CA2RE
Conference for Artistic and Architectural (Doctoral) Research

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Material Machine Trajectories

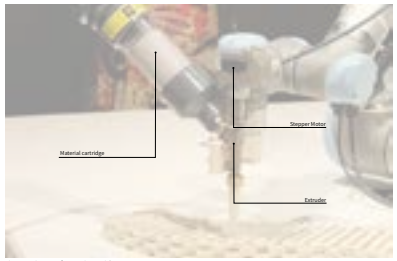

Fig 2. Extrusion Setup for ceramic materials

Fig. 1 Circular Design process

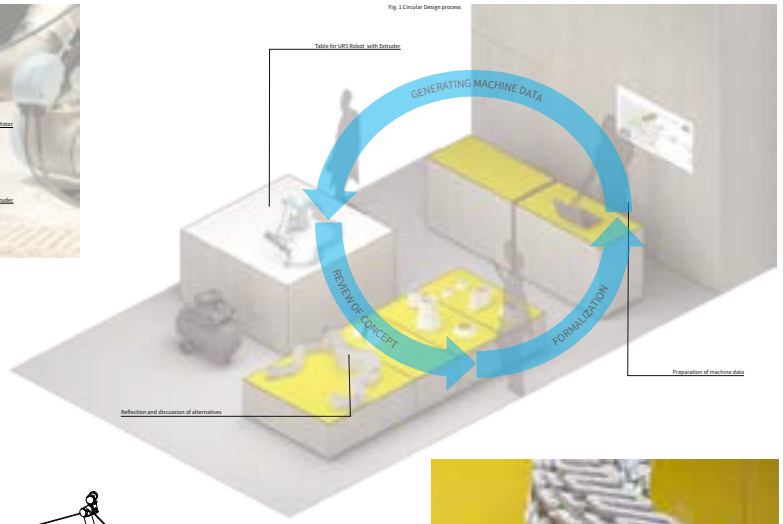


Fig 3 Different parts were produced in a cyclical setup


Fig. 4 Close-up of printed layers

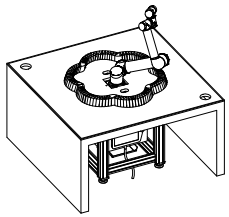
Fig. 5 Drawing of experimental setup for cyclical production


Fig. 6 Result after 2 hours of printing.


Fig 10. Shifted layer setup with varying thicknesses


Fig. 7 Robot simulation in Rhino Grasshopper. A custom script makes it possible to implement the complex forms of 3D design in robot trajectories


Fig. 8 A custom script makes it possible to implement the complex forms of 3D design in robot trajectories


Fig. 9 Example of overlapping paths, digital data model.

MATERIAL VS MACHINE TRAJECTORIES

Format: exhibition of models/prototypes, lecture

Keywords: man-machine-interaction, additive fabrication, local construction

The research project presents an approach for a shared design and fabrication process incorporating humans, materials and machines. An experimental design and fabrication environment for working with the properties and capacities of the material ceramics is created. By exploring the real-time interaction between code, matter, and machine parameters, a direct feedback between making and thinking becomes an integral part of the design process. The current purely replicative state of rapid prototyping in architecture is questioned. Whereas their extraordinary material properties make them very relevant for sustainable and local production, the handling of ceramics and other earthen materials is known to be a time-consuming and above all manual process. With a specially designed 3D printing setup using a robot arm and a custom printhead the deposition of the material can be automated and complex internal structures are made possible. Whereas the common materials in 3d printing such as PLA or ABS are stable during the printing process, the chosen material (Limoges) will behave differently depending on the proportion of material to water, the geometry, the printing speed and the discharge volume. Therefore the production data set has to be adjusted accordingly and the properties of the material have to be continuously negotiated with the degrees of freedom of the robotic printing process.

In several workshops, various tool-based conditions and parameters (extrusion direction, extrusion speed, extrusion thickness) and the resulting material behavior are evaluated to provide useful feedback for the next iteration of the digital model. Coincidences, repairs and defects are explicitly part of the process. The repetition, individualization and recombination of algorithms led to different forms which are not possible with traditional production methods. The resulting objects can be considered as an archive of pre-architectural elements, testing the constructive limits of the process and negotiating information, form and structural properties. Further tests to be conducted will focus on the development and simulation of shape-finding methods and on the integration of structural and material properties with various architectural parameters, which are essential for the generation of different spatial qualities. The aim is to mirror in the chosen setup the hierarchies across multiple scales observed in biological systems in architecture.

The collaborative project is a part of a dissertation on design approaches for localized construction processes in the PEP program, and will continue examining other fabrication processes and material systems.

Material: Limoges Porcelain
Firing shrinkage 12,4%
Bending strength of raw material 3,7 MPa
Bending strength of burnt material 95 MPa
Robot: 6-axis Robot Arm Universal Robot 5
Weight: 18,4 kg, Payload: 5 kg, Reach: 850 mm
Freedom of movement: +/- 360° an allen Gelenken
Speed: Joint: Max 180°/Sek.
Exactitude: +/- 0,1 mm
Extruder: https://lutum.vormvrij.nl/

Research Partners:
Caroline Hagsbro, Lara Wischnewski, IMD _Institute of Media and Design, TU Braunschweig
Team: Iman Zangooeinia, Ava Sadeghipour, Daniela Krause, Esra Oruc, Rolf Starke, Luisa Buchholz
Futurium Lab, David Weigend

ARENA ELIA Technische Universität Berlin PEP

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