

Genetic Algorithms for Robot Mobility

Deliverable 1: Final Year Dissertation

Jacob Cooper - H00251723 | Dr. Michael Lones | Computer Science|

# Introduction

## AiM

To implement a Genetic Algorithm in a robot for it to learn how to move in a simulated environment for the purpose of showing how Robots learning through Genetic Algorithms would perform in the real world.

## objectives

* Use Webots to Create a suitable simulated environment for the robot to move in ( M )
* Create a body for the robot to operate in Webots ( M )
* Add alternate bodies for the robot to operate in Webots( C )
* Create a genetic algorithm that allows a robot to traverse flat ground over a short distance ( M )
* Create a genetic algorithm for a robot to traverse uneven ground ( S )
* Create a genetic algorithm that allows a robot traverse obstacles ( C )
* Create a genetic algorithm that allows a robot to jump over gaps ( W )
* Apply different approaches to GA’s throughout the different scenarios ( C )
* Optimize the algorithm to move the robot efficiently across the terrain ( W )
* Have the robot learn the path from scratch as quickly as possible ( W )
* Have the robot learn to navigate a multitude of terrains at once ( C )

## Stakeholders

* Supervisor (Dr. Michael Lones)
* Heriot- Watt University
* Robotics Researchers
* Game Developers
* Companies which use robots
* Creators of any code libraries I use
* Creators of Webots
* Users of Webots

# Background

You might like the photo on the cover page as much as we do, but if it’s not ideal for your report, it’s easy to replace it with your own.

Just delete the placeholder picture. Then, on the Insert tab, click Picture to select one from your files.

# Project Management Plan

Research the multiple different implementations of genetic algorithms

## Work Breakdown Structure

### 1 –Initial Set-up and Research

* 1. - Research multiple different Genetic Algorithm implementations
  2. - Pick one Implementation method for GA’s to start with initially

1.3 - Acquire use of Webots and learn basics

1.4 - Create first environment with flat ground in Webots

1.5 - Create Initial robot body in Webots

1.6 - Add a start position and goal for Robot

### – Flat Ground Scenario Genetic Algorithm

* 1. – Implement first Genetic Algorithm for flat ground traversal
  2. – Combine the algorithm with the Webots Robot
  3. - Run GA in the Flat Ground scenario until Robot reaches goal or time runs out
  4. - Modify GA until Robot reaches goal or try different method for GA
  5. – Continue to run GA until Robot converges on method to reach goal

### 3 – Uneven Ground Scenario Genetic Algorithm

3.1 - Change Webots environment to include just uneven terrain on path

3.2 – Run Flat Ground GA on Uneven ground until robot reaches goal(Risk: or time runs out)

3.3 – Modify Flat Ground GA until Robot Reaches goal (Risk: or try different method for GA)

3.4 – Continue to run GA until robot converges on method to reach goal

3.5 – Add in flat ground and Uneven ground to simulation

3.6 – Run same GA on the new terrain until robot reaches goal

3.7 - Continue to run GA until Robot converges on method to reach goal

### 4 – Obstacle Scenario Genetic Algorithm

4.1 – Change Environment so there is a single obstacle on path to goal

4.2 – Run Uneven ground GA on Obstacle path until robot reaches goal

4.3 – Continue running GA until Robot converges on method to reach goal

4.4 – Add in flat and uneven ground to simulation before obstacle

4.5 – Run Same GA on new terrain until robot reaches goal

4.6 – Continue to run GA until robot converges on method to reach goal

### 5 – Final Testing of Genetic Algorithm

5.1 – Take final algorithm and run it on flat ground

5.2 -

### Webots

* Implement Robot in Webots
* In depth learning of the functionality and various uses of Webots
* Create alternate bodies in Webots

### Implementing Genetic Algorithms

* Implement first Genetic Algorithm in robot for traversing flat ground
* Use Flat ground GA for uneven ground and modify accordingly
* Use first ground GA for

### Testing

* Test Robot on flat surface
* Track how long Robot takes to learn path for flat ground
* Track how long Robot takes to learn path for uneven ground
* Track how long Robot takes to learn path for Obstacles
* Track how long Robot takes to learn path when robot has to jump over a gap