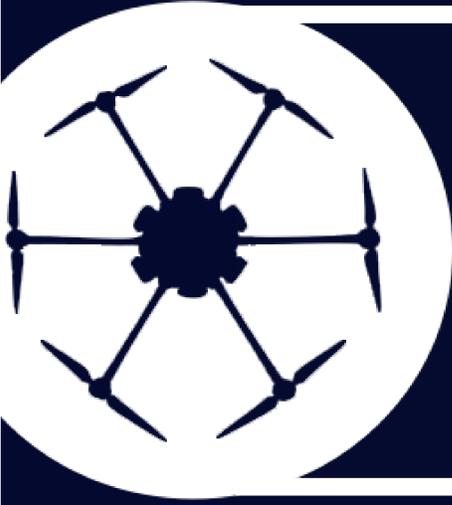


COMPREHENSIVE APPROACH TO THE ROBOTIC CONSTRUCTION IN ARCHITECTURE:

DRONES IN THE CONSTRUCTION INDUSTRY

PhD Thesis



GOALS AND MAIN INSPIRATIONAL WORK

This research focuses on the use of robotic construction, namely drones, in the building construction industry. **Three main goals are envisaged:** **i)** Revise and synthesize the ways robotic construction is influencing architecture and foresee perspectives about its use in the future decades; **ii)** Define the group of situations for which robotic construction

with drones and robotic arms bring advantages for architecture; **iii)** For such a group of situations develop a methodology for the simulation of robotic construction that assess the performance of such construction in advance.

Inspirational Work:

- The aerial construction
- Flight assembly project

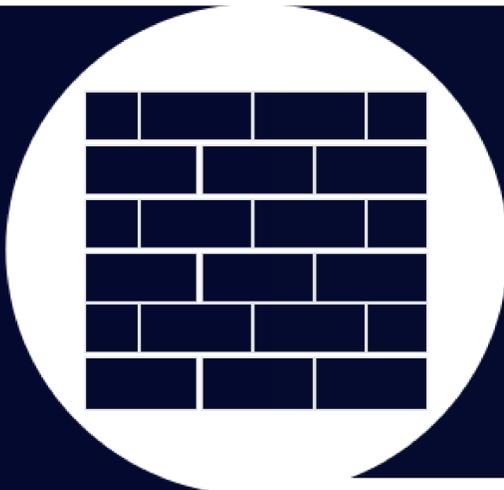
Eidgenössische Technische Hochschule Zürich

- ICD/ITKE Research Pavilion
- Cyber Physical Macro Materials

Stuttgart University

Technologies Used:

- Drones;



CONSTRUCTION ELEMENTS AND ROBOTIC CONSTRUCTION POSSIBILITIES

Systematization of construction elements and materials

The analysis and systematization of the architectural elements and building materials that compose any building, from roof to foundations. We classify materiality, characteristics and adaptability for different building construction

proposes. Prefabricated construction elements (concrete, wood, steel, and emerging materials) which are more fit to be assembled by robotic techniques are the main target of this research.

systematization we will select the type of construction element, building material and the type of building context that has a better potential to integrate robotic construction in the current building site.

Definition of the group of situations to which robotic construction is beneficial

Based on the previous



CONSTRUCTION SIMULATION METHODOLOGY

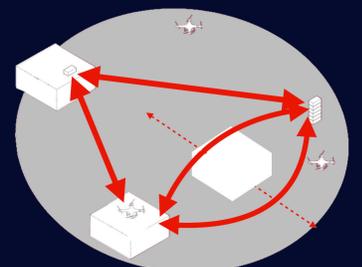
A simulation and modulation methodology was established for the experimental phase of the PhD Thesis: **I) Rhino and Grasshopper** for the creation of each architectural objects; **II) Unity** to create/test the building script and for the VR and AR experiment and result analyses; **IV) VR|AR** for the simulation and analysis of the construction.



PERFORMANCE OF A ROBOTIC MATERIAL ASSEMBLY EXPERIMENT

- I.** 6 Bricks Tower
- II.** Linear Brick Wall
- III.** Double curvature wall

For the building process **3 shapes were conceived and 3 coordinates** were established, a landing location, a brick dispenser location and a building location. In order to use more than one drone and for a collision free building process we've established a **script that maps the building space, programs the drone best trajectory while avoiding obstacles.**



ROBOTIC CONSTRUCTION POTENTIAL AND APPLICATIONS

Tools like immersive virtual reality and augmented reality are being explored. These tools will enable the approximation of the design to the built reality before it even started. The construction (simulation and reality) of a wall or another high rise and complex shaped, with further developed drone technologies in possible future scenarios is envisage.

Robotic Construction potentials:

- i)** build complex shape faster;
- ii)** promote the use of new materials;
- iii)** prospect the future of robotic technologies for building environments;
- iv)** think on architecture in a brand-new way.

