MASTER’S THESIS PROPOSAL

**RL-based gait control of quadruped robot for all terrain locomotion**

Master’s Educational Program: Engineering Systems

Student: Sergei Satsevich

CONTENTS

[BACKGROUND AND PROBLEM STATEMENT 3](#_Toc149775719)

[PURPOSE AND DEFINITIONS 4](#_Toc149775720)

[LITERATURE REVIEW (OR INFORMATION RETRIEVAL) 5](#_Toc149775721)

[METHODOLOGY 6](#_Toc149775722)

[TECHNIQUES 7](#_Toc149775723)

[WORK PLAN 8](#_Toc149775724)

[POTENTIAL IMPACTS 9](#_Toc149775725)

## BACKGROUND AND PROBLEM STATEMENT

Quadruped robots possess the capacity to revolutionize their application across demanding natural and artificial landscapes. Unlike traditional wheeled or tracked vehicles, their utilization of legs allows for a remarkable level of adaptability, granting significant benefits when operating in unpredictable settings.

## PURPOSE AND DEFINITIONS

Develop a quadruped robotic platform, developing of control system using RL-methods for making an effective variant of locomotion

## LITERATURE REVIEW (OR INFORMATION RETRIEVAL)

1. MIT Cheetah 3: Design and Control of a Robust, Dynamic Quadruped Robot, 2018

2. HyperDog: An Open-Source Quadruped Robot Platform Based on ROS2 and micro-ROS, 2022

## METHODOLOGY

The methodology of this work includes the following:

Iterative step-by-step approach to developing a workable structure of robot using CAD-system programs (3D-design, strength calculations, kinematic calculations)

Initial control of robot electronics using ROS2. Developing low-level and high-level code for starting poses of robot and simple variant of locomotion.

Implementation of RL-based methods in control system for making a unique gait for multi-terrain and climbing ladders locomotion.

## TECHNIQUES

The following instruments will be used in this work:

1. ROS2 – for electrics control and command codding
2. Unity 3D, Python3 and C++ – for simulation of robot behavior and training RL-model
3. Siemens NX - for 3D-modelling and kinematics calculations
4. Ansys - for strength calculations
5. SMath – for engineering calculations

## WORK PLAN

1. Developing a platform (October – December)
2. Developing an initial control (December)
3. Simulation of RL-based methodic for developing of gait (January)
4. Introduction of RL-based methodic to gait of the robot (February – Mart)
5. Testing of robot in different environments (Mart – Mai)

## POTENTIAL IMPACTS

1. Robotics Research: Quadruped robots are complex engineering systems that require the development of advanced control algorithms, sensors, and motion mechanisms. Research in this field helps in the development of new technologies and methods in robotics.
2. Search and Rescue Operations: Quadruped robots can be applied in situations that are hazardous for humans, such as searching and rescuing individuals in collapsed buildings after earthquakes or natural disasters. They can access narrow passages and hard-to-reach areas.
3. Robotics Research: Quadruped robots are sophisticated engineering systems, necessitating the development of advanced control algorithms, sensors, and motion mechanisms. Research in this field contributes to the creation of novel technologies and methods in robotics.
4. Planetary Surface Exploration: Quadruped robots can be designed for exploring the surfaces of other planets and moons, such as the Moon and Mars. They can be used for soil sample collection, geological and geophysical studies, and even the search for signs of life. Their ability to traverse challenging terrain can be particularly advantageous for accomplishing these tasks. Additionally, their use in low-gravity conditions can be justified in terms of energy efficiency, which is not always applicable in Earth's conditions.