Gauntlet Report

Aditi Vinod & Clay Oates

Overview

Mission:
Given the coordinates of the Barrel of Benevolance, the obstacles, and the walls, create a potential field and use gradient descent to move the robot through the Gauntlet.

Planned Strategy:
Greatest descent traversal; to make the Barrel of Benevolance a target or destination for the NEATO, an environment will be created where all of the obstacles are tall peaks (sources) and the Barrel of Benevolence is a deep hole (sink). Because the Barrel of Benevolence is the trough of the simulated environment, the NEATOl gradually move towards and eventually reach it.

Steps:
1-Initialize script parameter values - robot wheel base, omega, linear speed, and λ.
2-Define the function f(x, y) with obstacles as sources and the Barrel of Benevolence as a sink.
The equation for the potential field will be based off this general equation for a potential field:

$$V = ln\sqrt{(x^2 + y^2)},$$

where +V is a sink and -V is a source.
3-Compute the gradient ∇f(x, y).
4-Initialize orientation of robot
5-Initialize ROS
6-Place the robot in its starting position
7-Create a while loop to drive the robot:
    a-Compute the angle to turn the robot to align with the gradient
    b-Turn the robot
    c-Drive forward along the gradient vector
    d-Check if the stopping condition based on λ has been met

Gauntlet Objects Mapped Out w LIDAR

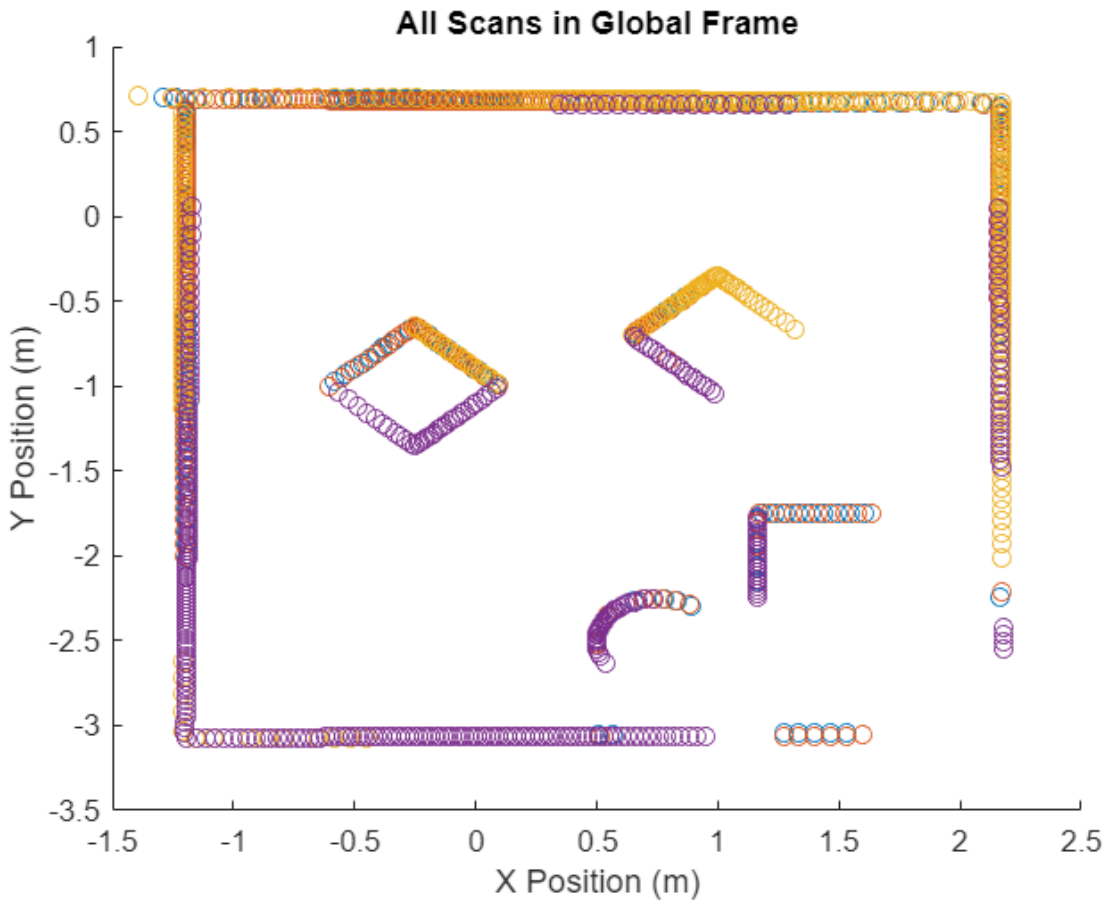

Figure 1: y position versus x position in the Global Frame of all the LIDAR sensors' readings; together these form the NEATO's view of the simulated Gauntlet environment.

3D Representation of Potential Field for Gauntlet

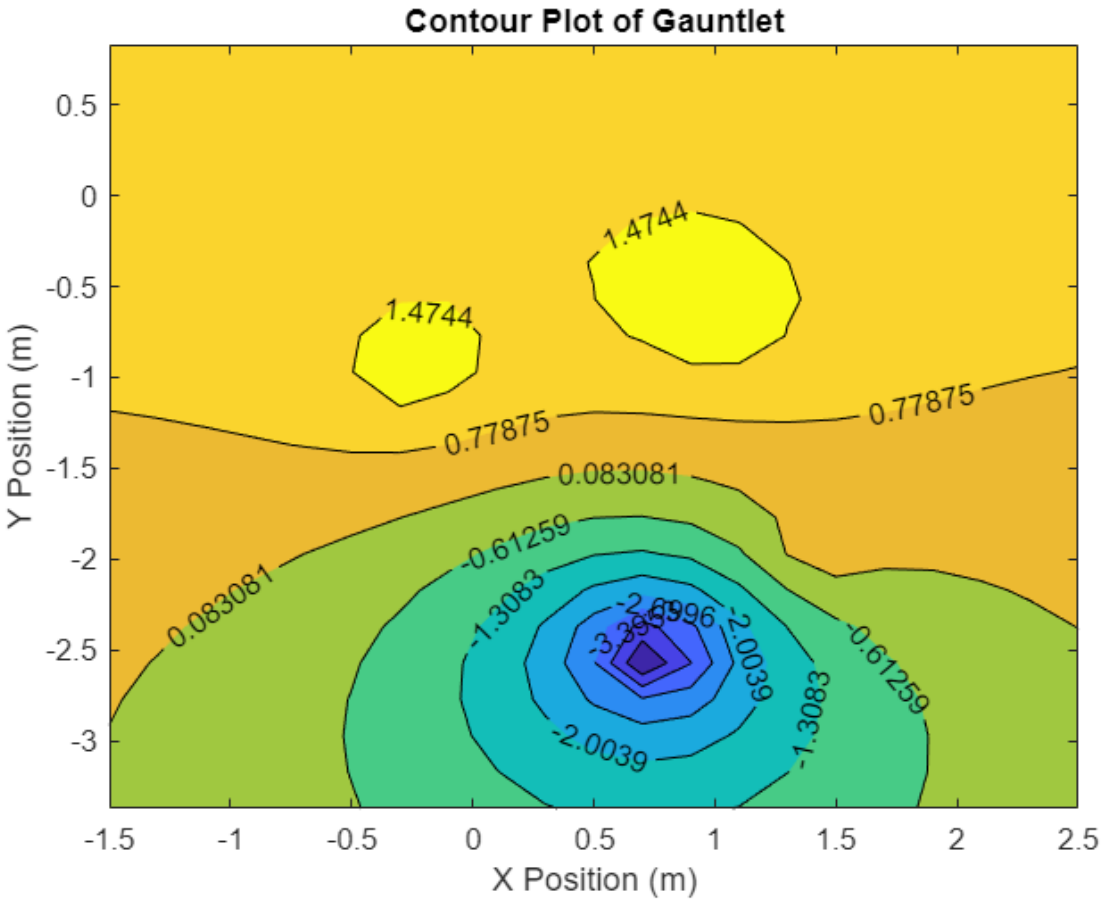

Figure 2: y position versus x position of the contour of the simulated Gauntlet environment. The yellow and orange areas represent higher pieces of land, while the blue is the tough, or the lowest point.

The contour field was determined based on the following equation:

$$f = -0.5\,ln\sqrt{(x-1.0)^2+(y+0.7)^2} - 0.5\,ln\sqrt{(x+0.25)^2+(y+1.0)^2} - 0.5\,ln\sqrt{(x-1.41)^2+(y+2.0)^2} + 2\,ln\sqrt{(x-0.75)^2+(y+2.5)^2}$$

Quiver Plot of Gradient of Potential Field

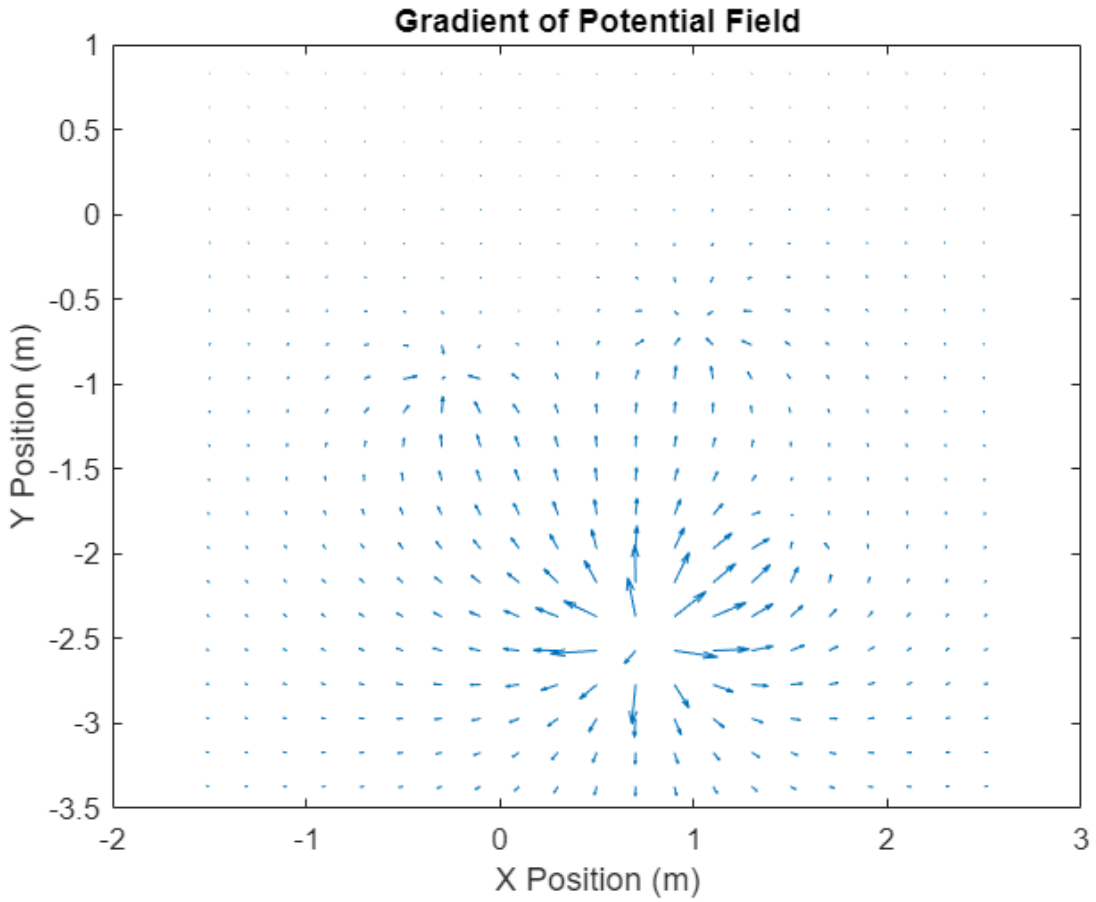

Figure 3: y position versus x position of the gradient field of the simulated Gauntlet environment. The arrows represent vectors that point toward higher elevation. They point toward two peaks and away from the tough.

Gradient Descent Path From BoB Over Contour Plot

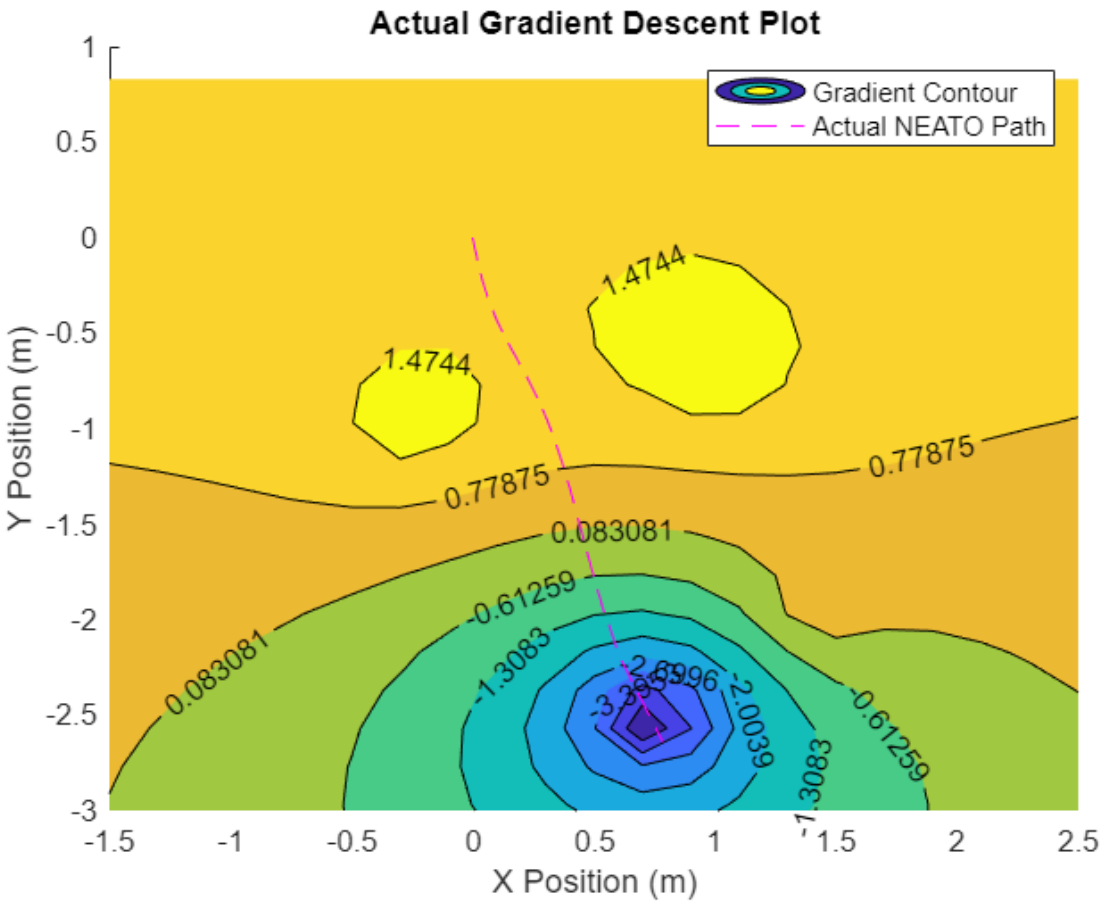

Figure 4: y position vs. x position graph of the Gauntlet's contour with a red dotted line that indicates the calculated theoretical path of the NEATO.

Gauntlet Traversal Results

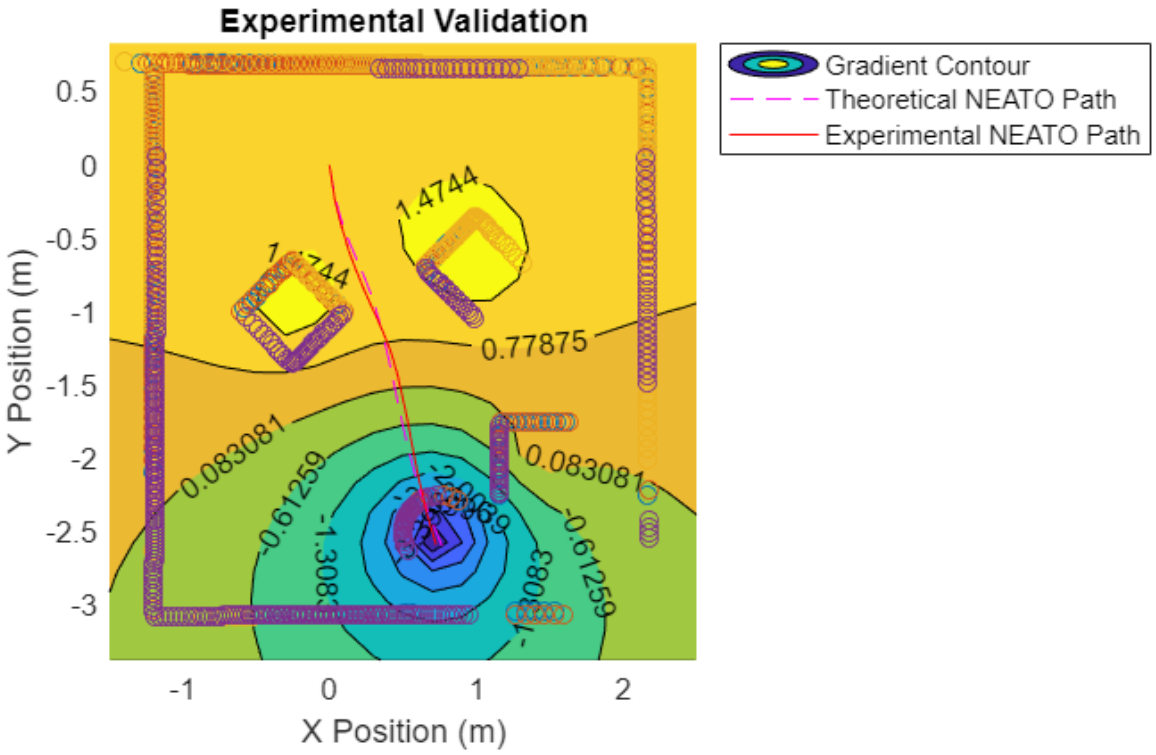

Figure 5: y position vs. x position graph of the calculated theoretical path of the NEATO (dotted) and the actual path of the NEATO (solid); the gradient descent contour and the LIDAR scan locations of the BoB, obstacles, and walls were also illustrated.

<u>Experimental Results:</u>
The simulated NEATO took 19.3 seconds to move 2.70 from its starting position to the Barrel of Benevolence.

Video

https://youtu.be/fsq0pp9a8ks