

THE MINISTRY OF SCIENCE AND HIGHER EDUCATION

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ITMO University

(ITMO)

Faculty of Control Systems and Robotics

ATP

For the Subject:

SIMULATION OF ROBOTICS SYSTEMS

Project Title

Modeling and Simulating a Hybrid Wheel–Leg Robot Using MuJoCo

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Project aims

In this project we aim to design and simulate a **hybrid locomotion robot** that combines **wheeled mobility** with **legged locomotion**. The robot includes two driven wheels for efficient movement on flat terrain and four 3R legs for navigating obstacles and rough terrain. The goal is to model the robot in MuJoCo, develop controllers for both locomotion modes, and demonstrate smooth switching between them.



Project targets:

Our project must accomplish the following objectives:

1. Explore the capabilities of **MuJoCo** for hybrid locomotion.
2. Calculate the **forward/inverse kinematics** of the robot's 3R leg.
3. Create a **MuJoCo XML model** describing the body, wheels, legs, joints, and actuators.
4. Implement controllers for:
 - Wheel-based differential drive movement.
 - Leg-based locomotion (walk/trot gait).
5. Demonstrate the ability to:

- Move forward and backward.
 - Rotate around an axis through its center.
 - Switch safely between wheel mode and leg mode.
6. Overcome a predefined obstacle using leg mode.

Project plans:

1. Find the suitable design of the robot (**20.11**).
2. Calculate the forward/inverse kinematics (**23.11**).
3. Create the MuJoCo XML model (**25.11**).
4. Write the Python control code for both locomotion modes (**29.11**).
5. Perform tests on movement, rotation, mode switching, and obstacle traversal (**30.11**).
6. Write the final report (**01.12**)
7. Presentation Preparation (**02.12**)