Chair of Computational Modeling and Simulation
TUM Department of Civil, Geo and Environmental Engineering
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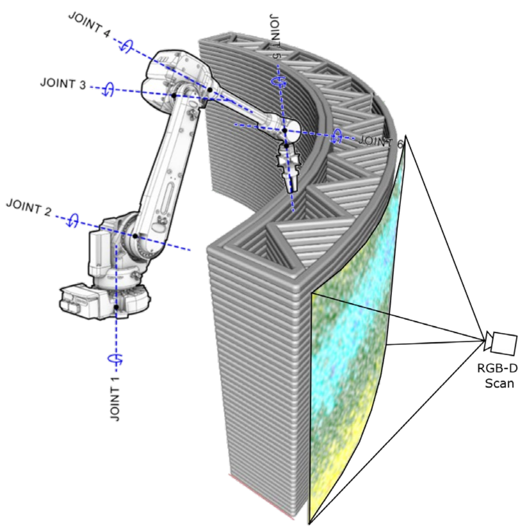
Modeling:
Mathematics:
Programming:
Science:

Software Lab:

Time-resolved optical process control for concrete 3D printing to prevent plastic failure

Description

3D concrete printing is becoming increasingly important in the construction industry, and more and more new techniques are being developed for this purpose. But still, full automatization of this construction method may often lead to failures. For a successful print a lot of parameters, such as concrete mixture, geometrical shape and print time, need to be aligned with each other. For complex shapes and dynamic environments a fixed set of these parameters is difficult to set up. Therefore, these parameters are usually monitored by a human operator and adjusted as needed. To minimize the need for a human to monitor the process optical process control systems may be implemented. Such a system can be set up in a way that changes to the printed body (e.g. development of elephant's foot) can be registered and resolved in time. This enables critical conditions to be detected at an early stage so that changes to the parameters involved can be initiated to avoid plastic failure or to increase the print quality.



Task

Implement an optical monitoring system (involving a RGB-D camera or other depth sensing equipment) that can monitor an object during its manufacturing process and compare the measured data to "as-planned" data and to previous states in time. The system should be able to adjust parameters accordingly.

- Get to know the technical equipment (RGB-D camera, UR10e robot).
- Get familiar with extrusion 3D concrete printing and the related robot control (URscript or ROS).
- Implement referencing methods to compare measured data with "as-planned" information as well as data of previous states.
- Test the implementation with a clay extrusion robot using different clay "mixtures" and printing speeds.

Supervisor

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Related literature:

Suiker, A. S., Wolfs, R. J., Lucas, S. M., & Salet, T. A. (2020). Elastic buckling and plastic collapse during 3D concrete printing. Cement and Concrete Research, 135, 106016.

Paolini, A., Kollmannsberger, S., & Rank, E. (2019). Additive manufacturing in construction: A review on processes, applications, and digital planning methods. Additive Manufacturing, 30, 100894.

Slepicka, M., Vilgertshofer, S., & Borrmann, A. (2021). Fabrication Information Modeling: Closing the gap between Building Information Modeling and Digital Fabrication. In Proceedings of the 38th International Symposium on Automation and Robotics in Construction (ISARC).