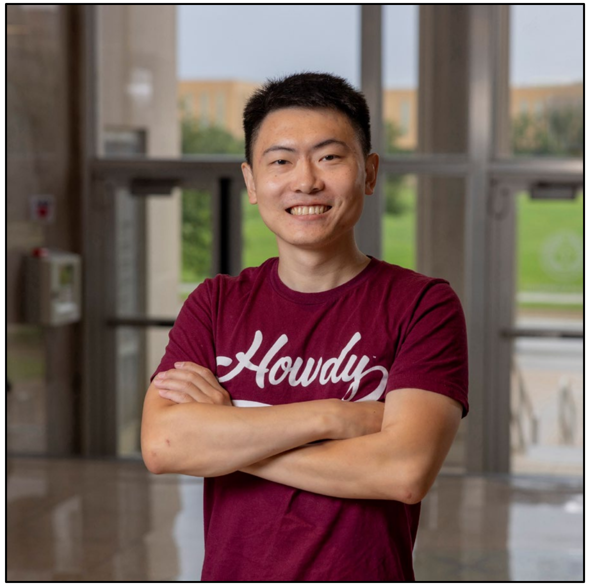
P-10 | Smart 3D Concrete Printing: Robotic Control Based on Real-time Environmental Feedback

COA〉SHOWCASE



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This research focuses on advancing real-time control methods in 3D concrete printing to ensure structural accuracy and consistency. 3D printing, particularly extrusion-based printing for cement-based materials, has transformed the construction industry by reducing costs and increasing design flexibility. However, maintaining geometric integrity in concrete structures is challenging due to factors such as print speed, extrusion flow, and temperature. In this study, a robotic system with real-time environmental feedback is utilized to address these issues. The setup includes an ABB robotic arm, a concrete pump (MAI 2Pump-Pictor), and sensors that monitor temperature (FLIR Lepton 3.5 thermal camera), geometry (ORBBEC Astra 2 depth camera), and pressure. These sensors provide real-time data, which is processed at a central workstation to adjust the robotic arm's speed and deposition rate during printing. The control system relies on a vision-based edge detection algorithm to monitor layer width, adjusting arm movement through a feedback loop if deviations are detected. Additionally, the system adjusts the interval between layer depositions based on real-time temperature data to ensure optimal concrete curing. This dynamic approach ensures high-quality prints with minimal deformation, resulting in precise and reliable 3D concrete structures.