

OpenMind: Human-Swarm Interaction

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Motivation

The field of swarm robotics is increasingly popular, however, human-swarm interaction is poorly understood. Here, we seek to understand how....

- One person can control a swarm
- Many people can work efficiently alongside swarms
- What metrics can be used to evaluate swarms



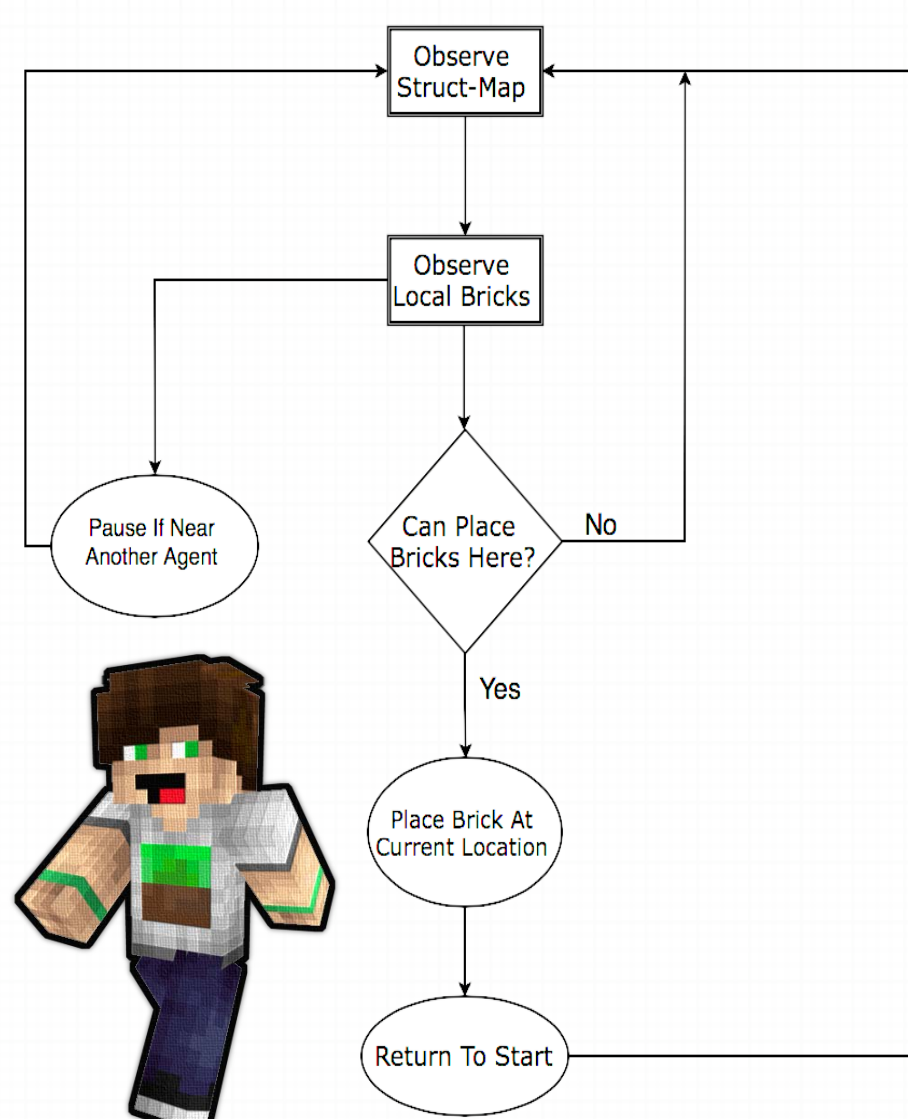
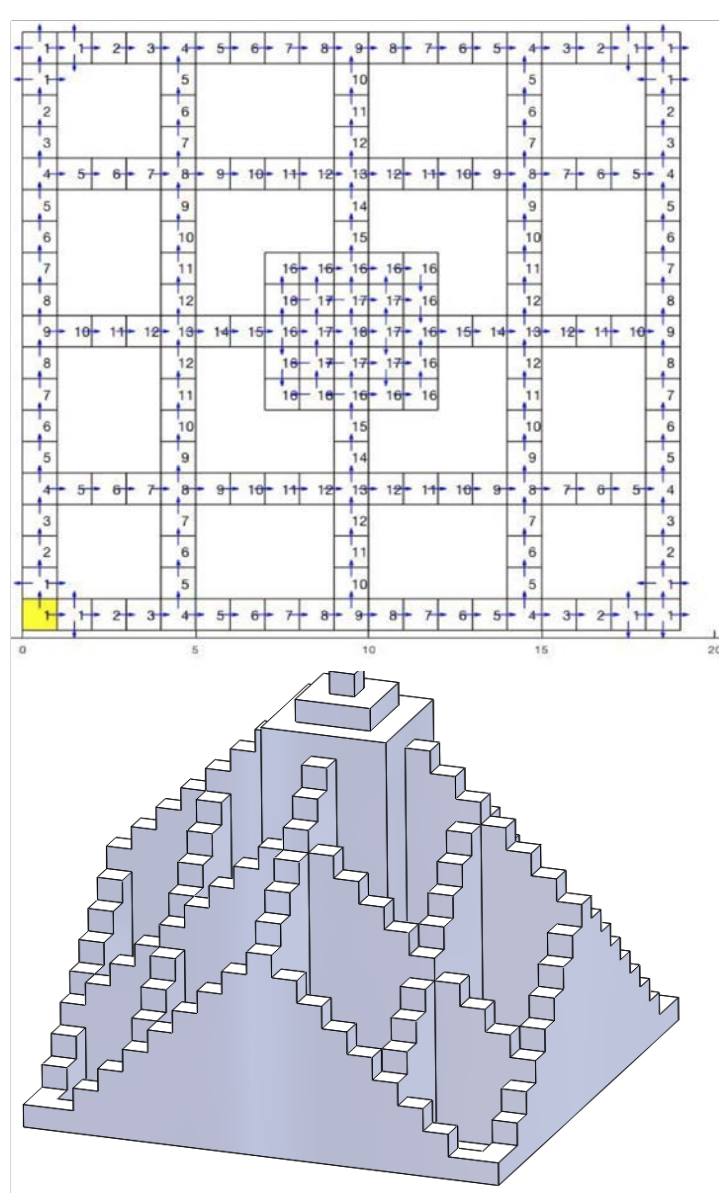
These robots work collectively to build user-specified 3D structures*. This is a complicated task, and failures are likely. The Open Mind framework will observe the robots and prompt a human user for help when necessary.

*Werfel, Justin, Kirstin Petersen, and Radhika Nagpal. "Designing collective behavior in a termite-inspired robot construction team." *Science* 343.6172 (2014): 754-758.

Minecraft Implementation

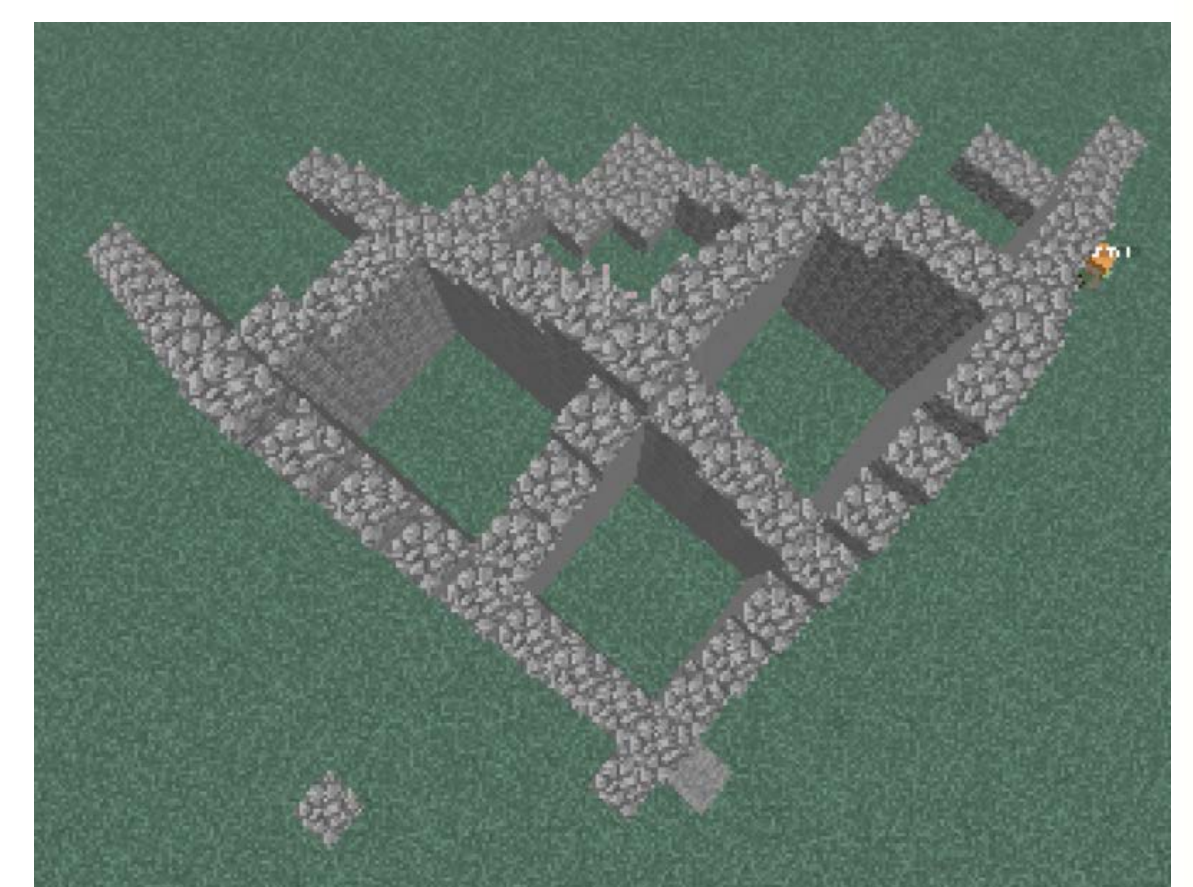


By developing a 'mod' for the online game Minecraft, we can experiment with large collectives of construction agents analogous to the real robots. Agents observe surrounding bricks and use a set of provably correct rules to decide whether to move along the structure, deposit a brick, pause, or return to the start.



Minecraft Agent Algorithm

- 1) Reads input from hashmap based on the agent's world position through local observation.
- 2) Determines what command the agent should be sent to replace a playable command such as:
 - Jumping Up or Forward
 - Moving in cardinal directions
 - Looking in cardinal directions
 - Placing bricks
 - Breaking bricks
 - Using objects
- 3) Agent continues to observe its local position and follows the struct map until it reaches ground level.
- 4) Uses right-hand wall rule to find its way to the beginning (0,0) and loops.



Suggested OpenMind framework to help layman users interpret and support a robot swarm:

Future Direction

Next, we will implement a large collective with realistic errors and sensor noise. We will also allow human players to work alongside the autonomous agents. This platform will enable studies of human-swarm interaction; showing how a 'foreman' user may support the collective by adjusting global and local discrepancies, such as wrong depositions or malfunctioning agents.

