

Construction Coordinated by Stigmergic Blocks

Yating Zheng^{1,2} , Michael Allwright² , Weixu Zhu² , Majd Kassawat³ ,
Zhangang Han¹ , and Marco Dorigo² 

¹ School of Systems Science, Beijing Normal University, Beijing, China
zhengyating@mail.bnu.edu.cn, zhan@bnu.edu.cn

² IRIDIA, Université Libre de Bruxelles, Brussels, Belgium
{michael.allwright,weixu.zhu,marco.dorigo}@ulb.ac.be

³ Universitat Jaume I, Castellon, Spain
majd@uji.es

In swarm robotics, robots coordinate their actions by communicating with their neighbors and by sensing and modifying their environment [3]. In previous work, swarms of building robots have been coordinated through stigmergy, where the observations of previous construction actions trigger further construction actions [1, 4]. In these systems, the intelligence that coordinates construction is usually embedded in the robots.

We are currently exploring how swarm construction can be realized when the intelligence that coordinates construction is distributed between the robots and the building material. In this abstract, we present a preliminary step to distributing this intelligence where the building material, in the form of building blocks, can send and receive messages from other blocks in the same structure. In our current implementation, we provide the blocks with a description of a structure. One block then takes the lead and determines where blocks are missing and should be placed. Figure 1 shows this block relaying this information by setting the colors of the light-emitting diodes on a structure during manual assembly.

In initial experiments, we have begun to explore how this setup can be used to influence the way in which construction unfolds. For example, Fig. 2 shows how the order in which robots attach blocks could be used to regulate construction so that the final structure has two blocks on the top layer on opposite sides (either front-back or left-right).

We have also started to investigate gradient following [5], where blocks use their light-emitting diodes to communicate the directions in which construction sites can be found. Figure 3 shows an example of this concept where blue blocks indicate that the nearest site is to the left and red blocks indicate that the nearest site is to the right. After both blocks have been attached, the controller sets all blocks to green to indicate that the structure is complete.

In future work, we will decentralize the approach in this abstract to realize a swarm robotics construction system where the intelligence is distributed across both the blocks and the robots. We will use the BuilderBot and Stigmergic Blocks to validate this approach in order to gain a deeper understanding as to whether these abstract concepts can be realized in a more realistic setting [2].

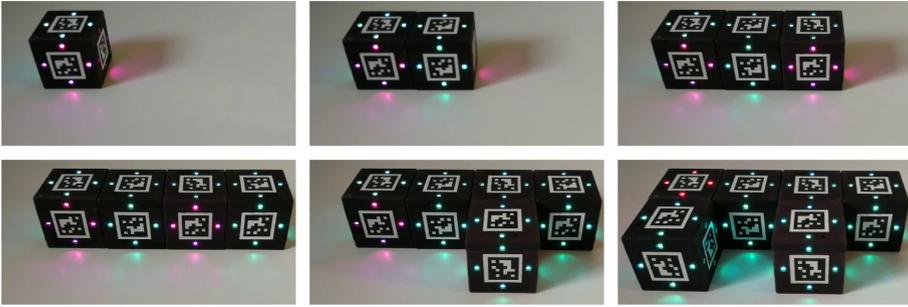


Fig. 1. Manual construction guided by the leftmost block

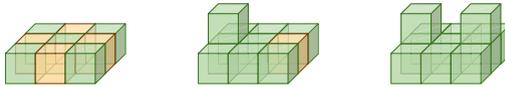


Fig. 2. The block in the center disables construction sites to regulate construction

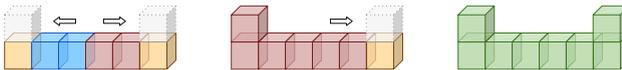


Fig. 3. The leftmost block shows how to reach a valid construction site

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