Development of an automated test section with Arduino for applications of nuclear techniques

R. F. Bostrom[1,2], R. S. F. Dam[2,3], W. L. Salgado[2,3], C. M. Salgado[3]
E-mail: rodrigo_bst@poli.ufrj.br, rdam@coppe.ufrj.br, william.otero@coppe.ufrj.br, otero@ien.gov.br

[1] *CENS, IEN;* [2] *UFRJ;* [3] *DIRA, IEN*

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In industrial processes, agitators or mixers are used to move materials by mechanical means in order to guarantee the agitation, mixing and dilution of a process. Having a diagnostic tool for these units is extremely important to ensure product quality and one of the techniques that most stands out in the analysis of performance in practical situations is the Radioactive Particle Tracking (RPT) technique [1]. This technique is used for studies of multiphase fluid patterns and for the development of industrial units. In previous studies, a methodology has been developed to reconstruct the trajectory of a sealed radioactive particle in real time using mathematical simulations and artificial intelligence methods [2]. Thus, this report aims to present the development of an automated test section with Arduino [3] to be used in RPT applications to obtain relevant parameters to the investigated flow. Initially, the proposed methodology consists of designing a static test section to simulate the passage of a radioactive particle in a single-phase flow. This test section consists of an acrylic tube measuring approximately 42 cm positioned above a polylactic acid (PLA) holder containing a 1¼ × ¾" NaI(Tl) detector, as follows Figure 1.

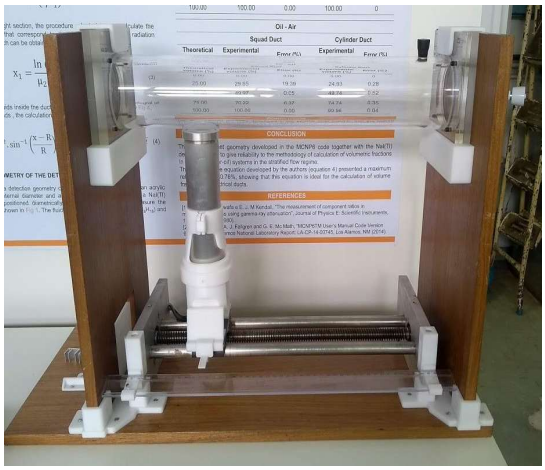

Figure 1. Test section.

The initial objective is to move the PLA support using a stepper motor connected to the section to make the measurement using a conventional meter and compare with RPT method.
In order to control this movement, the platform used was Arduino, which is a single-plate electronic prototyping platform where you can create affordable and low-cost tools to carry out various projects. Thus, a code was developed for Arduino Uno using a shield motor that has two L-293D drivers that support up to 18 V and 600 mA, being possible to control up to two stepper motors through it. This motor is used for the movement of the support because it has a satisfactory torque and good positioning accuracy, which is important for the quality of the experiments.
For this project, two cases will be analyzed:

i) Discrete: with the detector advancing 2 cm and stopping for a period to be used to measure the counts;
ii) Continuous: with the detector moving slowly until the end of the route being measured counts.

The detector presented some instabilities during the trajectory due to its installation in the test section having some flaws, but this did not affect the operation of the experiment.
With the stepper motor having a satisfactory torque, capable of making the support move smoothly, it was possible to perform all the movements necessary for the experiment to be carried out, either in the continuous or in the discrete case.
In future studies, the test section will also be used to perform measurements with sensors based on the Hall Effect.

References

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