XYZ SCANNER FOR MAGNETIC FIELD STUDIES*

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In the NICA project, it is necessary to analyse a magnetic field uniformity inside the detectors magnets. The XYZ Scanner is a device designed for placing a gauge (*e.g.* magnetometer) in a specified point in space, constructed using Bosch aluminium profiles. Motion is realised using a step motor. The developed software allows to control engines. The existing project is a one-dimensional scanner. This paper describes the current state of development of the XYZ Scanner.

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1. Introduction

The XYZ Scanner is originally intended to be used for magnetic field studies for magnets used in MPD [1, 2] (Multi-Purpose Detector) of NICA (Nuclotron-based Ion Collider fAcility) [3] Complex at JINR [4] (Dubna, Russia). The main field of author's research during TeFeNICA Program 2019 (Team for the Future of NICA) was development of a system for analysis of magnetic field uniformity. The uniformity of magnetic intensity determines linearity of an ion motion [5]. The system should allow analysis for a few meters long magnets. Combining the scanner with a gauge, acquisited data will give a gradient of magnetic field. Interpretation of the results should evaluate homogeneity of magnetic field. The one-dimensional project is currently available, three-dimensional is underway.

2. Materials and methods

The frame is designed of Bosch aluminium profiles. It is easy to assembly and confers stability for construction. Depending on the needs, it can be easily redesigned.

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Motion is realized using an integrated stepper drive and motor device from National Instruments — NI ISM 7411E [6]. The power supply dedicated to this motor is NI PS-12. A full rotation is 25 000 steps — it is highly precise, what confers high precision for analysis. The drive connects with the computer via an Ethernet port.

Additional elements such as the engine stand, as well as rollers, are produced using 3D printing technology.

The programming environment was National Instruments LabVIEW 2016 [7] for the purpose of connecting motors, controlling and monitoring. That software is widely used in the MPD project. Using the same technologies ensures higher compatibility for used components, easier management and additional options (*e.g.* error or position monitoring, preparing charts). The program is initially created for one motor but it is easily modifiable to expand for more engines.

3. Results

The complete one-dimensional scanner is shown in figure 1. An engine is mounted on the 3D printed engine stand. The roller is attached to the motor, another one is fixed to the frame. The magnetometer is mounted on the string, connected to NI MyRio, used for data acquisition [8].

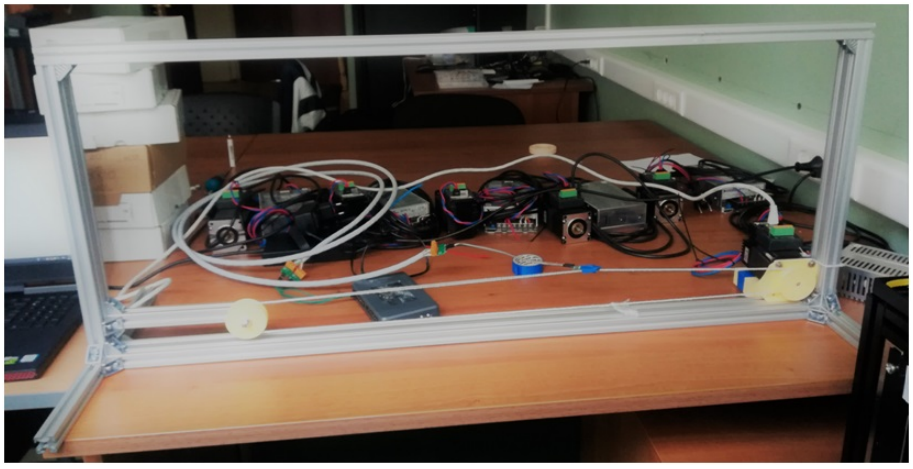

Fig. 1. One-dimensional scanner.

The control program (shown in figure 2) is divided into three parts — the run panel, engineering panel and service panel. The run panel is designed for simple operations using a basic configuration. The engineering panel has advanced settings and the service panel includes all available controls and information about the motor.

During tests, it turned out that the string should be replaced by *e.g.* shark grooved belt due to the slipping on rollers.

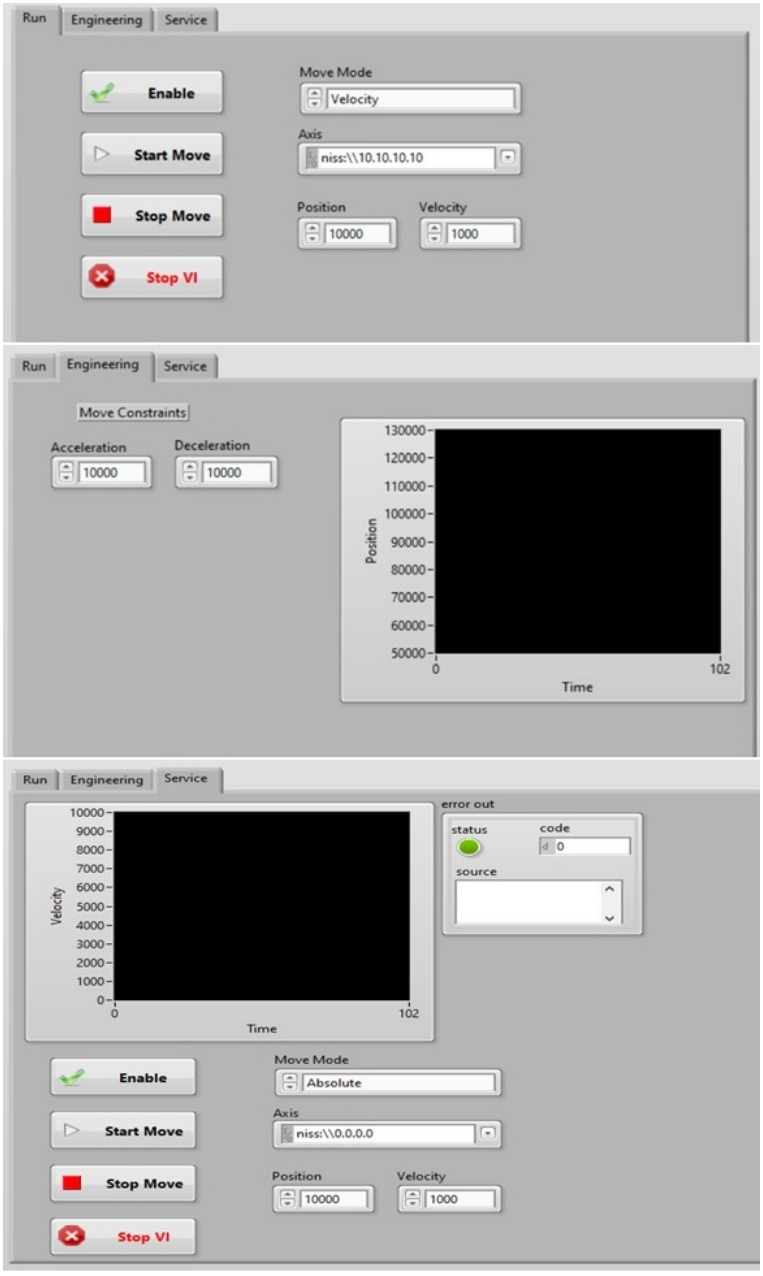

Fig. 2. View of the control panel.

4. Conclusion

The proposed system allows to place a gauge in specified point in three-dimensional space. For now, the prototype allows changing a gauge's position (*e.g.* magnetometer) in one dimension. It is actually Scanner X. The existing model is prepared for testing different solutions like Bosch aluminium profiles, a software for motor control, attaching a gauge to a string.

The next step is extending the scanner for the next two dimensions, it requires both development of a software and a mechanical structure. The LabVIEW control program can be easily expanded to regulate additional motors.

The current application of this project is magnetic field studies for magnets used in the NICA project, but it is possible to change its appliance for *e.g.* the radiation measuring in three-dimensional space.

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