

Leaderless Construction Systems

New Mexico

Supercomputing Challenge

Final Report

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107

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Table of Contents

| | |
|--|---|
| <u>Summary</u> | 3 |
| <u>Problem Statement</u> | 3 |
| <u>Method</u> | 4 |
| <u>Results and Analysis</u> | 5 |
| <u>Conclusion</u> | 6 |
| <u>Images of our Project</u> | 6 |
| <u>Achievements</u> | 7 |
| <u>Acknowledgements</u> | 7 |
| <u>Works Cited</u> | 8 |

Summary

Each robot would gather a piece of material then lay it down on the marked landscape that showed where they were supposed to start building but we only ever got as far as the robots eating away the ground which would happen but the materials wouldn't just disappear they would be moved.

Problem Statement

Our first proposal changed after we found an article on the possible use of autonomous construction vehicles on the moon to create structures for human use.

Our first proposal was...

A termite colony is well adapted to creating large structures, despite consisting of individuals smaller than the tip of a fingernail. They do this without any single unit controlling the construction, but rather their shared instincts allow them to collaboratively create impressive mounds. Human machinery could do well to use this strategy to create structures in areas humans cannot access, as this would allow them to be more autonomous. We are going to use NetLogo to model a cross-section of a termite mound, and how these mounds are built by many individuals working together. Termite mounds are frequently damaged by heavy rainstorms, and the model will demonstrate how the termites can quickly rebuild any destroyed areas. This could have potential applications in architecture, manufacturing and swarm robotics, as this allows for a system of units to collaboratively create a structure, instead of having a single point of failure.

After we changed our proposal it became...

Most construction efforts, throughout history, are created with a group of people that have to work together, each adding their own skills to the project. However, social insects are able to create much more massive structures in much shorter amounts of time.

With humans attempting to create structures in increasingly hostile environments for the future, the obvious solution is to use machines. However, these machines are currently much less efficient at creating these structures, and are nowhere near as advanced as even simple insects can manage.

Method

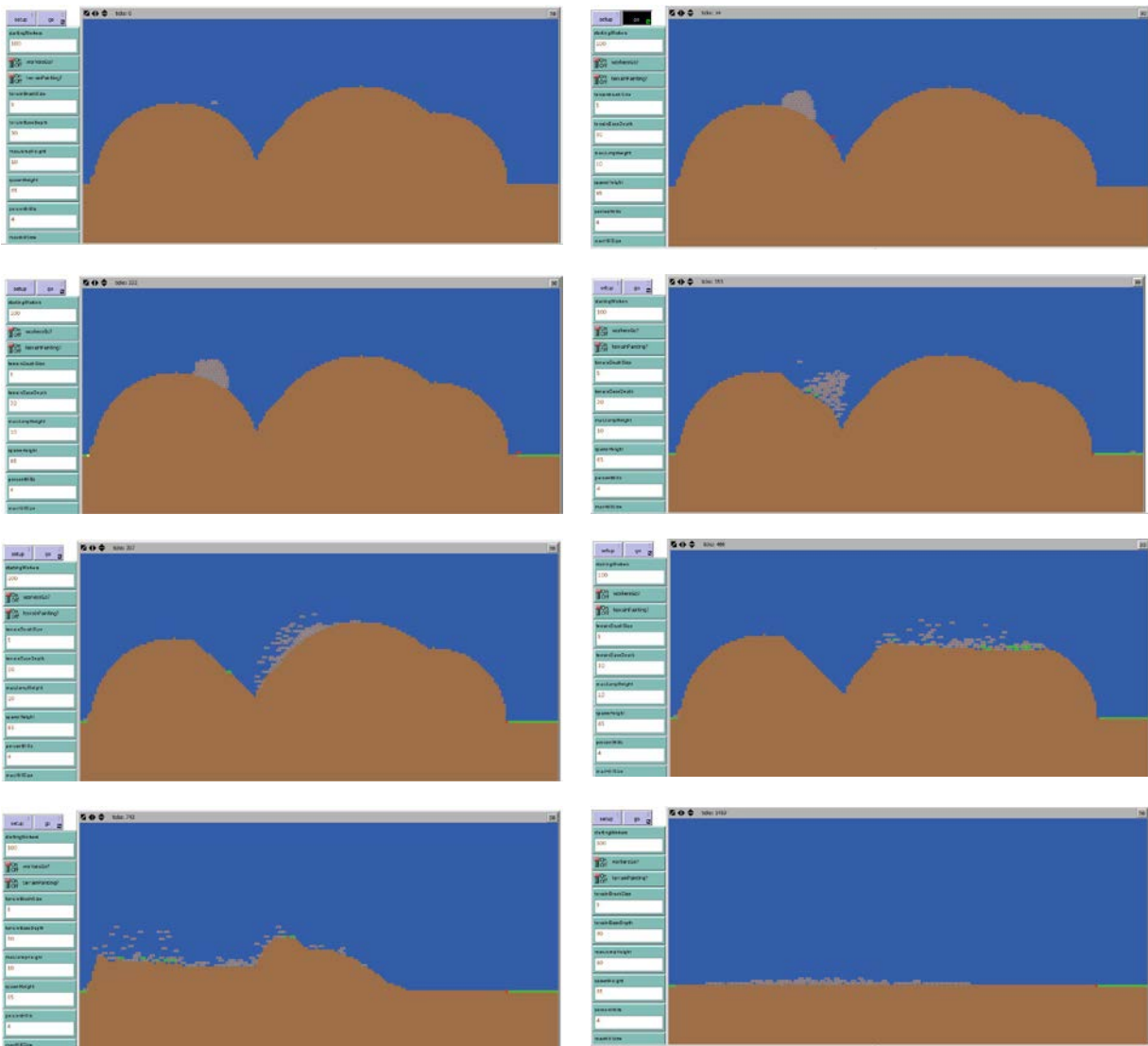
Our primary method of working was to first meet together and get the primary “engine” coding done via meeting together and using one computer, with one person coding as the others gave suggestions and tested it. Then, once this was done, we found any issues we wanted resolved in the code, each chose one in particular, and separated the program into different “versions”. Each of us then created the code to fix our chosen issue on our particular version. Then, once we were done, we combined all the bug fixes into one final version. This process was repeated as new “core” features were added, such as land generation, the behavior of the turtles when initialized, the addition (and subsequent removal of) damage trackers, and the process of mapping the terrain via a “scout” turtle.

We primarily used the file-sharing program *Github* to accomplish this, and indeed, the various ways *Github* functions likely shaped our process into its current form. When multiple people are working on files shared via *Github*, they technically “split” into different versions, and must be named as such to avoid un-doing someone else’s work. The process also took advantage of the time in school we had where we could all meet as a group frequently.

Conclusion

The bugs if not fixed would have made it so that the program can run smoothly and properly in an orderly fashion. These bugs took up a lot of time to fix and deal with since they weren't that noticeable but would ruin the program if they stayed, such as the ground where the robots were to start building would increase in size we then had to change the color of the patch so that they knew where they couldn't touch if we had gotten them to start building. If they had started building then they would have eventually made a tower like structure that would use the materials they were gathering.

Images of our Project



Achievements

Our biggest achievement was our presentation at our schools science night where we had to discuss to parents and fellow students what we were working on and most of these people haven't programed in NetLogo.

Acknowledgements

We would like to thank Ken Gant who helped us come up with ideas for how to program the robots. Ken ran a 3D Graphics Design class as an after school curriculum that was similar to what he does for work. He did this, unpaid, on his own time, in order to teach high school students the methods and practices of graphic design.

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