Automation of Large RPC Electrodes Surface Resistivity Measurement

S. Shree, M. K. Singh, A. Kumar, N. M. Muthu, D. Grover, V. Singh*, V. S. Subrahmanyam

(For the INO Collaboration)

Nuclear Physics Section, Physics Department, Banaras Hindu University, Varanasi - 221005, INDIA

**Email: venktesh.singh08@gmail.com*

This article discusses methods for the automation of the surface resistivity measurement of large Resistive Plate Chamber electrodes. These methods consist of placing two probes that make contact on the surface of the electrodes. Fabrications of experimental setup, calculation of time, computer control and data acquisition method are given for the chosen method.

Introduction

In case of large size and large number of sub-detector experiments fast and accurate measurement of parameters is one of the key factors to complete experiments timely and successfully. In this article we present an automated method for the surface resistivity measurement of large surface area (2m x 2m) and large number (~60000) of Resistive Plate Chamber (RPC) electrodes in a short period. We have designed a suitable computer controlled device using two, double bound (forward and backward or up and down), light weight and small size electrical motors for surface resistivity measurement by using the two-probe method. Some other possible automation devices will also be discussed.

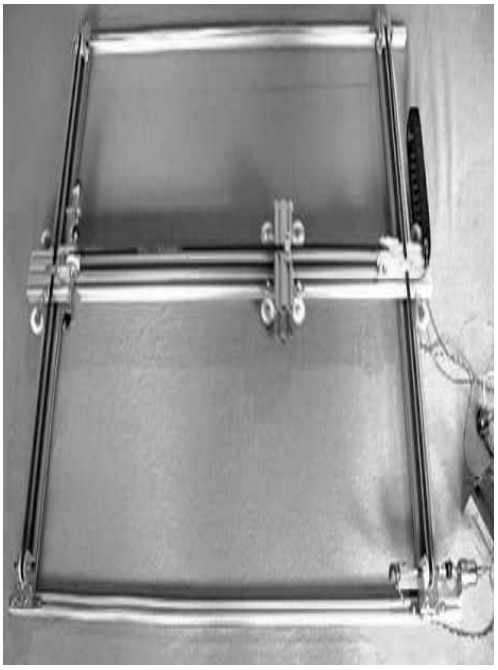

Fig. 1: Aluminium bars correspond to the X, Y & Z - axis.

Method

The surface resistivity is measured using a multimeter connected to a jig (made up of conducting foam). The jig moves on an aluminium bar attached to rectangular aluminium frame (200cm x 200 cm). The arrangement is shown in Figure 1. The aluminium bar and the jig on it can move freely on the frame along any desired axis. These are moved with the help of two small light weight motors, which are computer controlled. As the jig moves along the surface, the multimeter would record the resistivity values. For each step jig will take five seconds after that it will move 30cm in twenty second for the next step. Similarly we could take measurement of surface resistivity of complete glass electrode.

It is also possible to use six jigs (30cm x 30cm) attached by plastic sheet (200cm x 30cm) along X-axis. One digital multimeter will be connected corresponding to each of six jigs. A motor (DC/12 Volts/10 RPM) would be used for the movement of plastic sheet along Y-axis. Using this motor plastic sheet would move (30cm) along Y-axis in the time interval of 5 seconds. Other motor would be used for the up and down movement of the plastic sheet. Using this method, we could take observations of resistivity of the whole area along X-axis simultaneously.

Calculation of time

We calculate time of surface resistivity measurement for actual size (200cm x 200cm) glass plate assuming that the size of each jig is 30cm x 30cm, 100 RPM motor and ~ 5cm shaft diameter. Using the automated scheme for the measurement of surface resistivity of electrodes, time calculated for

both methods are about 240 days and 40 days respectively.

Prototype Construction for Surface resistivity measurement

The Resistive Plate Chamber consists of two parallel high resistivity electrodes plates. These plates are painted with a conducting coating, which is used to distribute high voltage on the electrodes [1]. We have taken second method to measure surface resistivity of a 50cm x 50cm glass RPC, using 6cm x 5cm long conducting foam jig. A plastic sheet attached with six jigs will be assembled on an aluminium slot may be made to move with the help of a motor (12V/DC/10 RPM). The fabrication of aluminium slot is shown in Figure 1. We plan to take two alignments for the same surface of RPC electrodes first along the horizontal direction followed by the vertical direction. For each face of RPC, we obtain two plots. Hence, we will take 83 readings on one surface. With the help of observed values, a contour plot will be drawn automatically using Root software package.

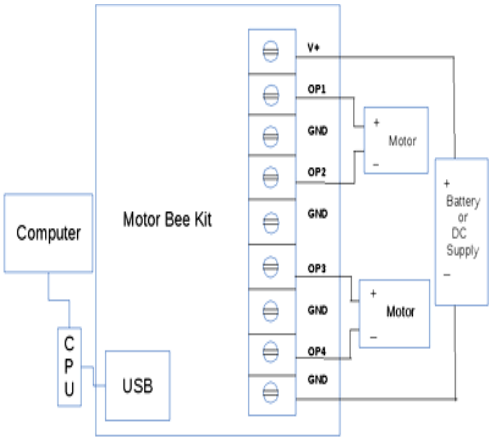

Fig. 2: Circuit diagram of the motor control kit.

Motor Control

Figure 2 shows the circuit diagram of the motor controller kit with two motors for desired movement and control of the setup. These two motors will be connected between two outputs OP1, OP2 and OP3, OP4 for the bidirectional movement of the motors. We will use the *motor way* software provided with motor bee to control both its speed and direction by tuning the slider controls along with the On/Off sectors.

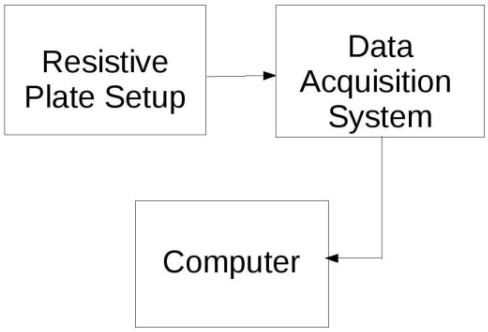

Fig. 3: Block diagram of the data acquisition for the surface resistivity measurement.

Data Acquisition for the surface resistivity measurement

A block diagram is shown in Figure 3 for data acquisition of the resistivity measurement. Data from digital multimeter will flow to data acquisition system to convert the resulting data into digital numeric values after which data will be transferred to computer for further analysis.

Summary and Out look

This method maybe used for precise measurement of the surface resistivity of electrodes in a short span of time and therefore, suitable in large scale measurements. This method may be employed for the calibration of the RPC detector by replacing the jig with radioactive source such as Cesium (^{137}Cs) at each crossed points of pickup panel strips. Our future work is to operate the movement of the plastic sheet using motor controller kit with PC and real-time data acquisition in order to devise a complete automated setup.

Acknowledgments

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References

[1] Christian Lippmann (2003). Detector Physics of Resistive Plate Chambers, PhD Thesis, Goethe University Frankfurt am Main, Germany