2022 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

Accurate and Efficient Collective Additive Manufacturing by Mobile Robots

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Award ID#: 1932187 Award Date: 08/21/2019

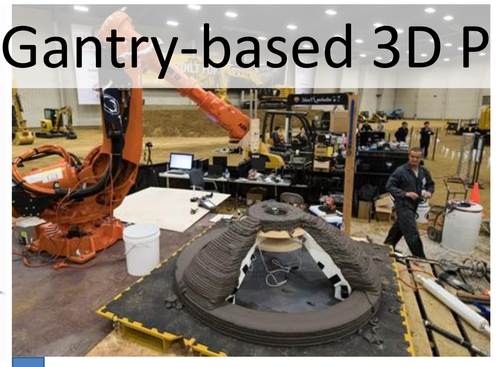
Challenge:

- ***Planning and Localization*** in dynamic environments
- ***Model Predictive Control*** for mobile manipulators
- ***Printing Coordination*** between robots and its evolving surroundings

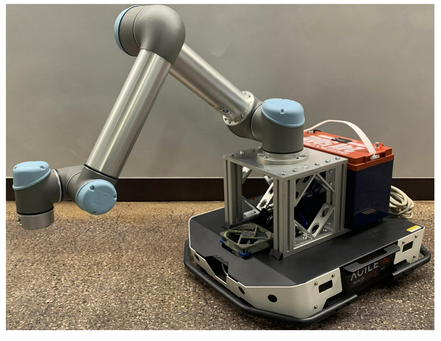
Solution:

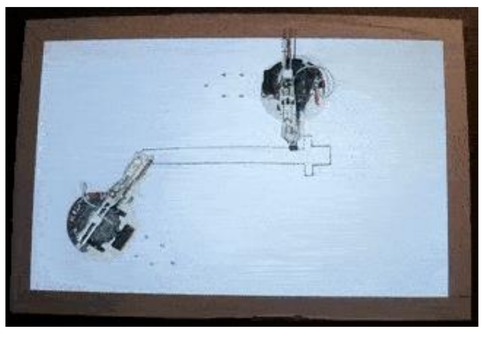
- AI-based simultaneous navigation and construction for mobile printing robots
- High-frequency model predictive control for mobile printing robots
- Sensing and inference of the shape of the printed structure from partial scalar measurements
- Continuification-based control for swarms of printing robots toward decentralized collective 3D printing

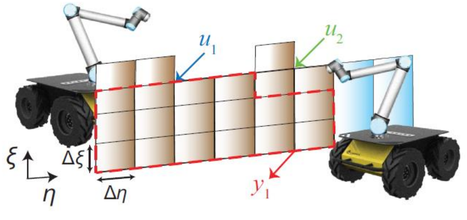
Existing: Gantry-based 3D Printing Inside a Box

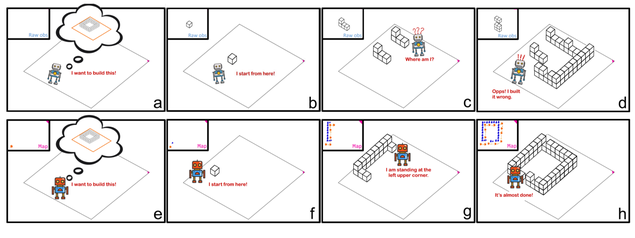


For better **printing scale and speed**







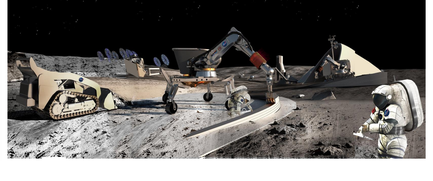


Ours: Mobile Robots for 3D Printing

Civil Infrastructure

Manufacturing

Space Exploration



Scientific Impact:

- Enable robots to proactively change its surroundings
- Our navigation, control, and coordination methods are translatable to other distributed CPS
- Promote AI for real-world CPS (robotics, AM, etc.)

Broader Impact:

- ICRA workshop for CPS and robotics in construction
- Affordable/open educational CAM kit
- K-12 desktop-scale CAM competition (2023)
- Outdoor public art exhibition (2023)