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| Project Work – Group 3  SIMULATION OF A QUADRUPED ROBOT IN ROS | AUTHOR:  Jeen Ann Abraham – S355989,  Kristoffer Anderssen Valderhaug – S,  Marius – S  COURSE WORK: ACIT4820-1 20H APPLIED ROBOTICS AND AUTONOMOUS SYSTEMS |

CONTENTS

[**Chapter 1 : INTRODUCTION** 2](#_Toc57068691)

[1.1. Open Dynamic Robot Initiative 2](#_Toc57068692)

[1.2. Objective 3](#_Toc57068693)

[**Chapter 2 : BACKGROUND** 4](#_Toc57068694)

[2.1. Related Works 4](#_Toc57068697)

[**Chapter 3 : 3-DIMENSIONAL MODELLING** 5](#_Toc57068698)

[3.1. Tools 5](#_Toc57068700)

[3.2. Quadruped Robot 3-Dimensional Models 5](#_Toc57068701)

[3.3. Model Modification using Blender 5](#_Toc57068702)

[3.4. Geometrical Calculations 5](#_Toc57068703)

[**Chapter 4 : ROS SIMULATION** 6](#_Toc57068704)

[4.1. Tools 6](#_Toc57068706)

[4.2. Importing Model to ROS-Rviz 6](#_Toc57068707)

[4.3. Importing Model to ROS-Gazebo 6](#_Toc57068708)

[4.4. Testing in Gazebo 6](#_Toc57068709)

[**Chapter 5 : FUTURE WORK** 7](#_Toc57068710)

[5.1. Improvement in model 7](#_Toc57068712)

[5.2. Controller Tuning 7](#_Toc57068713)

[5.3. Implementation of Algorithms for GAIT 7](#_Toc57068714)

[**APPENDIX I: REFERENCES** 8](#_Toc57068715)

[**APPENDIX II: SOURCE CODE** 9](#_Toc57068716)

# **: INTRODUCTION**

## Open Dynamic Robot Initiative

The project aims to build a low cost and low complexity actuator module using brushless motors that can be used to build different types of torque-controlled robots with mostly 3D printed and off-the-shelves components. Two works has been published under this project, one describing the actuator module and the quadruped design [1] and the other describing Tri-Finger Manipulator Platform and real-time reinforcement learning experiments [2]. The work is done in collaboration between the Motion Generation and Control Group, the Dynamic Locomotion Group and the Robotics Central Scientific Facility at the Max-Planck Institute for Intelligent System , the Machines in Motion Laboratory at New York University's Tandon School of Engineering and the Gepetto Team at the LAAS/CNRS. All the hardware and software has been open sourced under the BSD 3-clause license so that the robots can easily be reproduced by other research laboratories.

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| *Figure 1: Open Dynamic Robot Initiative* |

The dictionary says that the word “quadruped” means an animal which has four feet, especially an ungulate mammal which primarily includes opposite arm and leg lifts for the movements that is interlimb coordination. There are several ways in which a four-legged robot can be designed. Quadruped robots imitate animal walking gait which has many advantages like moving on uneven landscapes and extremely rough territories due to high nonlinear dynamic characteristics. To perform real-time operations, quadruped robots must have good stability which is a hot research topic in the field of robotics. To achieve the stability of the robot, most widely adopted path is the design and optimization of the structure of the robot or improve the control algorithm. A robot that moves on wheels has difficulties to overcome obstacles, but quadruped robots can adapt to avoid obstacles by adjusting its height. The quadruped robot has four leg with each leg having two degrees of freedom. quadrupeds can change their locomotive patterns, e.g. walking, trotting, and galloping to adopt the most energy-efficient gait for a given speed. Interlimb coordination mechanism works on autonomous decentralized control.

## Objective

The main objective in this work is to develop a ROS based simulator for Open Dynamic Robot Initiative. The Open robotics quadruped robot consists of eight identical actuator modules, four lower legs with foot contact sensors, IMU sensor and battery monitor. To navigate obstacles the quadruped will rely on simple depth data retrieved from a depth sensor (LiDAR/Camera). This will be limited to immediate collision detection, as this project will not go into depth about mapping. Positional data should be limited to registered depth data and inputted movement data. Orientation is cross referenced from IMU data force vector.

# **: BACKGROUND**



## Related Works

# **: 3-DIMENSIONAL MODELLING**



## Tools

## Quadruped Robot 3-Dimensional Models

## Model Modification using Blender

## Geometrical Calculations

# **: ROS SIMULATION**



## Tools

## Importing Model to ROS-Rviz

## Importing Model to ROS-Gazebo

## Testing in Gazebo

# **:** **FUTURE WORK**



## Improvement in model

## Controller Tuning

## Implementation of Algorithms for GAIT

# **APPENDIX I: REFERENCES**

# **APPENDIX II: SOURCE CODE**