# Performance study of automatic connection scanner for readout strips panel of RPC Detector

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A fast and accurate automatic connectivity scanner mechanism may impact the appraisal of the scientific results. This article is focusing on the performance study of earlier developed automatic connectivity scanner for readout strips panels of RPC detectors.

## 1. Introduction

The **I**ndia based **N**eutrino **O**bservatory (INO) experiment is going to use ~30,000 Resistive Plate Chamber (RPC) detectors along with the 60,000 readout strips panels. Two readout strips panels are used to pick up charge of the particle from both side of the RPC detector [1]. The readout strips panel on one side is made of copper strip and other side is covered with aluminum sheet which will act as ground and terminated with 50 Ω resistances. So each read out strip panel (2m × 2m) has ~67 readout strips. It means INO will have to check around 08 million connections before going in full-fledged operation. To make this measurement fast, accurate and least human-dependent, we developed an automatic connectivity scanner. In this article we present performance results of this system based on 50 cm × 50 cm readout strips panel. We address some criteria fixing problems related to the parameter of this system such as, not properly connected connection, shorted strips, broken connection etc.

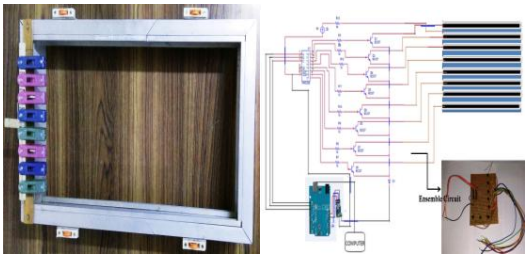

**Fig. 1:** A photograph of prototype ACS and complete working circuit.

## 2. Prototype of automatic connectivity scanner (ACS)

In fig. 1, photograph of prototype ACS having size 35 cm × 62 cm is shown along with working circuit diagram. The fabrication process and working mechanism of prototype ACS has been discussed in detail in Ref. [2].

We first performed the connectivity checking test with the prototyped ACS machine while applying 2 Amp current as an input for all the eight strips of the readout strips panel, and the obtained result is shown in Fig. 1. From Fig. 1, we may observe that the current value is almost constant within the error bar.

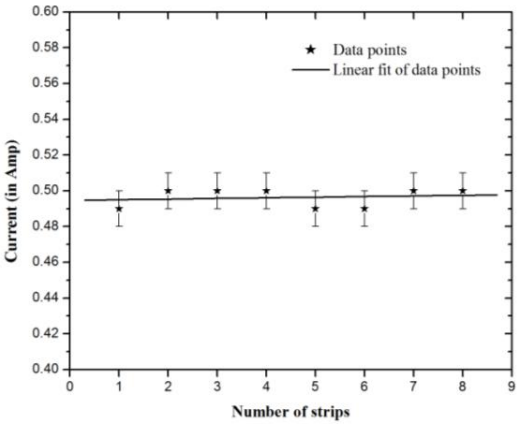


**Fig. 1:** Variation of output current value of different strips of the panel.

## 3. Parameter fixing criteria

Sometimes connections are not properly connected due to the improper soldering.

***a) Well connected connection***

For this purpose we performed connectivity checking test about 1000 times of one well connected connection of strip. The obtained result is plotted in Fig. 2. In case of well connected connection, the mean value of current 2.85mA is observed while the applied input value is 50mA.

The efficiency of the ACS machine is 82% within 1σ. There is a still chance of improvement in this value.

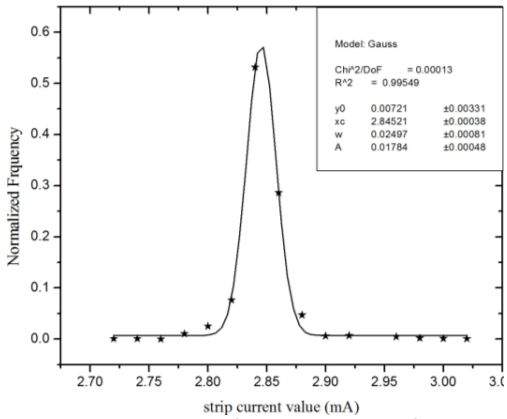


**Fig. 2:** Distribution of output value of the well connected connection.

***b) Shorted strips connection***

There is a high chance of short connection of strips of the readout strips panel. We studied various options of shorting the two strips such as shorted at the top, middle and the bottom side of the strips. The observed results are plotted in Fig. 3.

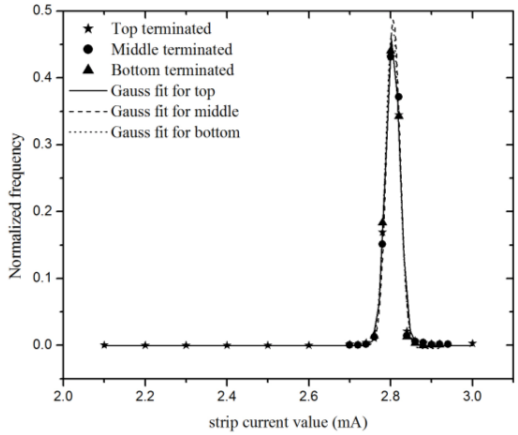


**Fig. 3:** Distribution of shorted strips connection.

It may be seen from the Fig. 3 that there are no change in current value among three type of shortening of strips, i.e., the current value is independent of the position of shortening. From both Figs. 2&3, we can observe that the mean current values are well separated from each other with more than 2σ value margin.

***c) Loose connection***

We made the connection loose forcefully in the strip of the panel. Loose means not well connected but by eye it is hard to identify that this connection is loose or well connected. We performed the test 1000 times in a similar condition and obtained results are shown in Fig. 4. Fig. 4 shows that the present ACS machine is not in position to distinguish between loosely connected and short circuited connection.

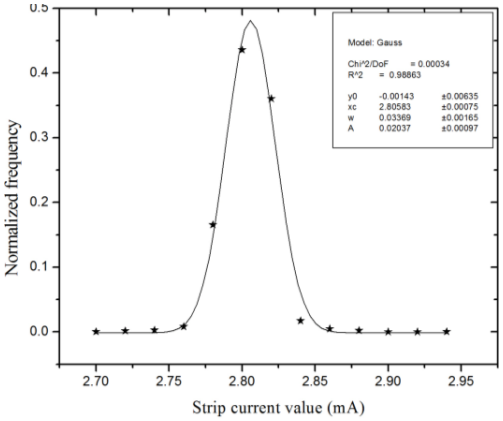


**Fig. 4:** Current distribution of loosely connected connection.

## 4. Conclusion

The above mentioned tests shed light on the performance of the prototype ACS machine. It shows that ACS is capable of checking the connectivity of the connection with 82% efficiency. We are still working to improve the efficiency of this system. There is still a room of improvement in the separation of various types of bad connections so that fixation of connections may be quick.

## Acknowledgement

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## References

[1] Satyanarayan Bheesette, PhD Thesis on design and Characterization Studies of Resistive Plate Chambers (2009).
[2] N. Marimuthu et al., IJIRSET **5(3)**, 3807 (2016).