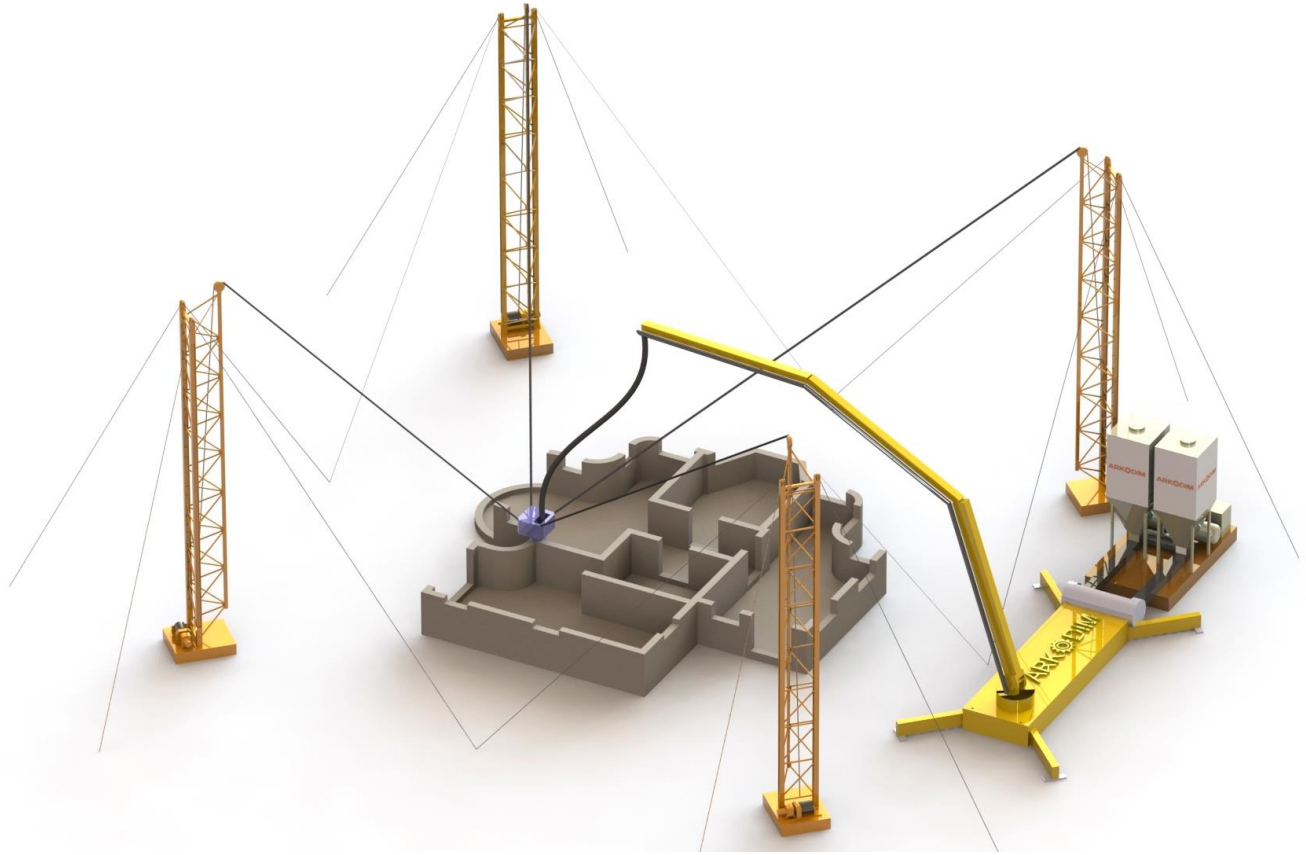
FRAMELESS 3D PRINTER FOR CONSTRUCTION

DESCRIPTION

Construction 3D-printer based on a cable-driven robot. The robot does not have a single rigid frame, and consists of 4 masts stabilized due to stretch marks. The printhead is suspended on ropes moved by servomotors. The installation includes an automation system for the preparation and supply of concrete mix, which allows you to simultaneously make two types of concrete - structural and heat insulation. The print head is equipped with two nozzles for feeding two different types of concrete.



First, structural concrete is printed bearing part of the wall. Then the cavities are filled with light cellular concrete, which plays the role of thermal insulation. At the end we get a strong warm wall.

Advantages:

1. Large size - a print head movement control system based on a cable-driven robot allows you to make a huge 3D construction printer.
2. Variability of the working field - this system can be deployed in areas with different sizes of the working field, depending on the task. For example, you can deploy the installation with the size of the working field 30x50 meters, and on the next object 20x40 meters.
3. Mobility and speed of deployment - in a civilian version, a 3D printer is disassembled into individual elements and transported by ordinary transport on public roads. In the version for military mast and servomotors can be mounted on separate wheelbases in the form of a trailer with the possibility of rapid semi-automatic deployment.
4. Unpretentiousness to the deployment area - the installation does not require leveling the site for deployment. Can be mounted and calibrated even on hilly terrain.
5. Low cost in comparison with analogs of frame type. The absence of transverse elements of the frame leads to a reduction in the cost of manufacture, as well as savings in logistics during operation..

Problems:

1. Problems of positioning the print head - with large sizes of the cable-driven robot it is difficult to achieve accurate positioning due to the effects of stretching and sagging of cables.
2. The lack of recipes for preparing concretes for 3D printing of buildings — when printing with conventional types of concrete, the lower layers begin to flatten out and float under the influence of the mass of the upper layers. To eliminate this effect, it is necessary to periodically stop printing until the concrete has reached the required strength and only then continue printing.
3. Lack of technology for printing buildings - to date, there are no technologies approved for the construction of various buildings approved by supervisory authorities using 3D printing.

PROJECT STEPS

This project involves not just the development of a mechanism for printing concrete various buildings and structures and its further sales. Developed technologies within the project are designed to solve the problem of 3D printing by concrete in the complex - first the formulation of concrete mixes and the printing technology of structural elements are developed, then or in parallel the mechanism and control system of a frameless 3D construction printer is developed.

1st step, «Concrete»:

- Formulation of concrete mixes for 3D-printing.
- Patenting in Russia and abroad
- Development of technologies for printing structural elements

2nd step, «Robot»:

- Designing a frameless 3D-printer for construction.
- Development of a control system for a cable-driven robot.
- Patenting in Russia and abroad

3rd step, «Manufacturing and commercialization»:

- Organization of production in Russia, sale of the device in Russia and abroad.
- Organization of joint ventures in China, earning income through royalties.
- The provision of services for the construction of buildings and structures by 3D-printing.

WHAT WE HAVE TODAY

Today an experimental prototype of a size 9 (D) x 4 (W) x 3 (V) m cable-driven robot has been developed and manufactured. It is used to develop kinematic and dynamic models of the robot, to test them on a physical prototype, to develop control algorithms and to work them out typical scenarios. Works are carried out jointly with the Innopolis University. Video: https://youtu.be/XQLoiKeZcrk

WHAT WE HAVE TODAY

Samples were obtained In the lab close to the desired characteristics. Has been tested nano-modifying additive for concrete, which increases strength and accelerates the setting time, filed for patent. There is a patent for quick-hardening cellular concrete with a density of d 200-d 900, for the manufacture of wall structures in whole or as their middle insulation layer.

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