InternPro Weekly Progress Update

Name	Email	Project Name	NDA/ Non-NDA	InternPro Start Date	OPT
Adharsh Prasad Natesan	anatesan@asu.edu	IT-Core Foundation Suriname	Non-NDA	2024-08-05	Yes

Progress

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

#	Action Item/ Explanation	Total Time This Week (hours)
1	Plowing Task with rovers	3
2	3D Terrain-Adaptive Movement for Agricultural Rover Simulation	3
3	Developing Real-Time Terrain Modification System for Agricultural Rover Simulation	3
4	Enhancing Visualization and Analysis of Plowing Simulation for Agricultural Rover	3
5	Implementing Gradual Terrain Modification for Realistic Plowing Simulation in Agricultural Rover Model	3
6	Report Writing	1
7	Veterans Day	2
8	Veterans Day	2
	Total hours for the week:	20

Verification Documentation:

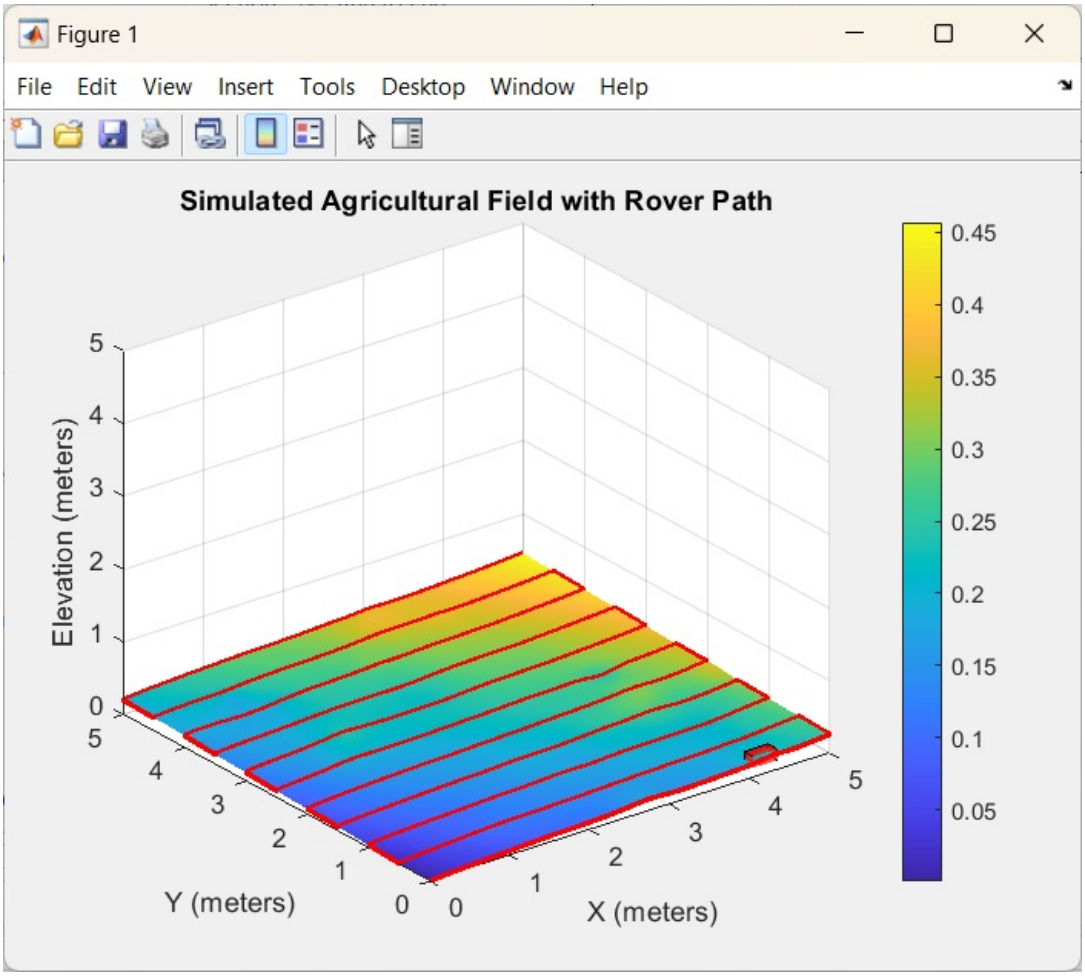
Action Item 1: Plowing Task with rovers – 3 hour(s).

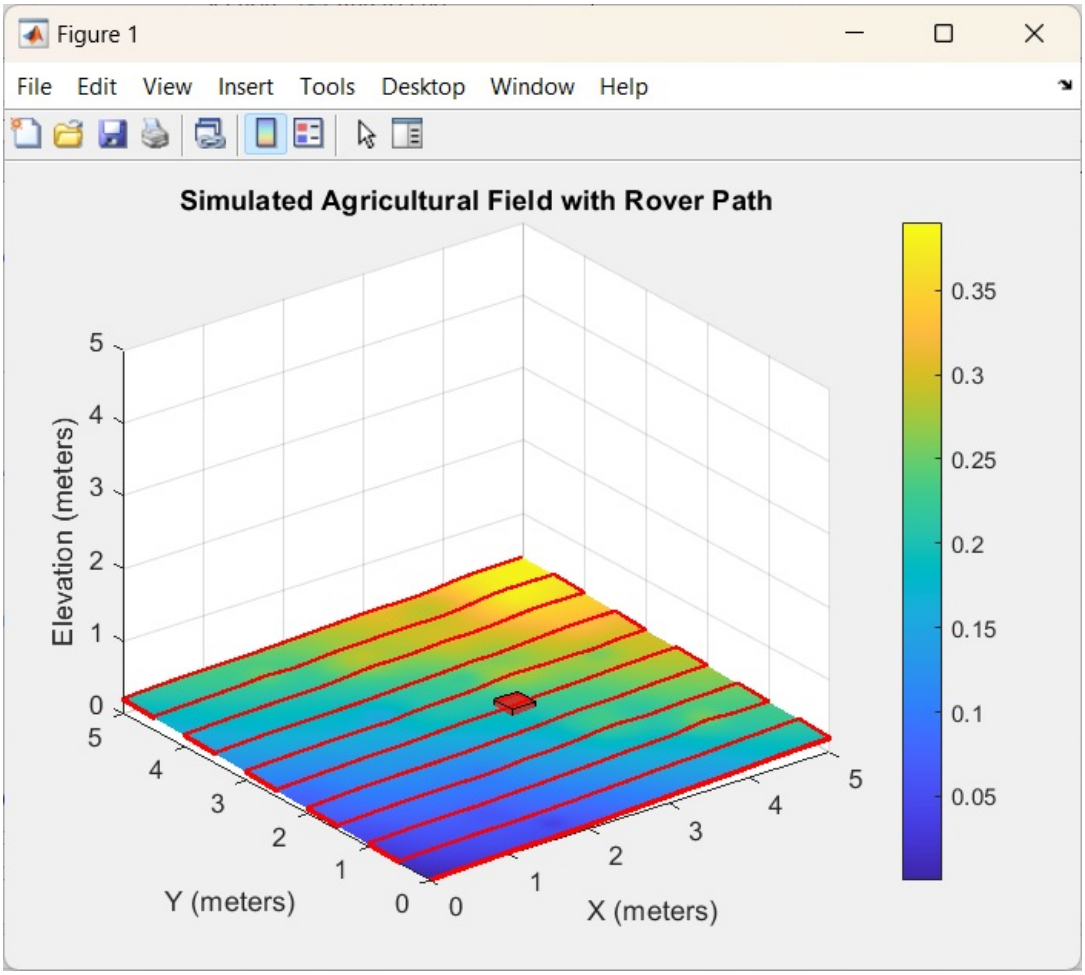
Project Work Summary

- Building upon our previous work on terrain modeling and rover simulation, we focused on implementing a plowing pattern for the agricultural rover in our simulated 3D farmland environment using MATLAB.
- To simulate the plowing action, we developed a path planning algorithm that creates a zigzag pattern covering the entire field from one corner to the diagonally opposite corner, mimicking real-world agricultural practices.
- We implemented this pattern using a series of straight-line paths with U-turns at the field edges, adjusting the

number of rows to control the density of the plowing pattern.

- The algorithm projects this zigzag path onto the 3D terrain surface using MATLAB's interp2 function, ensuring that the rover follows the contours of the land while maintaining the overall plowing pattern.
- We integrated the plowing path with the rover's enhanced movement capabilities, allowing it to adjust its orientation based on the local terrain slope as it follows the plowing pattern.
- The resulting visualization demonstrates how the rover systematically covers the entire field in a plowing pattern while realistically adapting to the terrain's elevations and depressions.

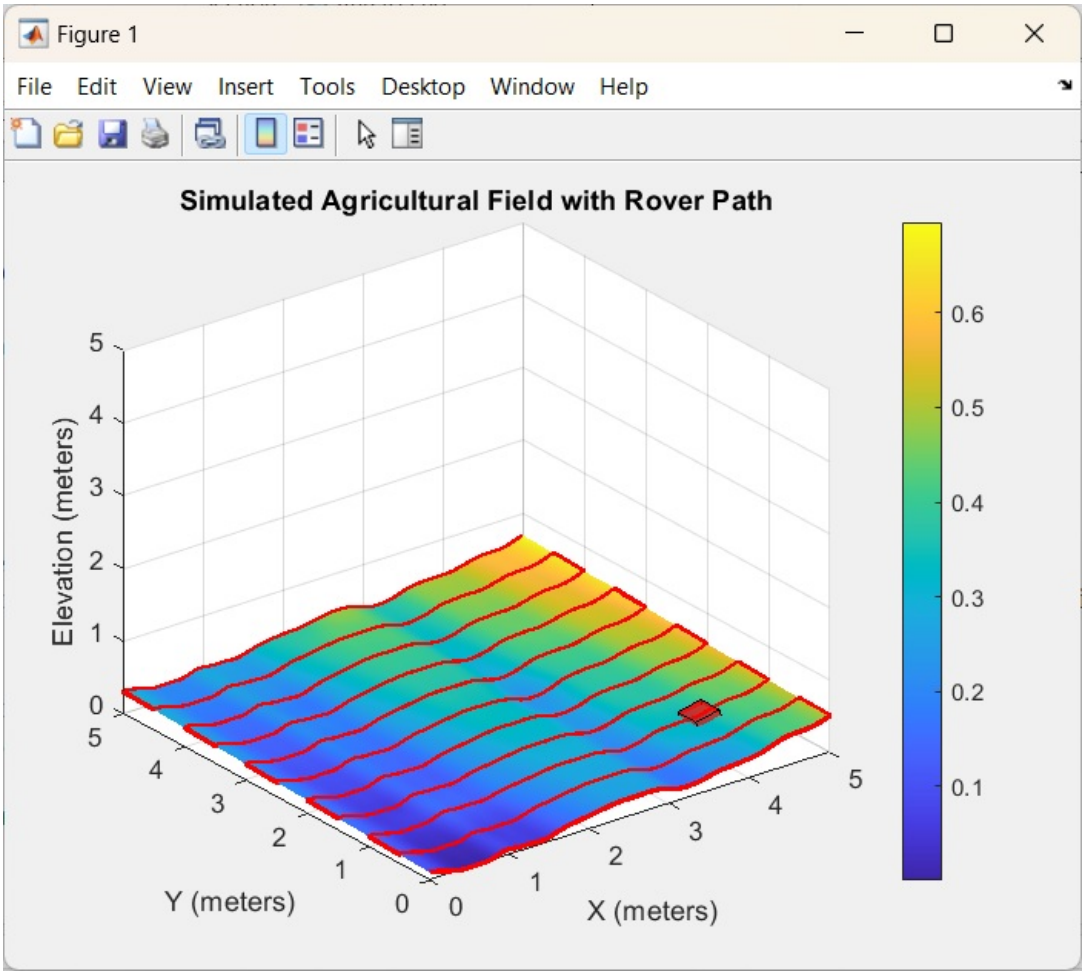


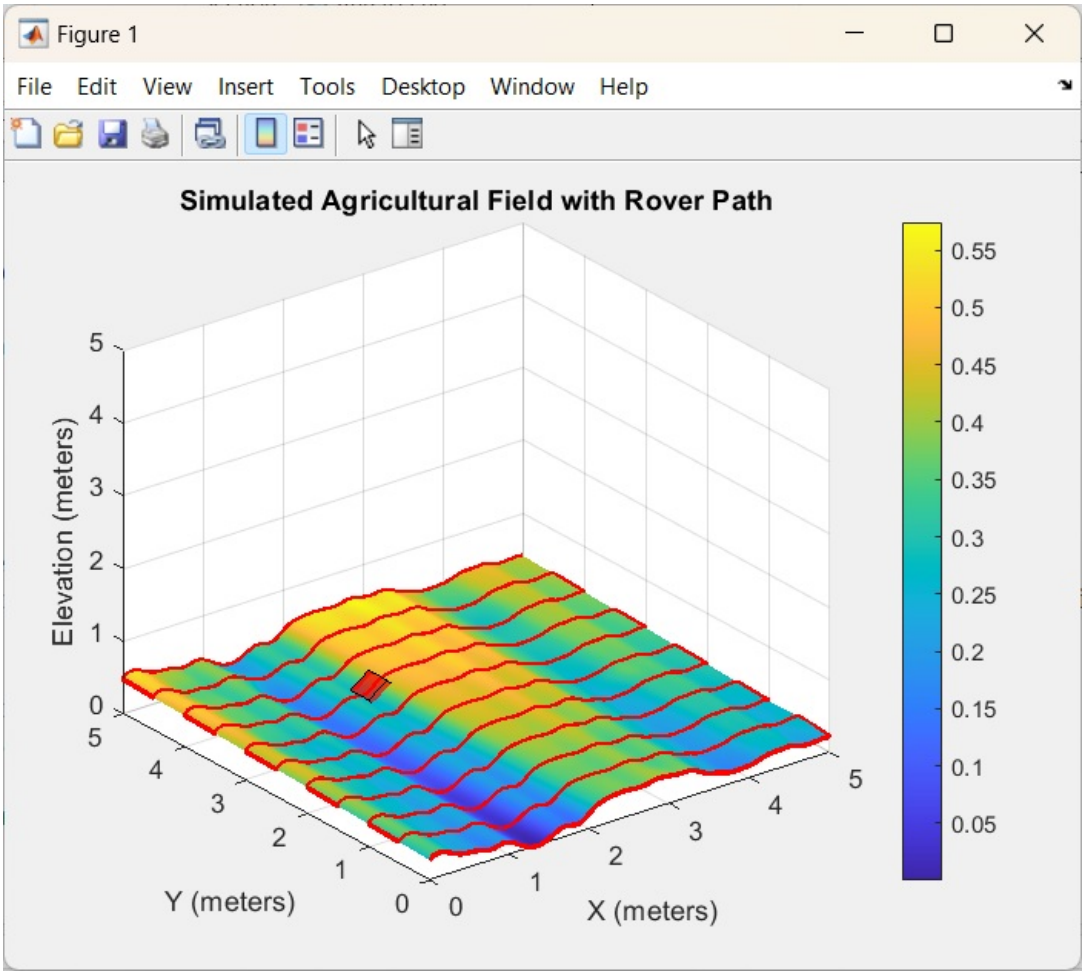


Action Item 2: 3D Terrain-Adaptive Movement for Agricultural Rover Simulation – 3 hour(s).

Project Work Summary

- We enhanced our MATLAB simulation to incorporate a 3D terrain-adaptive movement system for the agricultural rover, allowing it to navigate realistically over the simulated farmland.
- The implementation utilizes MATLAB's gradient function to calculate the 2D gradient of the terrain, which is then used to determine the local surface normal at each point along the rover's path.
- The rover's orientation is now adjusted in all three dimensions (pitch, roll, and yaw), providing a more accurate representation of how it would navigate uneven terrain in real-world conditions.
- To better visualize the rover's terrain-adaptive movement, we enhanced the bumps in the simulated farmland, making the movement of rover more pronounced for demonstration purposes.
- We implemented a local coordinate system for the rover at each point along its path, allowing for precise control over its orientation relative to the terrain.
- The resulting visualization clearly demonstrates the rover's ability to "hug" the terrain, showcasing how it tilts and rotates to match the contours of the farmland, including the more pronounced bumps and depressions.

- 
Figure 1
File Edit View Insert Tools Desktop Window Help
Simulated Agricultural Field with Rover Path
Elevation (meters)
Y (meters)
X (meters)
0 1 2 3 4 5
0.6 0.5 0.4 0.3 0.2 0.1

- 
Figure 1
File Edit View Insert Tools Desktop Window Help
Simulated Agricultural Field with Rover Path
Elevation (meters)
Y (meters)
X (meters)
0 1 2 3 4 5
0.55 0.5 0.45 0.4 0.35 0.3 0.25 0.2 0.15 0.1 0.05

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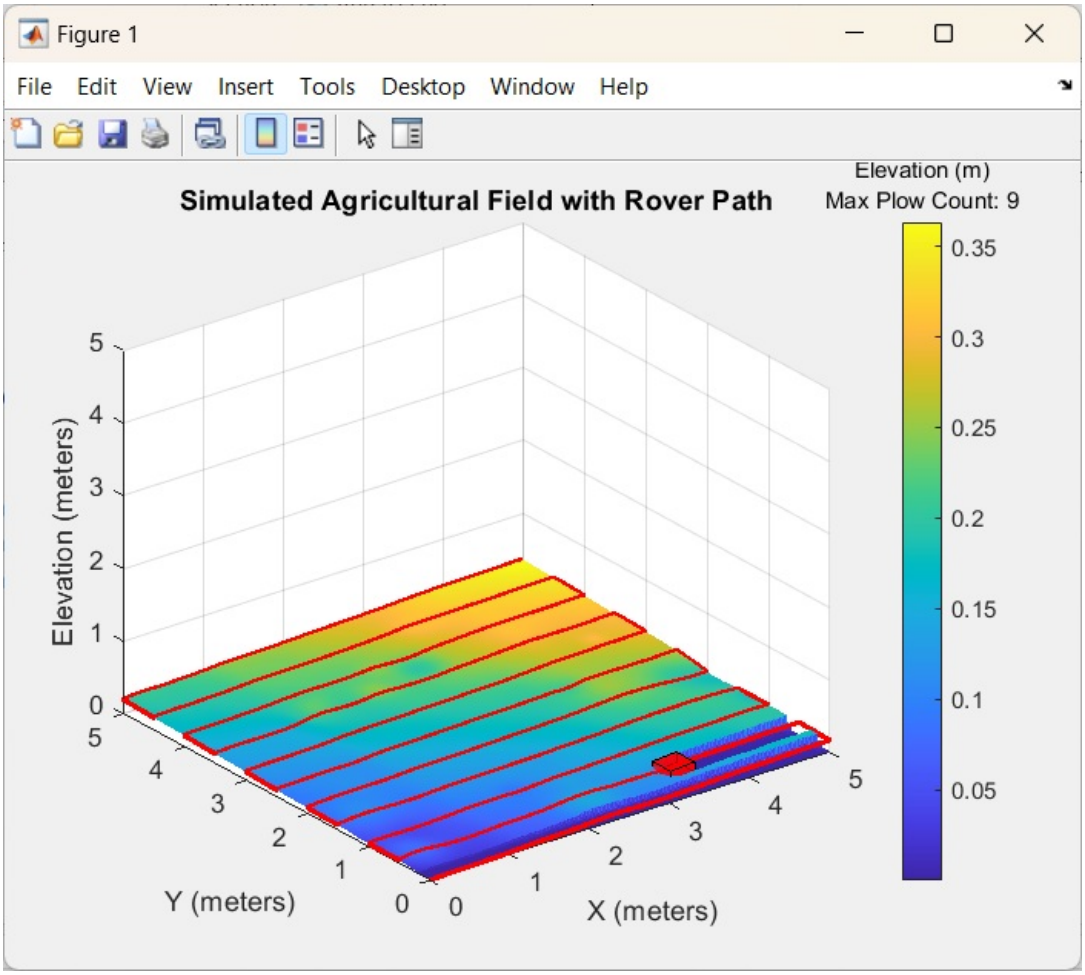
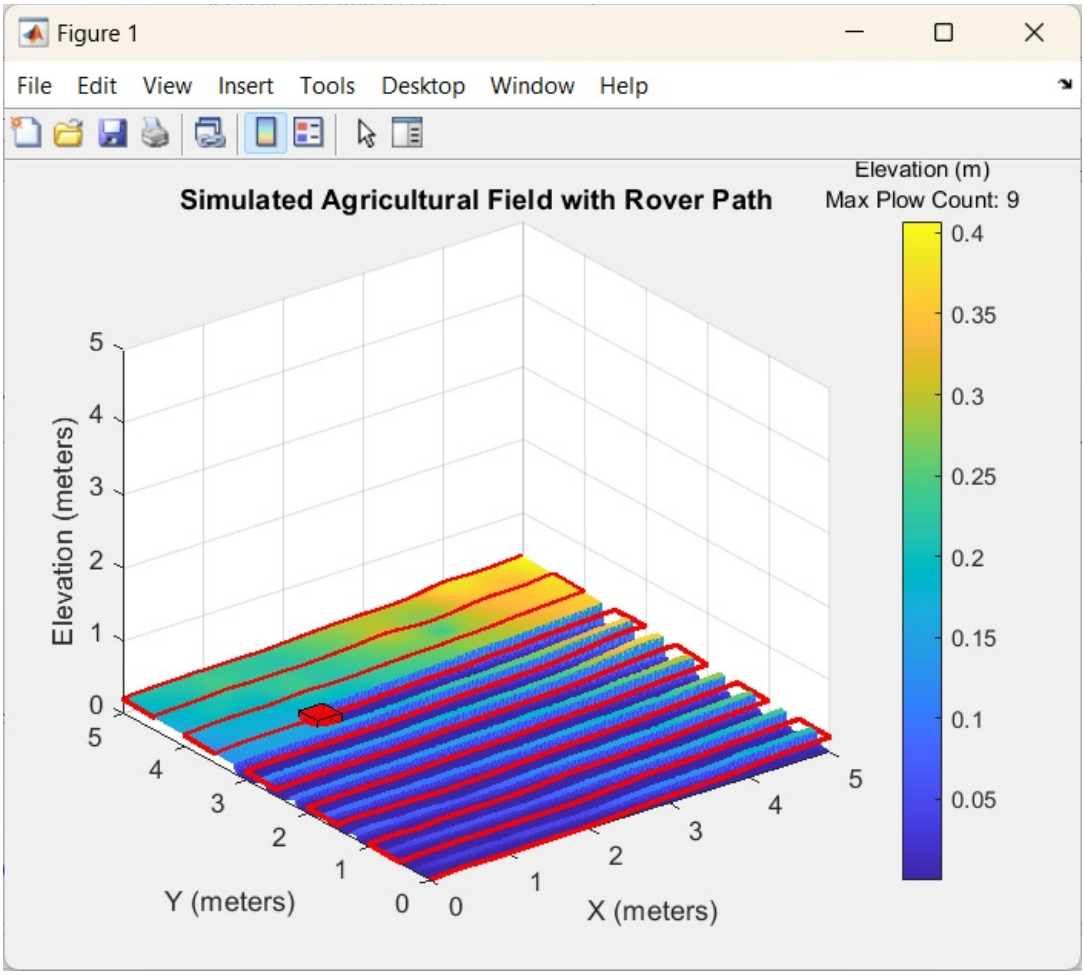
Action Item 3: Developing Real-Time Terrain Modification System for Agricultural Rover Simulation – 3 hour(s).

Project Work Summary

- Implemented a dynamic terrain modification system in our MATLAB simulation to replicate the plowing action of the agricultural rover.
- Created a 'plow_count' matrix to track the number of times each area of the field has been plowed, enabling progressive terrain modification.
- Developed an algorithm that modifies terrain height in real-time as the rover moves, simulating a more realistic plowing process.
- Implemented a circular area around the rover's current position to simulate the width of a plow attachment, updating this area at each step of the rover's movement.
- Introduced an exponential decay factor for terrain modification, ensuring diminishing effects on terrain height with subsequent passes, mimicking real-world plowing behavior.

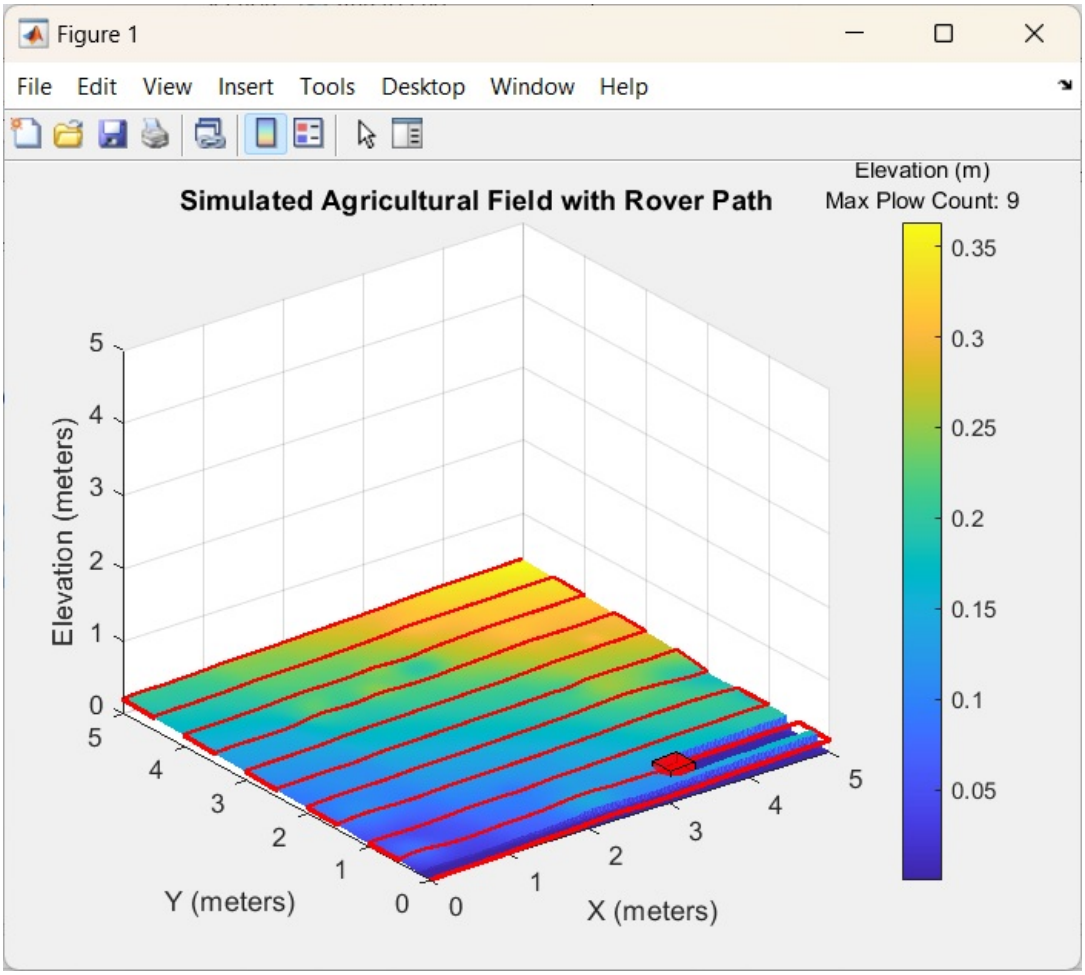
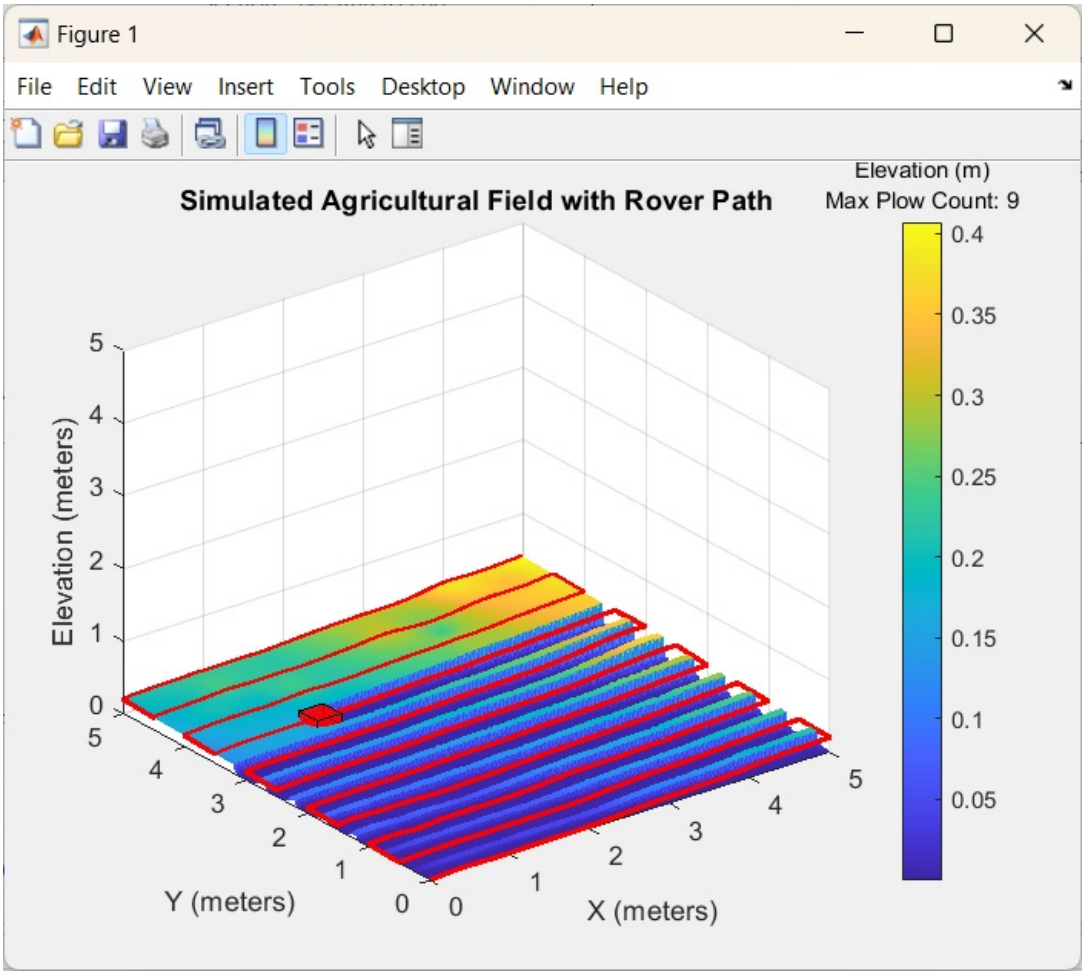




Action Item 4: Enhancing Visualization and Analysis of Plowing Simulation for Agricultural Rover – 3 hour(s).

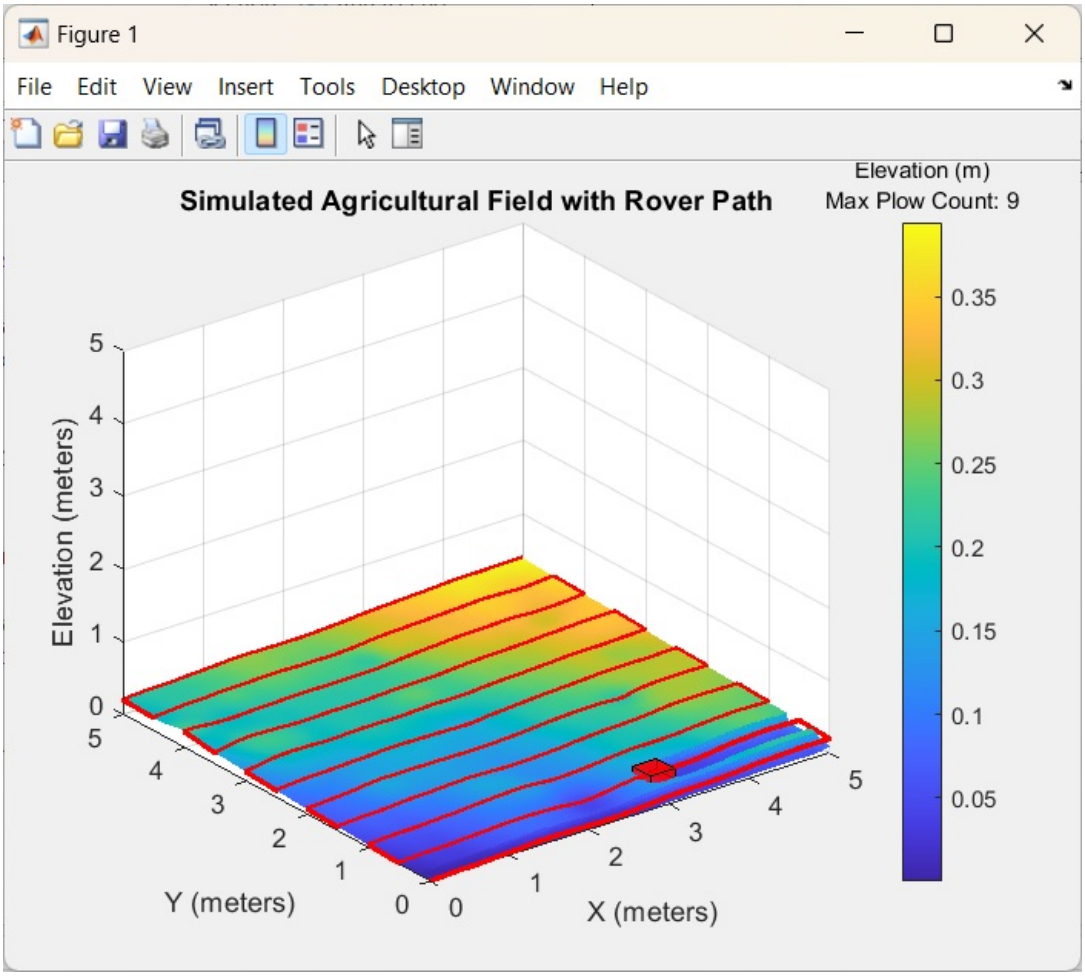
Project Work Summary

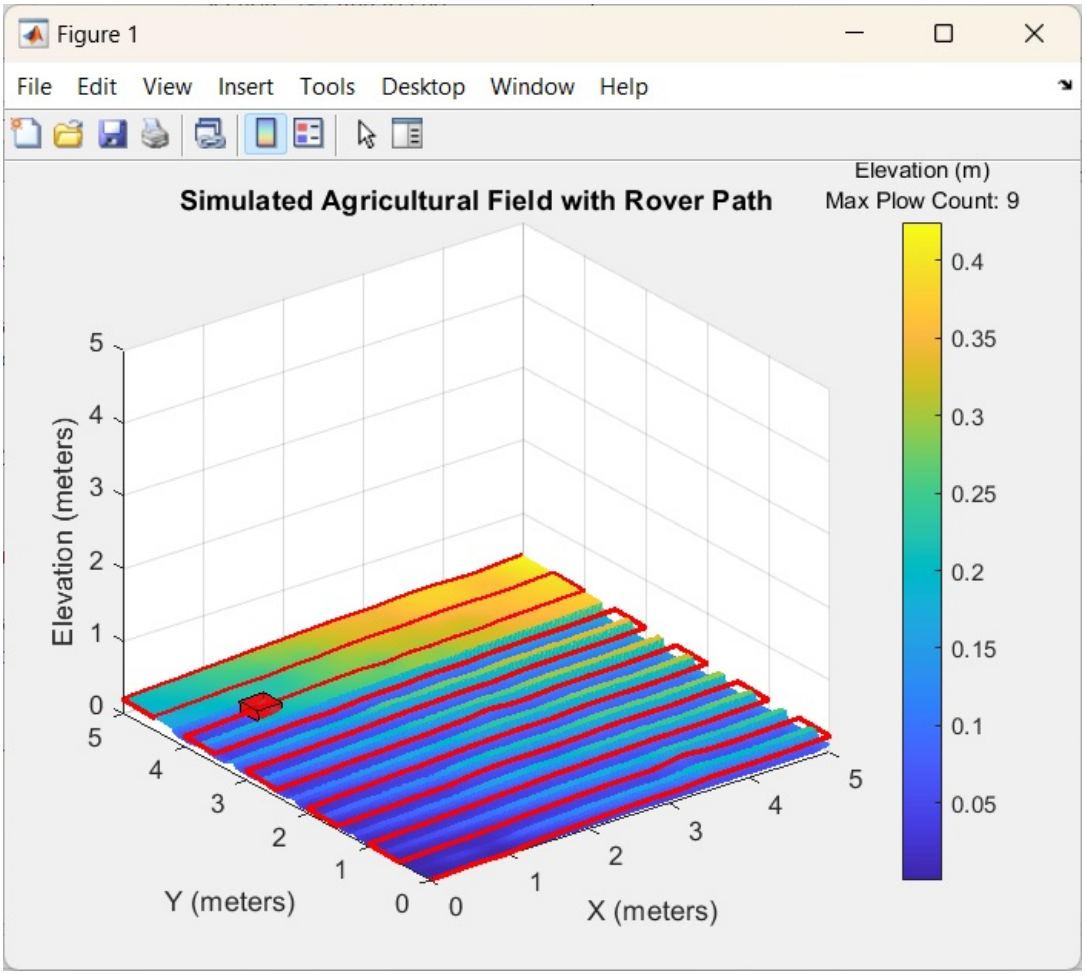
- Updated the visualization to reflect dynamic changes in terrain, with the surface being redrawn in each frame to show progressive field flattening.
- Added a feature to update the colorbar title with the maximum plow count across the entire field, providing a visual indicator of plowing progress.
- Implemented functionality to observe multiple plowing passes, demonstrating how repeated field traversals lead to a more uniform surface over time.
- Enhanced the simulation to allow testing of different plowing strategies and their effects on field leveling, crucial for optimizing real-world agricultural practices.
- Integrated the new plowing simulation with existing terrain modeling, path planning, and rover movement systems, adding a new layer of complexity and realism to the agricultural rover simulation.

- 
Figure 1
File Edit View Insert Tools Desktop Window Help
Simulated Agricultural Field with Rover Path
Elevation (m)
Max Plow Count: 9
0.35
0.3
0.25
0.2
0.15
0.1
0.05
Elevation (meters)
Y (meters)
X (meters)
- 
Figure 1
File Edit View Insert Tools Desktop Window Help
Simulated Agricultural Field with Rover Path
Elevation (m)
Max Plow Count: 9
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
Elevation (meters)
Y (meters)
X (meters)

Action Item 5: Implementing Gradual Terrain Modification for Realistic Plowing Simulation in Agricultural Rover Model – 3 hour(s).

Project Work Summary

- Enhanced the MATLAB simulation to incorporate a more realistic plowing effect that gradually levels the terrain instead of completely flattening it.
- Implemented a target height calculation system where the plowed areas approach 50% of their original height, mimicking the partial leveling effect of real-world plowing.
- Developed an algorithm that gradually reduces the terrain height towards the target height with each pass of the rover, simulating the cumulative effect of multiple plowing sessions.
- Updated the visualization to reflect these incremental changes in terrain height, showcasing a more nuanced and realistic representation of the plowing process over time.
- Ensured that the terrain maintains some of its original topography even after multiple passes, preserving a degree of natural variation in the field surface.
- This enhancement significantly improves the realism of the simulation, providing a more accurate representation of how actual agricultural plowing modifies terrain over repeated passes.
- 



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Action Item 6: 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.

Action Item 7: Veterans Day – 2 hour(s).

Veterans Day holiday and corresponding hours entry to complete the 20 hours per week, so that I could submit my progress.

Action Item 8: Veterans Day – 2 hour(s).

Veterans Day holiday and corresponding hours entry to complete the 20 hours per week, so that I could submit my progress.