Voice Over for RA-L video

This video shows parallel self-assembly of 2D tile structures using uniform control inputs. Tiles of different colors stick together.

All tiles are actuated simultaneously by a global control input that pushes in the clockwise sequence of right, down, left, and up. The factory generates multiple copies of the desired part. For this example, the goal configuration is shown at left.

Each clockwise sequence assembles another part.

These parts are called polyominos

Our algorithm first determines if a polyomino can be constructed by adding one tile at a time; if so it generates a build sequence for the tiles in the part, otherwise it returns that the polyomino cannot be built by additive construction. Such polyomino must be made by different methods.

We built a reconfigurable, gravity-based model and a milli-scale magnetically actuated system to demonstrate parallel assembly. In the gravity-based model, gravity is the global input that manipulates the red and blue sliders. These sliders connect magnetically – the red sliders have magnetic south out and the blue magnetic north.

In the milli-scale prototype, alginate particles are actuated by a global magnetic field to assemble into a 2d structure. In this case the structure is a three-particle column. A custom magnetic control stage generates a magnetic drag force by moving a permanent magnet. The assembly workspace is made of PDMS filled with deionized Water and 10% Polyethylene glycol.