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Singapore scientists develop smart technology for synchronized 3D printing of concrete

By Enterprise Innovation editors | 2018-10-04



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Scientists from Singapore's Nanyang Technological University (NTU Singapore) have developed a technology where two robots can work in unison to 3D-print a concrete structure.

This method of concurrent 3D-printing, known as swarm printing, paves the way for a team of mobile robots to print even bigger structures in future.

Developed by Assistant Professor Pham Quang Cuong and his team at NTU's Singapore Centre for 3D Printing (SC3DP), this new multi-robot technology was published in *Automation in Construction*, a top-tier journal for civil engineering. The NTU scientist was also behind the Ikea Bot earlier this year where two robots assembled an Ikea chair in 8 minutes and 55 seconds.



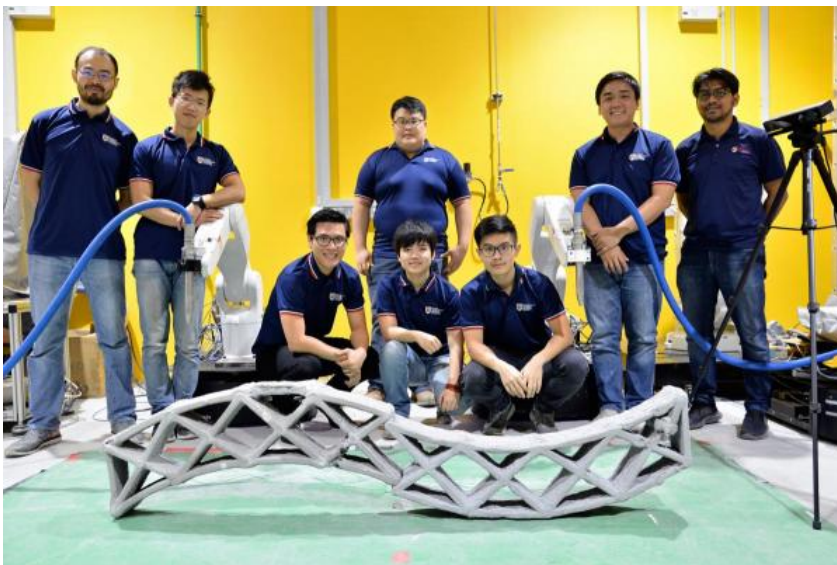
Using a specially formulated cement mix suitable for 3-D printing, this new development will allow for unique concrete designs currently not possible with conventional casting. Structures can also be produced on demand and in a much shorter period.



Currently, 3D-printing of large concrete structures requires huge printers that are larger than the printed objects, which is unfeasible since most construction sites have space constraints.

Having multiple mobile robots that can 3D print in sync means large structures like architectural features and specially-designed facades can be printed anywhere as long as there is enough space for the robots to move around the work site.

The NTU robots 3D-printed a concrete structure measuring 1.86m x 0.46m x 0.13m in eight minutes. It took two days to harden and one week for it to achieve its full strength before it was ready for installation.



https://www.enterpriseinnovation.net/files/u8730/ntu_sc3dp.jpg

Asst Prof Pham Quang Cuong and the multidisciplinary team of roboticists, civil engineers and mechanical engineers from NTU SC3DP (photo credit: NTU Singapore)

"We envisioned a team of robots which can be transported to a work site, print large pieces of concrete structures and then move on to the next project once the parts have been printed," explained Asst Prof Pham from NTU's School of Mechanical and Aerospace Engineering.

"This research builds on the knowledge we have acquired from developing a robot that can autonomously assemble an Ikea chair. But this latest project is more complex in terms of planning, execution, and on a much larger scale."

Printing concrete structures concurrently with two mobile robots was a huge challenge, as both robots have to move into place and start printing their parts without colliding into each other.

Printing the concrete structure in segments is also not acceptable, as joints between the two parts will not bond properly if the concrete does not overlap during the printing process.