Realistic Simulation Environments to Achieve Visual Servoing on Soft Continuum Arms in Constrained Environments

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MOTIVATION

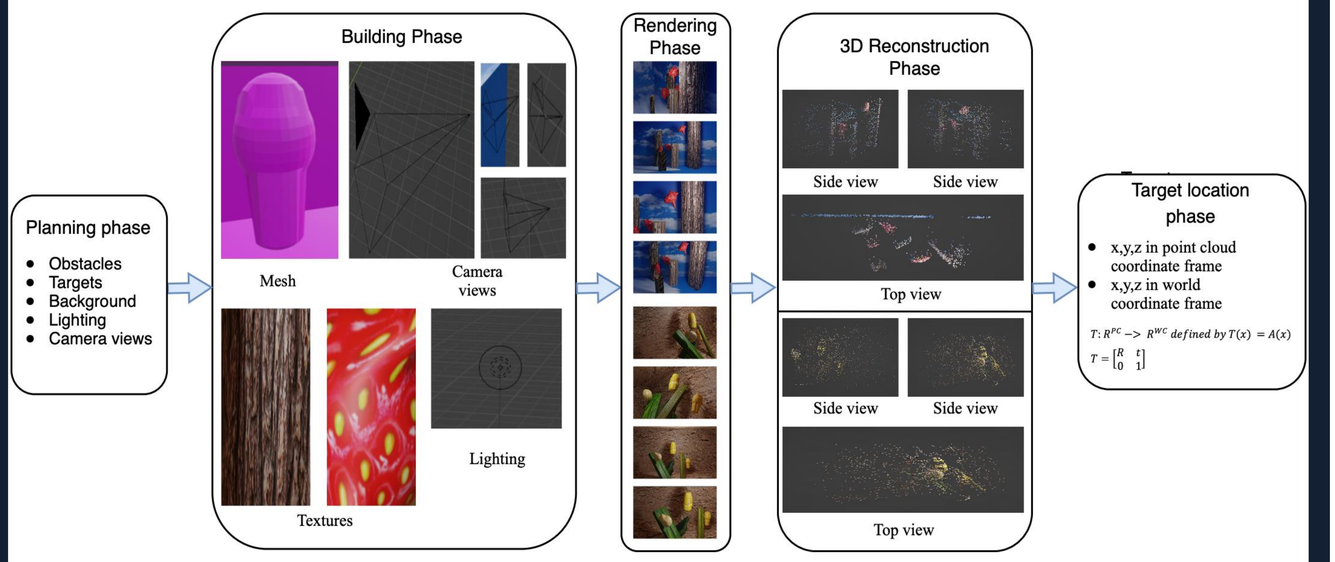
- Soft Continuum Arms (SCA) gaining popularity for dexterous manipulation.
- Robust visual servoing for 3D pose control is a challenge in SCA.
- Requires reliable feature extraction, accurate control models, and sensors.
- Challenges come from difficulties in recreating real-world cluttered workspaces for training, testing, and experimentation
- **Need to develop simulation environments ("digital twins") for robot learning tasks in agricultural settings.**

OVERVIEW

- Created multiple realistic simulations using Blender.
- Can be used for various robot learning tasks such as manipulation and navigation
- Each environment consists of several obstacles and targets created using geometrical meshes
- Multiple cameras in the workspace provide different viewpoint renderings of the environment.
- The rendered 2D RGB images obtained from the simulation environments are passed through a 3D reconstruction algorithm.
- Realistic environments result in dense accurate 3D point clouds representing the environments.

SIMULATION ENVIRONMENTS

METHOD



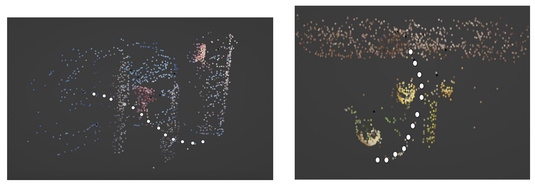
PATH PLANNING

- 3D point clouds used to get the targets' x,y, and z coordinates

$$T: R^{PC} \rightarrow R^{WC} \text{ defined by } T(x) = A(x)$$

$$T = \begin{bmatrix} R & t \\ 0 & 1 \end{bmatrix}$$

- WC – world coordinate frame
- PC – point cloud coordinate frame
- R – rotation matrix
- t – translation matrix



DISCUSSION AND FUTURE WORK

- Find **waypoints** to reach target
- Validate **path planning** algorithm on SCA.
- Make image to waypoint network
- Make the system more **generalisable** and adaptable to different environments

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