InternPro Weekly Progress Update

Name	Email	Project Name	NDA/ Non-NDA	InternPro Start Date	OPT
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Progress

Include an itemized list of the tasks you completed this week.

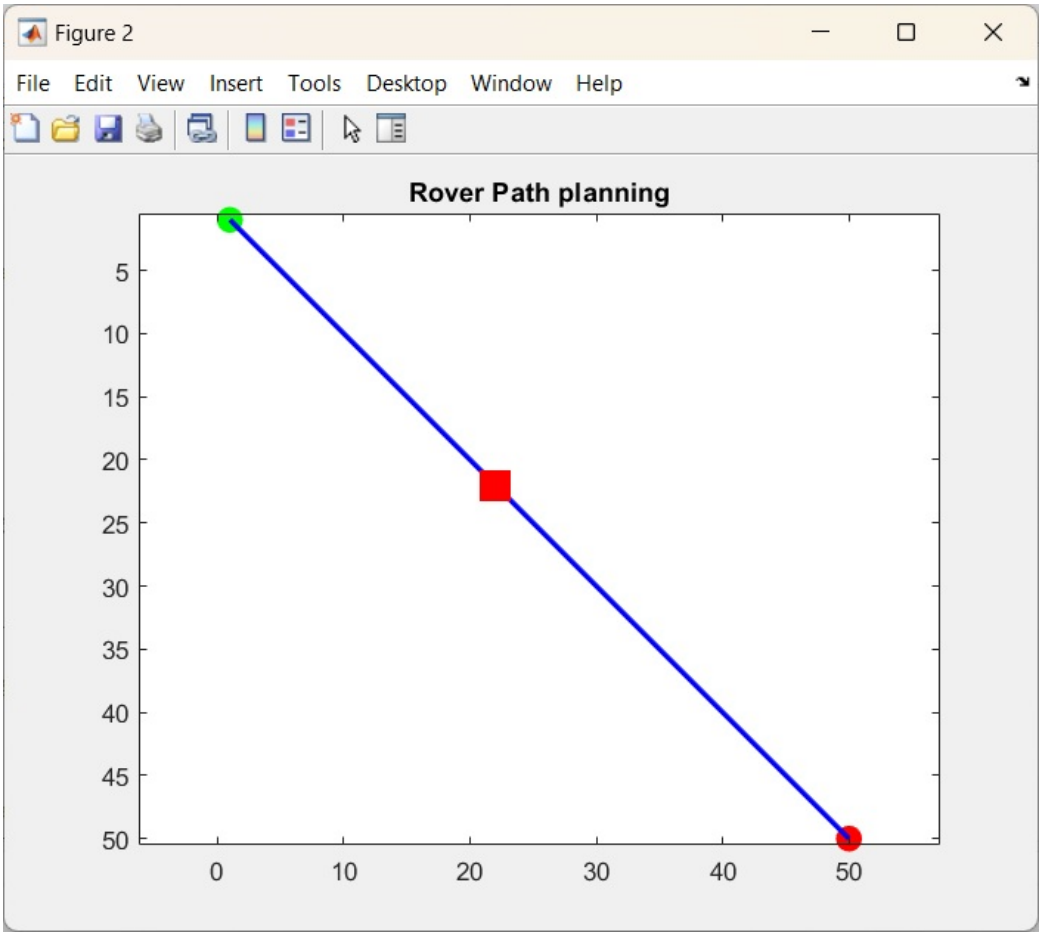
#	Action Item/ Explanation	Total Time This Week (hours)
1	Path planning for rover along a obstacle free environment	3
2	Path planning for rover along a obstacle free environment	3
3	Rotate the rover in different Orientations for better simulation in farmland	3
4	Path planning algorithm implemented for the 3D farmland map	3
5	Simulating rover on a path along the farmland 3D map	3
6	Added a speed feature to control the movement of the rover in the map	3
7	Weekly plan for next week	1
8	Report Writing	1
	Total hours for the week:	20

Verification Documentation:

Action Item 1: Path planning for rover along a obstacle free environment – 3 hour(s).

Project Work Summary

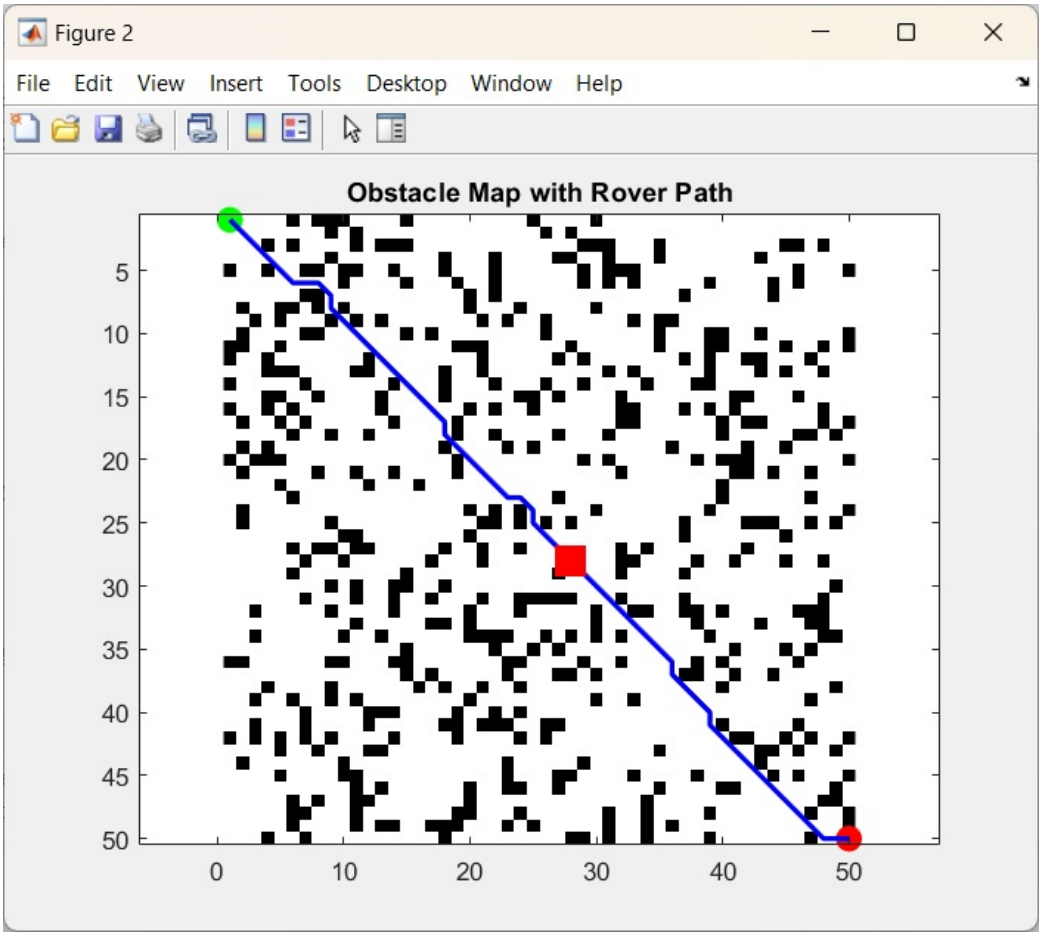
- For the first task, we implemented a rover navigation simulation in a obstacle free map using MATLAB.
- The simulation creates a 50x50 grid representing a 10x scaled environment without obstacles of the 5mx5m farmland map.
- Created a straight path connecting the start point and goal point within the map since there is not obstacle in the map.
- Finally, we visualized the map, path, and rover movement using MATLAB's plotting functions, providing a clear representation of the rover's navigation through the constrained environment.
- This implementation demonstrates basic path planning and obstacle avoidance in a 2D grid-based environment.



Action Item 2: Path planning for rover along a obstacle free environment – 3 hour(s).

Project Work Summary

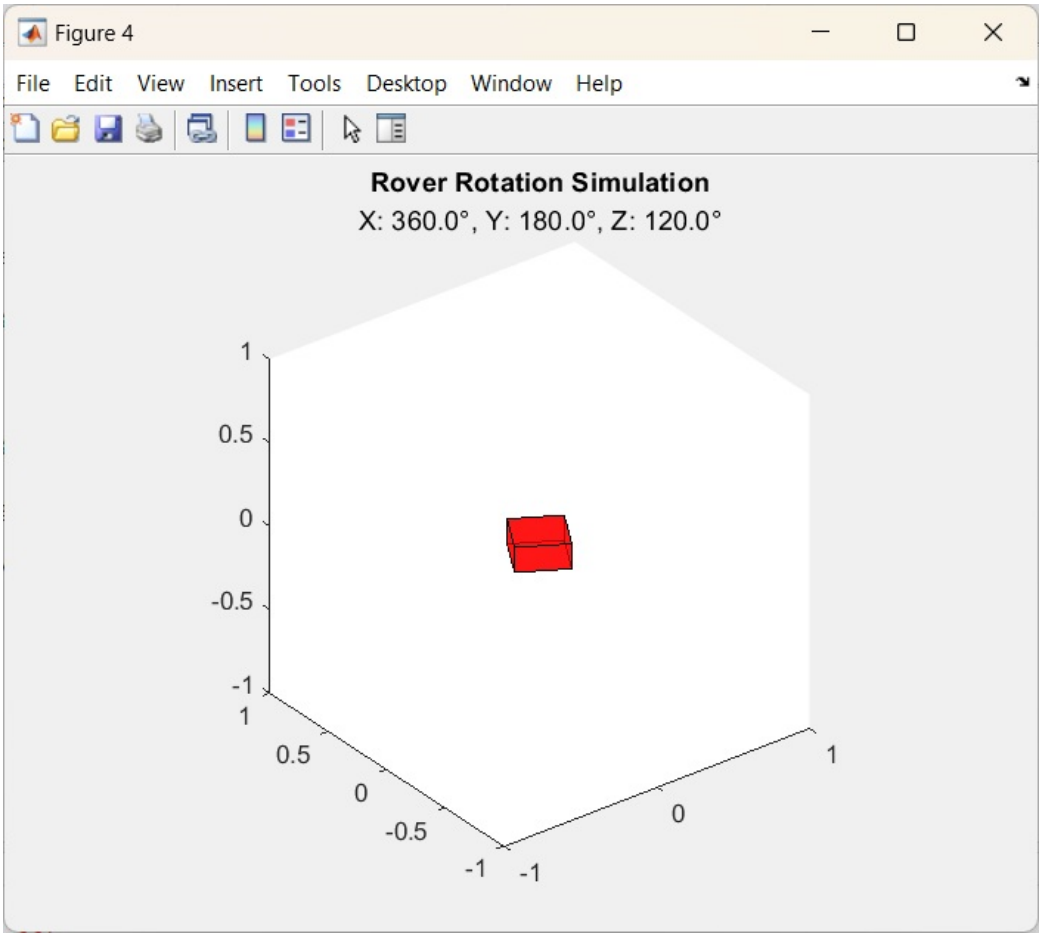
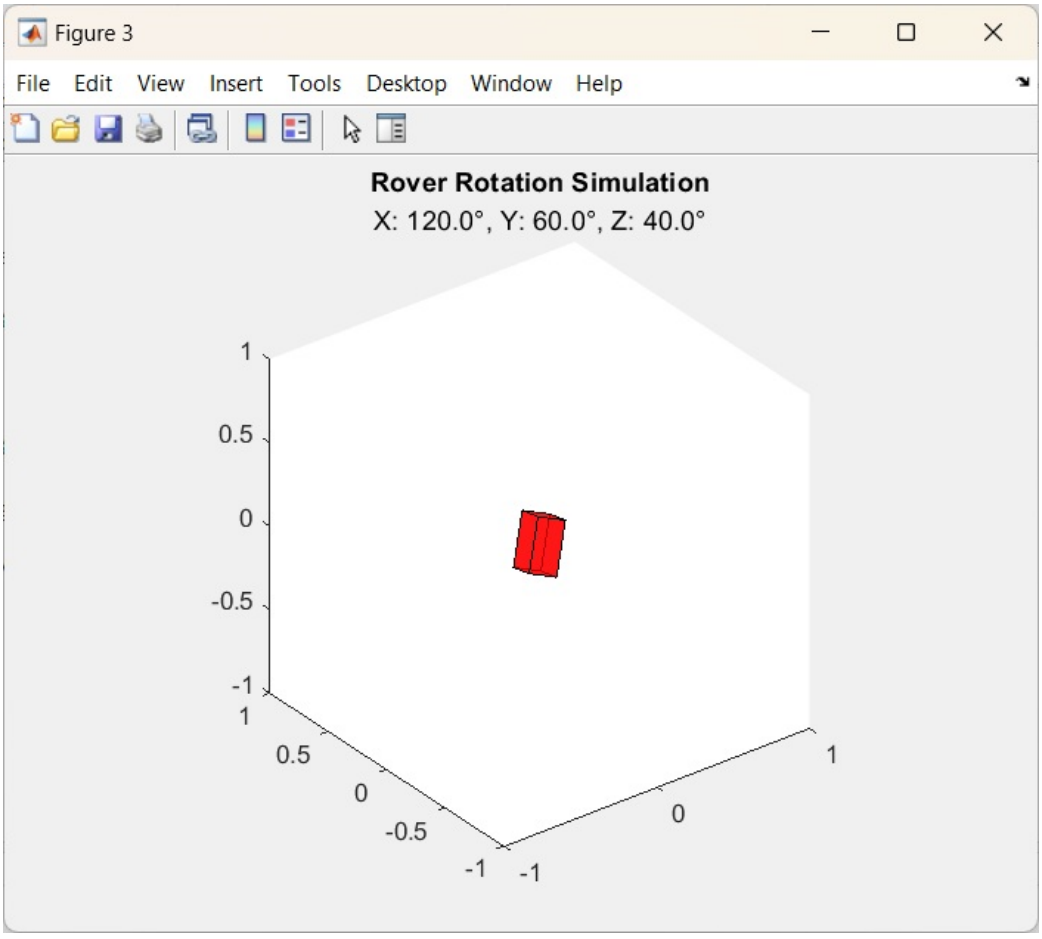
- For the second task, we enhanced our MATLAB simulation to include obstacles in the 50x50 grid environment, representing a more complex and realistic scenario for rover navigation.
- We added random obstacle to create a constrained environment with approximately 30% of the grid cells occupied by obstacles.
- To navigate this terrain, we utilized MATLAB's bwdistgeodesic function to create a distance transform map, which allows for efficient path planning around obstacles.
- We visualized the map with obstacles, the calculated path, and the rover's movement using MATLAB's plotting functions, clearly demonstrating the rover's ability to navigate from start to goal while avoiding obstacles.
- This implementation showcases more advanced path planning and obstacle avoidance techniques in a 2D grid-based environment, building upon the foundation established in the first task.

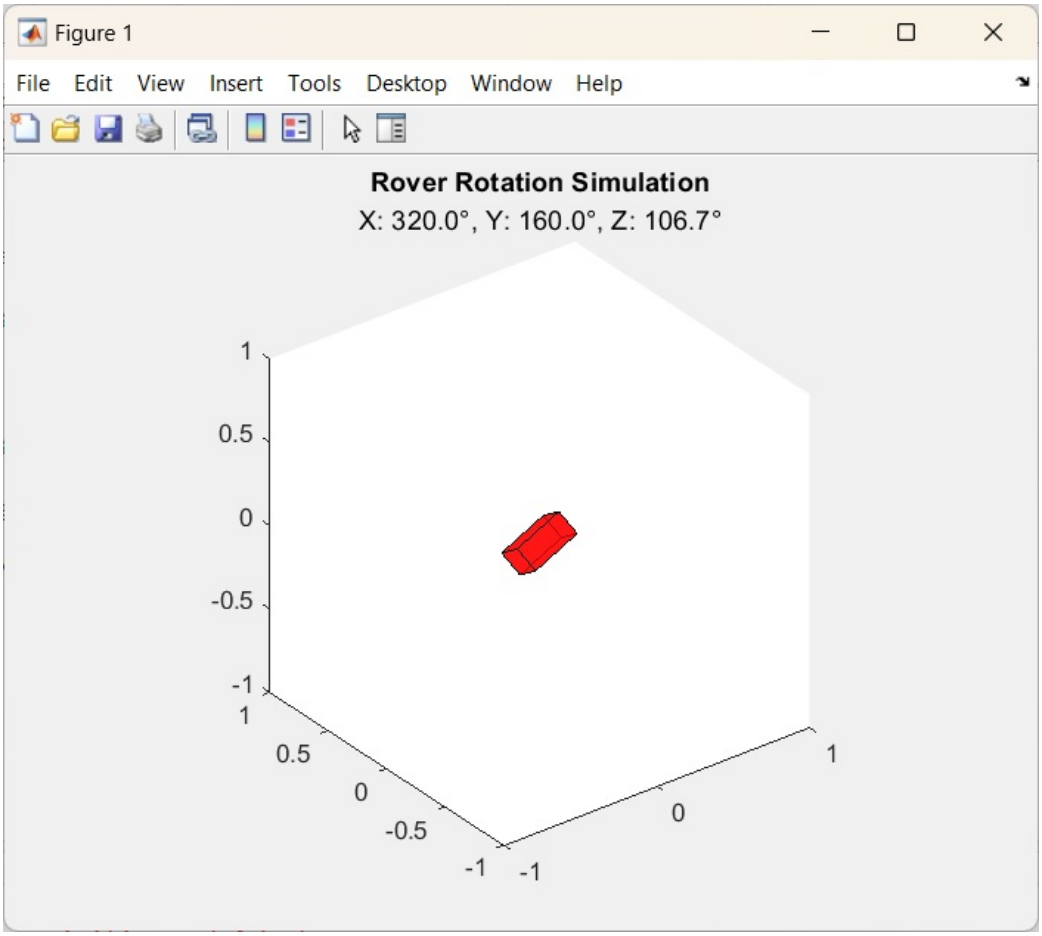


Action Item 3: Rotate the rover in different Orientations for better simulation in farmland – 3 hour(s).

Project Work Summary

- Since the rover has to move along terrains with varying terrains and hence in simulation the rover have to be displayed with different orientations.
- We utilized MATLAB's transformation functions, specifically 'makehgtform', to create rotation matrices for each axis (X, Y, and Z).
- By combining these rotations and applying them to the rover's vertices, we achieved a smooth 3D rotation animation.
- This approach offers a clear and concise way to track the rover's orientation throughout its rotation, combining visual and numerical data efficiently.
- The implementation allows for a comprehensive understanding of how the rover can be oriented in different directions, which is crucial for simulating complex navigation scenarios in agricultural environments and for planning sensor placement and field operations.

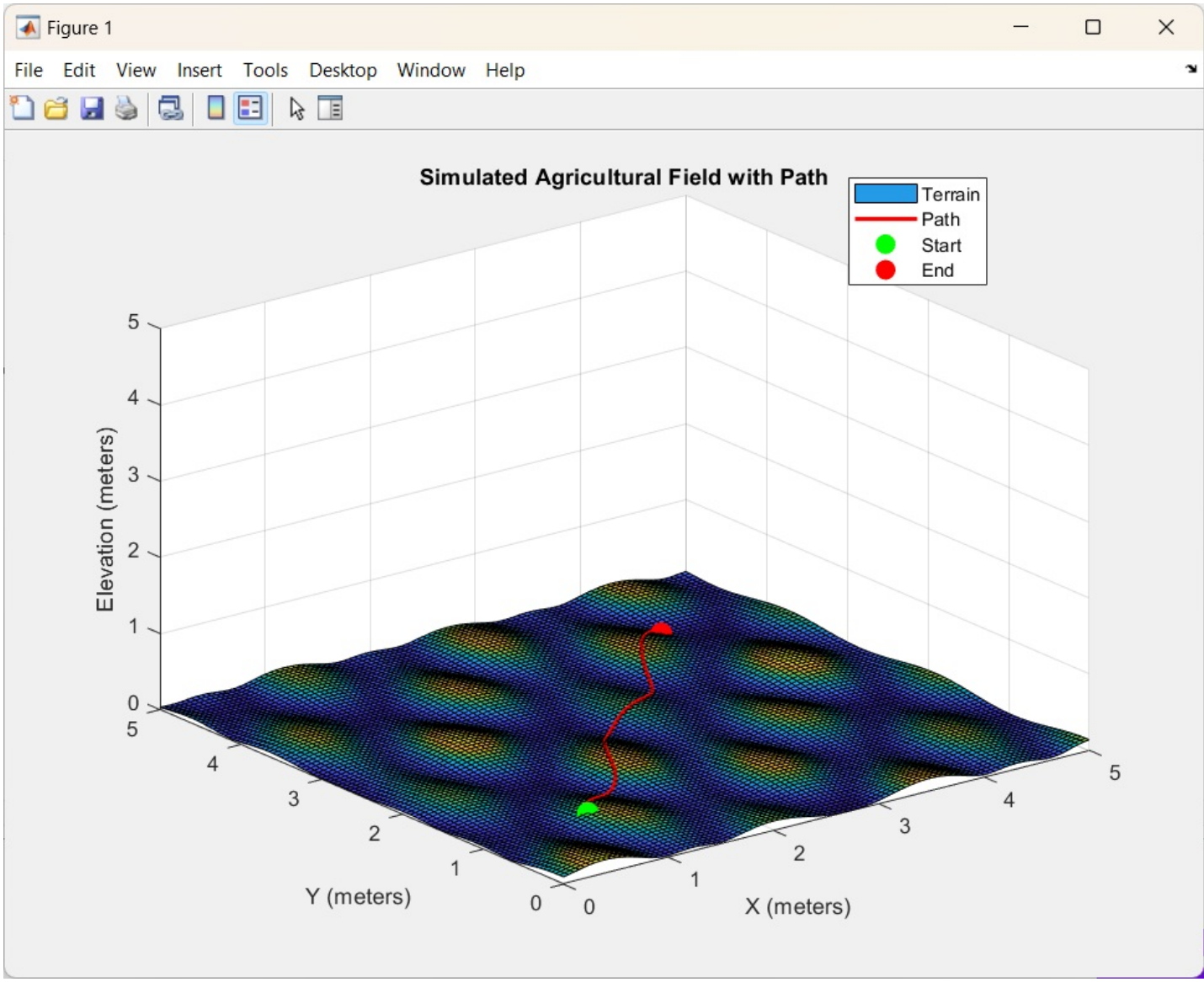
- 
Figure 4
File Edit View Insert Tools Desktop Window Help
Rover Rotation Simulation
X: 360.0°, Y: 180.0°, Z: 120.0°
1
0.5
0
-0.5
-1
1
0.5
0
-0.5
-1
-1
0
1
- 
Figure 3
File Edit View Insert Tools Desktop Window Help
Rover Rotation Simulation
X: 120.0°, Y: 60.0°, Z: 40.0°
1
0.5
0
-0.5
-1
1
0.5
0
-0.5
-1
-1
0
1



Action Item 4: Path planning algorithm implemented for the 3D farmland map – 3 hour(s).

Project Work Summary

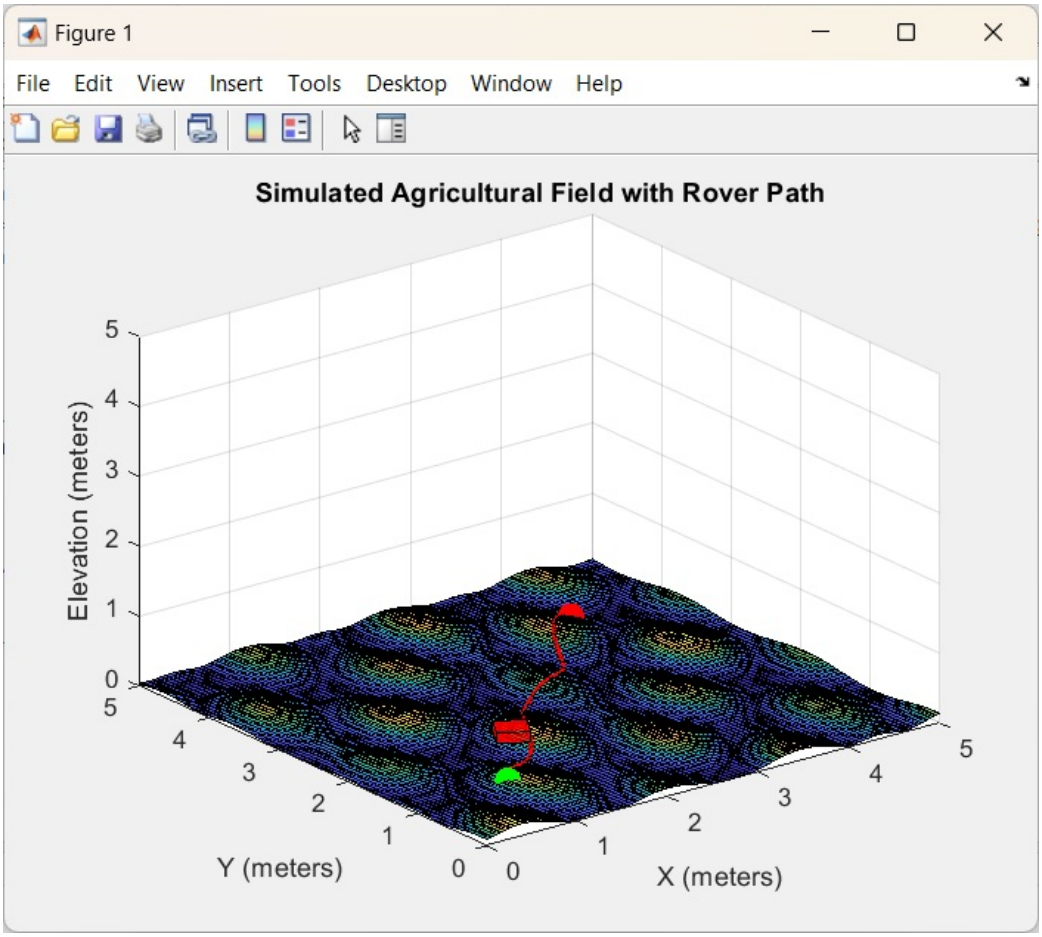
- Now that we have done all the preliminary work with the rover, we then focused on creating a terrain-following path for the agricultural rover in our simulated farmland environment using MATLAB.
- We built upon our previously established 5x5 meter grid terrain, which was generated using a combination of sine waves and smoothed with a Gaussian filter.
- We implemented a path planning algorithm that creates an initial straight-line path and then projects it onto the terrain surface using MATLAB's interp2 function.
- This approach resulted in a path that follow along the terrain while maintaining a general direction between the start and end points.
- The resulting visualization clearly shows how the path follows the elevations and depressions of the terrain, providing a more accurate representation of the rover's potential movement in the agricultural field.



Action Item 5: Simulating rover on a path along the farmland 3D map – 3 hour(s).

Project Work Summary

- Now that we have every bits and pieces of the problem solved individually we have to combine all these into
- We once again built upon our existing 5x5 meter grid terrain, generated using a combination of sine waves and smoothed with a Gaussian filter.
- We implemented a path planning algorithm that creates a naturalistic route between two points, accounting for the terrain's topography.
- The rover's movement along this path was simulated using MATLAB's patch and makehgtform functions, allowing for realistic translations and rotations as it traverses the uneven terrain.
- This comprehensive simulation combines our previous work on terrain modeling, path planning, and rover representation, providing a realistic visualization of how the agricultural robot would navigate in a real-world scenario.

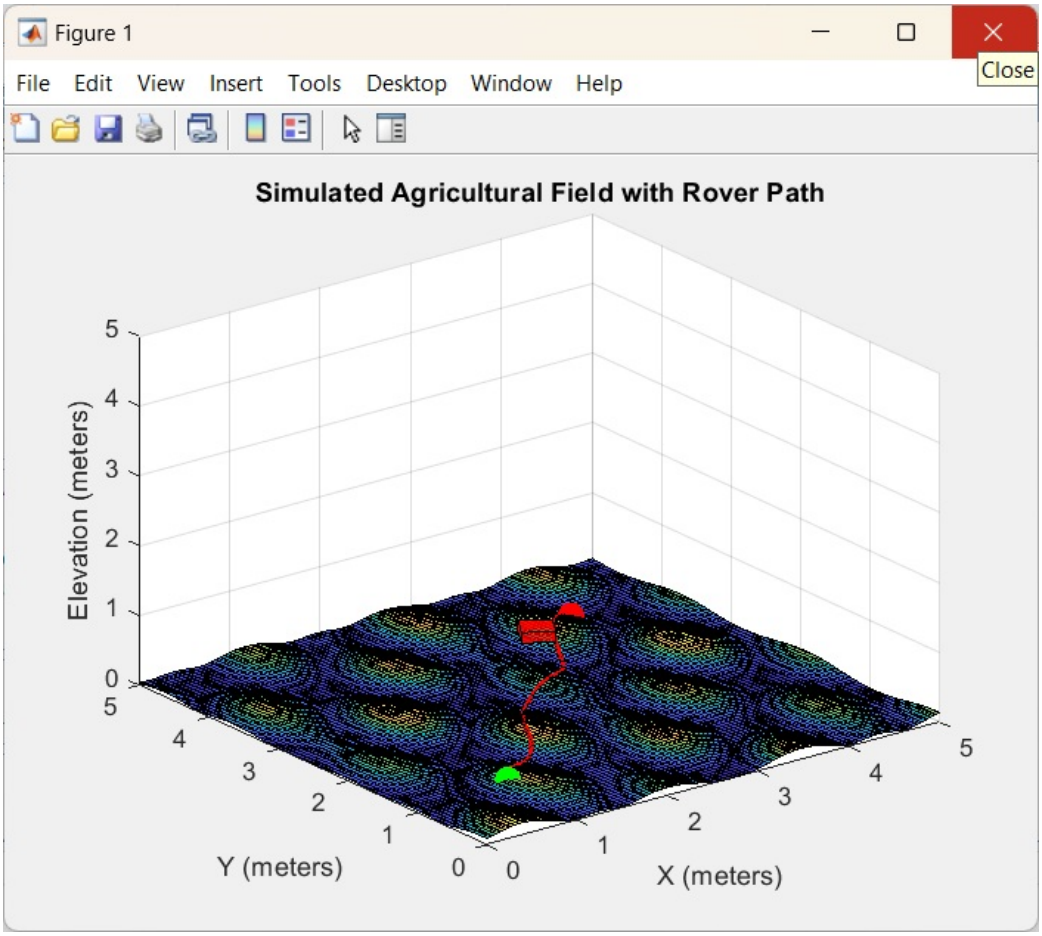
- 

Action Item 6: Added a speed feature to control the movement of the rover in the map – 3 hour(s).

Project Work Summary

- For the final enhancement of our simulation for this week, we focused on implementing a speed control feature for the agricultural rover in MATLAB.
- Building upon our existing 5x5 meter grid terrain and path planning algorithm, we introduced a variable to control the rover's speed in meters per second.
- We modified the animation loop to calculate the total path length and adjust the time step based on the specified speed, ensuring consistent movement along the terrain contours.
- We incorporated a real-time display of the rover's current speed in the simulation title, providing immediate feedback on its movement rate.
- This speed control capability enhances the realism of our simulation, enabling us to test various operational scenarios such as slow-speed precision tasks or faster traversal between work areas.

```
% Calculate time step based on speed
rover_speed = 0.5;
total_time = path_length / rover_speed;
time_step = total_time / (num_points - 1);
```



Action Item 7: Weekly plan for next week – 1 hour(s).

Project Work Summary

- For the upcoming week, we will focus on expanding our simulation capabilities and refining our hardware research for the agricultural rover project.
- We plan to enhance our MATLAB simulation by implementing more realistic GNSS and sensor models, incorporating potential inaccuracies to better represent real-world conditions.
- We will explore advanced path planning algorithms for the rover, considering terrain variations and obstacle avoidance in our simulated farmland environment.
- We will also begin preliminary work on integrating the rover's movement simulation with sensor data collection, creating a more comprehensive representation of field operations.
- This work plan builds upon our previous achievements in terrain modeling, path planning, and rover visualization, pushing towards a more sophisticated and realistic agricultural robotics simulation platform.

Action Item 8: Report Writing – 1 hour(s).

Project Work Summary

- Created word document layout to write contents of the weekly progress.
- Created relevant subsections in the epicspro website and documented 20 hours of weekly progress.
- Collected relevant documents research papers, relevant links and company's objective from their portal.