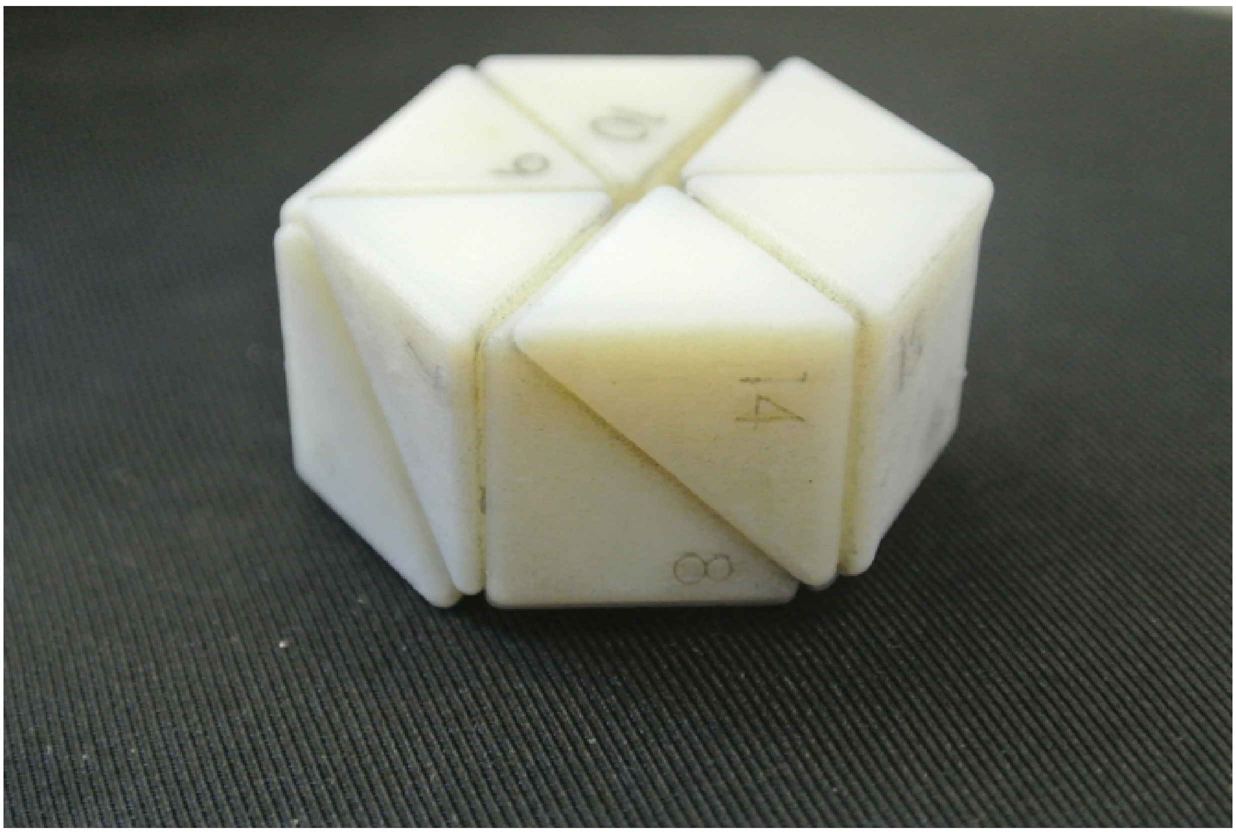
Self-building 3D printed bricks hint at future without assembly lines

July 31 2015, by Eliza Berlage



All 18 bricks assembled perfectly. Credit: Adar Hacohen.

A new study has shown that high frequency vibrations can cause bricks to self-assemble into a larger 3D object, a finding that may one day help do away with the need for factory assembly lines.

The findings, published today in the journal Scientific Reports, signal a key advancement in programmable self-assembly, which was previously thought to only be possible using one dimensional or two dimensional objects.

The research team, led by Dr Ido Bachelet from the Institute for Nanotechnology and Advanced Materials at Bar-Ilan University in Israel, used an algorithim from the Computational Geometry Algorithm Library (CGAL) as part of a design that allowed 18 tetrahedral bricks to self-assemble into a larger 3D cylinder.

This video shows the blocks in the assembly process. Credit: Adar HacohenWhole object assembly. Credit: Adar Hacohen

"Assembly rules are encoded by topographic cues imprinted on brick faces while attraction between bricks is provided by embedded magnets," the researchers said in their paper. "The bricks can then be mixed in a container and agitated, leading to properly assembled objects at high yields and zero errors.

"Improved designs inspired by our system could lead to successful implementation of self-assembly at the macro-scale, allowing rapid, on-demand fabrication of objects without the need for assembly lines."

Natural self-assembly

The ability for life to self-assemble is something that continues to puzzle scientists: proteins, viruses, living cells and multi-cellular organisms are all examples of systems in which parts are bonded to each other through attraction to form a structure or pattern.

Hamza Bendemra, a Research Engineer at the Australian National University, who was not involved in the study, said the research of 3D printed assemblies is remarkable.

"The algorithm was inspired by the molecular assembly of the DNA," he said. But he added that more research was needed to address challenges of time, space and safety for the model to be more efficient at forming and remaining together.

"In the study, a two-brick assembly took less than a minute to self-assemble. However, an 18-piece assembly required over two hours to perform the same feat."

"The components are subject to high vibrations and collide over and over again until they fit in the right combination. It would be a challenge to implement such a method with materials with low strength and poor impact tolerance without causing damage."

The future of construction?

Bernard Meade, Head of Research Compute Services at the University of Melbourne, said that while the initial research is limited to building small objects, future demonstrations combining other techniques, such as embedded electronics, could make the rapid construction of larger devices viable.

"For example, ordering a smart phone with specific components, automatically assembled and shrink-wrapped with a protective coating, might take only a few minutes –- and no longer require thousands of phones to be pre-made. Perhaps furniture scale production might be possible in future – imagine flatpack IKEA – but I think it would be hard to get to something the size of a house."

The next step in developing this study for construction and manufacturing industries is to use both magnetic forces and adhesives to ensure the assembly stays in place.

Bendemra agreed, saying that "the researchers did a great job at adding topographic cues to ensure a unique combination only would lead to the pieces locking in. Their footage clearly shows that pieces that collide in a non-desired formation detach until they lock-in as planned."

"The number of pieces involved in the assembly and the nature of the materials being used (including the magnet) in more complex assemblies could limit the use of such a method."

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