Large Scale Mobile Robotic 3D Printing

Mengran Wang, Lujie Zhao, Eli Zhu

Mentor: Xuchu Xu Faculty mentor: Chen Feng

Abstract

While Useful, traditional gantry-based 3D printers have a few significant disadvantages. The printing scale is strictly confined to the printer platform, and the printing process has relatively low efficiency.

Using mobile robots for 3D printing can be one potential solution, and highly accurate localization of these robots is the key to this challenge. Accurate 3D printing requires millimeter level accuracy of the printhead, but traditional cost-effective localization methods are at most of centimeter level accuracy.

We proposed a new localization method which uses deep neural network to fuse tracing sensors and cameras and incorporates other sensors such as odometry from IMU/wheel-encoders to further increase the efficiency and accuracy.

Mobile Robot Simulation

Our preliminary work on Mobile Robot 3D Printing has focused on the robot simulation, control and localization in 2D. To successfully draw an image in real environment, an algorithm for image processing was developed and tested. A 2D floor plan was printed in the simulated environment. After redesign the robot, the robot model was changed accordingly. A Gazebo world was built with random generated patterns, and the robot is able to capture images of the surrounding environment.

Mobile Robot Control

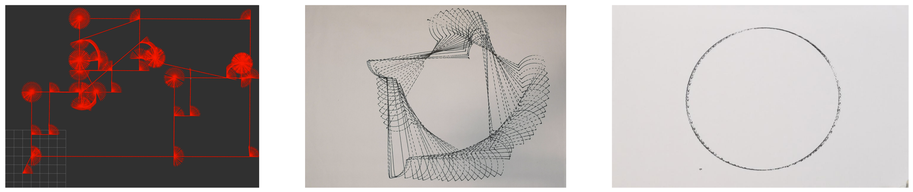

***Figure 1-3**: Turtlebot Drawing in simulation and the real environment*

We have designed and modified the Turtlebot3 Burger model with a printhead, a camera, and a tracking sensor attached. Given the robot a series of coordinates, it can travel through them with negligible offset. Navigation of the robot was run in the real environment, shown great improvement in accuracy overtime.

Localization for 2D Printing

Traditional localization for autonomous robots rely on odometry, particle filters, or cameras. We intend to combine these methods with deep neural networks in order to obtain greater accuracy in localization.

The primary sensors that will be used in the localization will be a tracker sensor to detect lines that the robot draws. Additionally, a camera will be attached to the robot in order to provide additional information to train the neural network.

Conclusion

The attempts to localize robots with deep neural networks have shown to be lacking in accuracy. A large contribution of the uncertainty in robot location is from the laser sensors used to detect distance. The uncertainty in measurements results in lower accuracy than traditional robot localization methods.

Future Work

After completing a single robot drawing in 2D, our next stage is to bring it to the 3D printing with multiple robots.

- Use large data to train neural network
- Combine the coordinate systems of two robots and make them work at the same time