0) feather to (4, 0) then getting on with (4, 1) to (1,1) and with (1, 2) to (4 2).

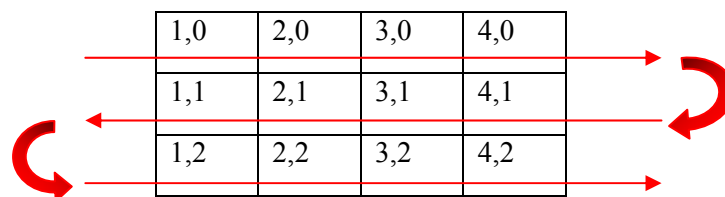| 1,0	2,0	3,0	4,0	
1,1	2,1	3,1	4,1	
1,2	2,2	3,2	4,2	

Figure 2 The points of measurement in the field

The position of the point of measurement is generate by the program using the sequence   which create two arrays representing the couples of X and Y of a point. On front panel they could be noticed the digital indicators X and Y, the couples formats would be identical with one from the field. Locating on the front panel of the two digital controls **number of measurement point per row** and **number of rows** allows us to do you own sets in regard with these dates, but also to the program to compute through **Function, All Function, Numeric, Multiply** the number of points of measurement, what value is logged on terminal N of the For structure where are the program sequence for providing the values of the voltage and the amperage.
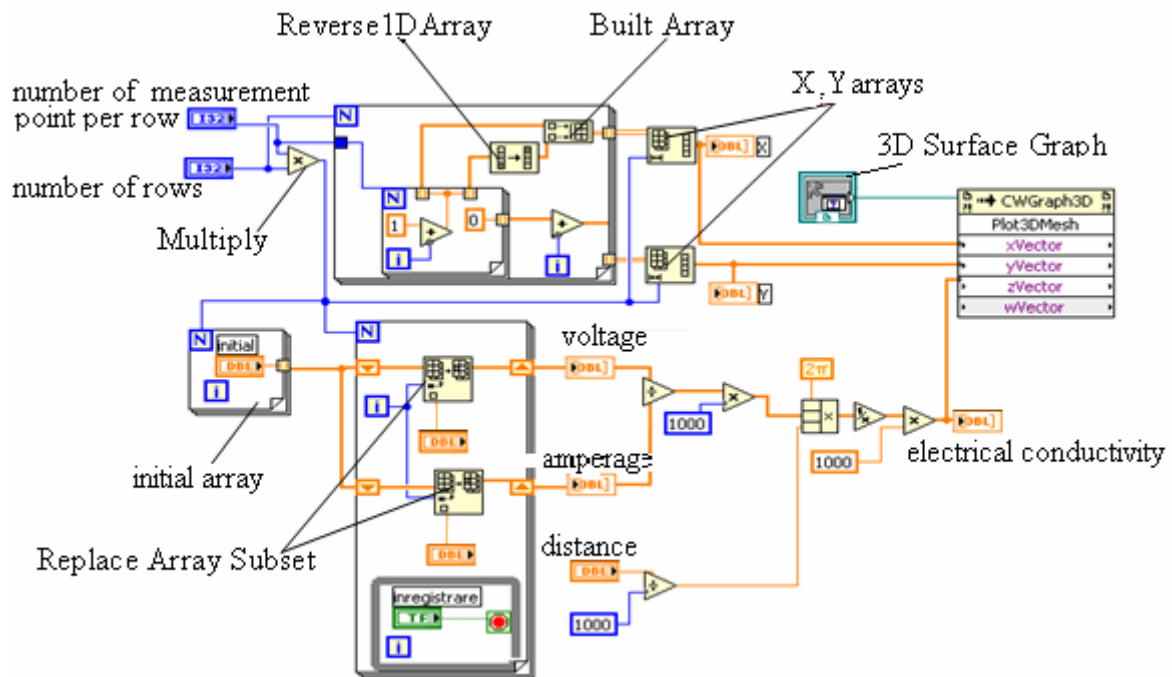

Figure 3 The diagram of the virtual instrument virtual for computing and 3D plotting of the electrical conductivity

Sequence of program contains two For sequence one into another. In the internal FOR sequence was written the program for the generation of two vectors, one with values from 1 to a number set up by the user at **number of measurement point per row** , the second with the values from the set up number to 1. This second the vector is due to contains same elements as the first, but in reverse order, what is obtained with function **Reverse 1D Array(All Functions, Array, Reverse 1D Array).** This two vectors are concatenate through function **Built Array**. The same sequence allows to generate another array with current number of the row (starting at 0 from program). The external For allows the repetition of the sequences that generates vectors in an equal number with **number of rows**, logged at N terminal of a this For. So are obtain two vectors, one for X, the other for Y, placed on the frontal panel as Array exit elements **(Controls, All Controls, Array& Cluster, Array).**

Is enforced the generation of an initial array witch provide a series of value that will be replaced with the values provide numeric control present at panel as voltage and current. This is accomplished in sequence of program containing a For with terminal connect to previous Multiply entered, in the sequence is placed **initial** control that set up initial value in the. This control is hidden on panel, with option **Hide Control**, so that isn't accessible to the user.

The controls for the introduction of the numeric values presenting the value of the voltage and the current are placed in the forth For sequence from the diagram, that so contains two functions **Replace Array Subset** t its index 0 is bound the counter i of the For sequence. In this way, each new value entered replace one value from initial array, from corresponding position of the current value of index i. This control is placed in the diagram window in a **While** structure **(Functions, All Functions, Structures, While Loop)** that give permission to pass at a new measurement point only after we place the electrodes at a new position.

On the front panel we can noticed that we express the voltage in Volts and the current in milliamper. Sequences of program compute the value of electrical resistance using the mathematic function Div, with one entrances connect to the voltage and the other to current, and if we want to express final result in ohms it's required an amplifier with 1000.

$$[R]=[U]/[I] =V/mA=V*10^3/A=\Omega*10^3$$

To compute the electrical resistivety in the point of measurement we use the **Compound Aritmetic** function set up as **Multiply.** It has to be considered that the distance between electrodes is set up in millimeters, an so far we need it in meters we have to divide it with 1000.

$$[\rho]= 2\pi*[R]*[d] =2\pi*\Omega*10^3*m*10^{-3}=2\pi*\Omega*m$$

The electrical conductivity result as inverse of the electrical resistivity, and usually is express in mS, so it has to be multiply width 1000

$$[\sigma]=1/[\rho] =1/(2\pi*\Omega*m)= Simmens /m$$

Were conceived this application for the 3D representation of the values electric moderate conductivity in different points in field. On front panel we place an indicator **3D Surface Graph**, available in **All Controls, Graph**. In the diagram we erase **3D Surface. Vi**, what uncage the terminal of the **Activex container**. This terminal connect with the terminal **reference** of **Invoke Node** function, from **All Functions, Application Control**. So far we chose the method **Ploth3Dmesh**, through right clicks mouse on method. Using the **Operating** tool from the **Tools palette** (from the Window menu), we should connect that three matrix previously define, respective X, Z and electrical conductivity.

To set up the front panel we proceed to activate the pop-up menu of the chart, through right click on it, from which we chose **Cwgraph3d, Properties**. We could also add some graphic elements available in **Controls, Decorations**.

3. CONCLUSIONS

The coordinates of the points of measurement are provided by a GPS Garmin, what permits to maps the measured property of the soil, so far electrical conductivity. This the virtual instrument permits, through the connecting-up to a mobile system of pick-ups, the gathering of the date conserning to the electric conductivity of in a soil in less time than in traditional variant in which a pesron gathers proofs of soils. The automatic of a generation maps of electric conductivity of the soil, for big off-road surfaces permit the decrease number of points of collection of the proofs of soils, only in points with diferent values or electrical conductivities.

4. REFERENCES

[1] Olteanu, C., Zamfira, S., Olteanu, Gh., Turcu, C., Olteanu, F. – Designing and implementing an intelligent system for measuring, aquiring and tracing maps with regard to soil electrical conductibility experimental model, Acta Technica Napocensis, Tehnical University of Cluj Napoca, 2006, volIII, pag 601-606
[2] Braun, B; Turcu, C; Drugă, C –The electrical conductivity of soil measurement with the virtual instrumentation –International Workshop „Advanced Reaserches in Computational Mechanics and Virtual Engineering", 18-20 October, Brasov, Romania
[3] Cottet, F., Ciobanu, O. Bazele programării în LabVIEW, Editura MATRIX ROM, Bucureşti, 1998
[4] Ursuţiu, D., Iniţiere în LabVIEW, Editura LUX LIBRIS, Braşov, 2001