Magnetic FreeBOT balls make giant leap for robotics

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A freeform MSRR system - FreeBOT. Credit: Guanqi Liang et al.

A unique type of modular self-reconfiguring robotic system has been unveiled. The term is a mouthful, but it basically refers to a robotic enterprise that can construct itself out of modules that connect to one another to achieve a certain task.

There has been great interest in such machines, also referred to as MSRRs, in recent years. One recent project called simply Space Engine can construct its own physical space environment to meet living, work and recreational needs. It accomplishes those tasks by generating its own kinetic forces to move and shape such spaces. It does this through adding and removing electromagnets to shift and construct modules into optimum room shapes.

MSRRs nevertheless face some constraints. They require gender-opposite components, which is limiting in some circumstances, and the modules must coordinate trajectories to efficiently connect components during self-assembly operations. Those tasks are time consuming and the success rates for connections between modules haven't consistently been high.

A research team at the Chinese University of Hong Kong, Shenzhen, has come up with a system that overcomes those limitations. Led by Tin Lun Lam the researchers devised a system composed of modular robotic "genderless" vehicles that can morph into whatever shapes are required. It has fewer physical restraints according to the researchers, and does not require components to to be precisely aligned with one another. That allows for a greater variety of configurations. Connections are simpler and essentially instantaneous.

These FreeBOTs are compose of two elements: a spherical ferromagnetic shell and an internal magnet. The individual balls—up to 50 were used in a demonstration video, though much larger numbers may be used—can move independently or join together to sweep across

floors, traverse steps and even crawl up walls. The magnets can be triggered to connect when the bots come near each other, and can disconnect simply by steering one away from the other.

A short video prepared by the group demonstrating the capabilities of FreeBOTs combing steps is somewhat reminiscent of the popular Slinky toy of the 1940s that amazed onlookers with its ability to self propel itself down a stairway. The FreeBOT balls, similarly, rely on gravity and magnetic force to coalesce and move in unison in various directions.

FreeBOT has advantages over the most advanced MSRR systems, according to Lam. In a research report, he said: "FreeBOT has the same basic functions as the most advanced MSRR: module independent motion, connection/separation between modules without manual assistance and system reconfiguration. However," he said, "the previous MSRR module is equipped with multiple actuators for different tasks, which increases the weight, volume and manufacturing cost of the robot. FreeBOT has only two motors for these tasks, but it can form an MSRR system with fewer physical constraints."

The research team's work is summarized in a paper titled: "FreeBOT: A Freeform Modular Self-reconfigurable Robot with Arbitrary Connection Point—Design and Implementation."

The researchers will discuss their work this week at the IEEE/RSJ International Conference on Intelligent Robots (IROS), being held online through Nov. 25.

More information: FreeBOT: A Freeform Modular Self-reconfigurable Robot with Arbitrary Connection Point - Design and Implementation, www.researchgate.net/publicati …
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