

## **Robots in great physical experiments, automation of measurements**

### **Purpose and objectives of the project**

The Rover Vehicle Measuring Robot for Great Physical Experiments is a versatile and fun starting point for various mechatronics and robotics design Projects. It is a ground vehicle controlled by NImyRIO and equipped with motors and sensors. You can start by following instructions to build the Rover Vehicle Measuring Robot for Great Physical Experiments and run the provided code. This will allow you to teleoperate the rover to travel and grasp objects with its pincer end effector. You can expand the rover's functionality to utilize control algorithms and complete given tasks.

#### **Base Functionality**

- The two front wheels are driven independently by DC motors. The back wheel is used for balance and can rotate freely.
- The DC motor speed is controlled using PWM, and their directions are controlled using a digital line (this wiring is done for you via the motor board).
- The Rover has differential steering, meaning that the rover's direction can be changed by varying the relative rotational velocity of DC motors.
- The IR infrared range finder data is read through an analog line and converted to centimeters. It can detect distance from other objects or distinguish color/material differences based on IR reflectivity.
- The pincer end reflector is controlled by a servo motor. The position of the servo motors is controlled by PWM (Pulse-Width Modulation).
- A VI will be deployed NImyRIO, enabling it to output motor signals, input sensor data, and transfer data to and from a host computer via Wi-Fi.
- A VI will run of a host computer for teleoperation. Here the User can input movement commands, open and close the pincers, and view the IR sensors data.

#### **Expansion and Teaching Options**

- Implement open-loop and closed-loop control algorithms in LabView to precisely control the rover's positions and velocity.
- Use the IR sensor to detect objects. You can write LabView code to avoid the objects or grasp them with the pincers.
- Use the IR sensor to detect a line and write LabView code to follow it.
- Program the Rover to operate autonomously so that it does not require users from the host.
- Add additional features to the rover.
- Example ideas: USB camera ultrasonic sensor custom 3-D printed parts.

#### **Job description:**

The work is an essential part of the NICA-MPD Project, carried out in the international research and development center JINR Joint Institute for Nuclear Research in Dubna

(Russia), Poland, has been a member since 1956 and has a significant contribution to its scientific and research achievements.

The work consists of discerning and formulating the needs of a group of specialists from Polish scientific and research institutions, SCS Slow Control System, MPD detector control system and

NICA complex. The proposed engineering and technical task combine most of the engineering and research work characteristics.

### **Tasks for students:**

The Rover Vehicle Measuring Robot for Great Physical Experiments relates to controls concepts like relative stability, robust stability, and fundamental tasks consisting of prefabricated components and electronic modules, which should be designed, developed, and programmed in NI LabView. The student must understand the theoretical knowledge and analyze the theoretical and practical levels of the project. A working prototype (model) is planned. Then, a technical analysis of the system and its functionality will be performed. Applications should be used when formulating subsequent technical and functional robots' measuring systems. Define the required algorithms and write the software. The apprentice will perform tests and study the work of the finished robot. As a result of the subject matter, a working robot system should be created. In the end, you should give a 15-minute lecture in English about the work done.

### **Note:**

To better understand the project, check other projects this supervisor offers to students.

It is possible to continue cooperation, for example, in the form of an engineering or a master's thesis and further scientific contacts.