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Instant Data-Driven Robotics Fabrication of Light-Transmitting Ceramics: A Responsive Computational Modeling Workflow

Authors : Shunyi Yang, Jingjing Yan, Siyu Dong, Xiangguo Cui

Abstract : Current architectural façade design practices incorporate various daylighting and solar radiation analysis methods. These emphasize the impact of geometry on façade design. There is scope to extend this knowledge into methods that address material translucency, porosity, and form. Such approaches can also achieve these conditions through adaptive robotic manufacturing approaches that exploit material dynamics within the design, and alleviate fabrication waste from molds, ultimately accelerating the autonomous manufacturing system. Besides analyzing the environmental solar radiant in building facade design, there is also a vacancy research area of how lighting effects can be precisely controlled by engaging the instant real-time data-driven robot control and manipulating the material properties. Ceramics carries a wide range of transmittance and deformation potentials for robotics control with the research of its material property. This paper presents one semi-autonomous system that engages with real-time data-driven robotics control, hardware kit design, environmental building studies, human interaction, and exploratory research and experiments. Our objectives are to investigate the relationship between different clay bodies or ceramics' physio-material properties and their transmittance; to explore the feedback system of instant lighting data in robotic fabrication to achieve precise lighting effect; to design the sufficient end effector and robot behaviors for different stages of deformation. We experiment with architectural clay, as the material of the façade that is potentially translucent at a certain stage can respond to light. Studying the relationship between form, material properties, and porosity can help create different interior and exterior light effects and provide façade solutions for specific architectural functions. The key idea is to maximize the utilization of in-progress robotics fabrication and ceramics materiality to create a highly integrated autonomous system for lighting facade design and manufacture.

Keywords : light transmittance, data-driven fabrication, computational design, computer vision, gamification for manufacturing
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