Mærsk Mc-Kinney Møller Instituttet

SDU

Made ReAct

Intelligent In-feed systems for Flexible Robotic Workcells

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Introduction:

This PhD focuses on developing part feeders that adhere to global tolerance requirements by:

- Quantifying 6D pose uncertainty estimation to infer accurate part pose errors in feeder systems.
- Minimizing the part pose errors across the entire feeder system.

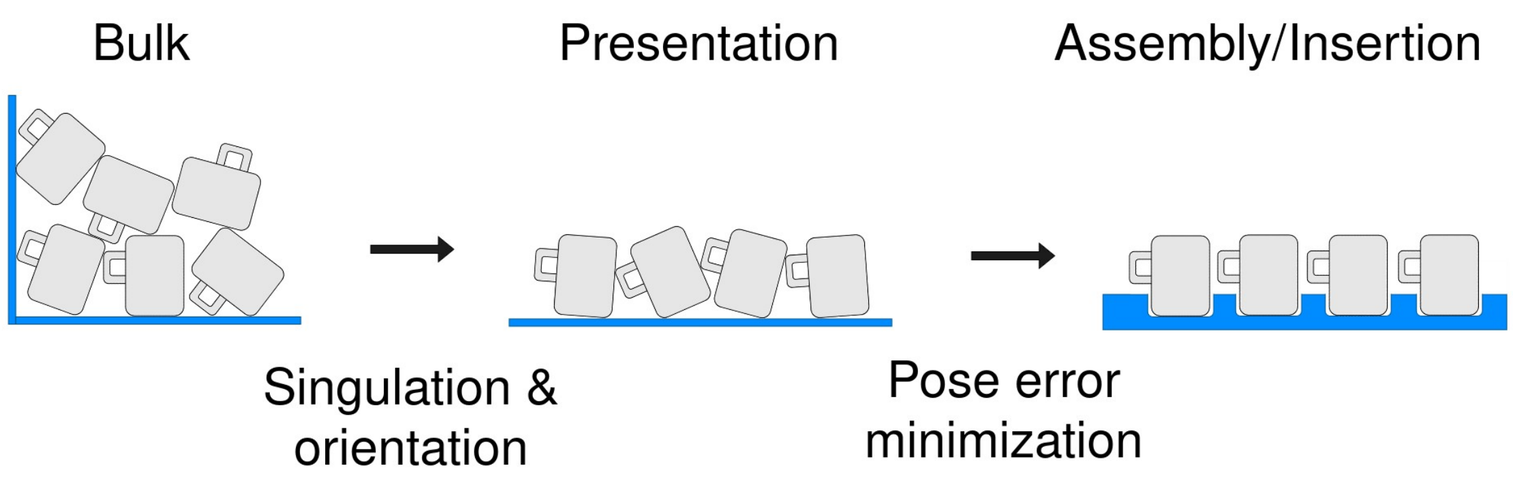

Fig. 1: Demonstration of feeder device part manipulation, with pose error minimization step before assembly.

Background:

- Modern manufacturing requires parts to be transitioned from bulk to an assembly-ready state.
- A feeder device prepares parts for assembly by singulating, orienting, and presenting the parts.
- Effective presentation that uses robust 6D pose tolerance estimations has yet to be explored.

Motivation

- Accurate pose tolerances could drastically decrease assembly failure, increasing manufacturing throughput.
- Uncertainty propagation and robust pose estimation enable accurate quantification of pose tolerances.

Objective:

- Use 6D pose estimation and propagation to quantify part pose uncertainty in feeder systems.
- Create simulation environments for feeder systems with uncertainty propagation properties.
- Develop robust singulation and orientation methods, measured by pose uncertainties.
- Develop a robust presentation of parts that also minimally impacts pose uncertainties.

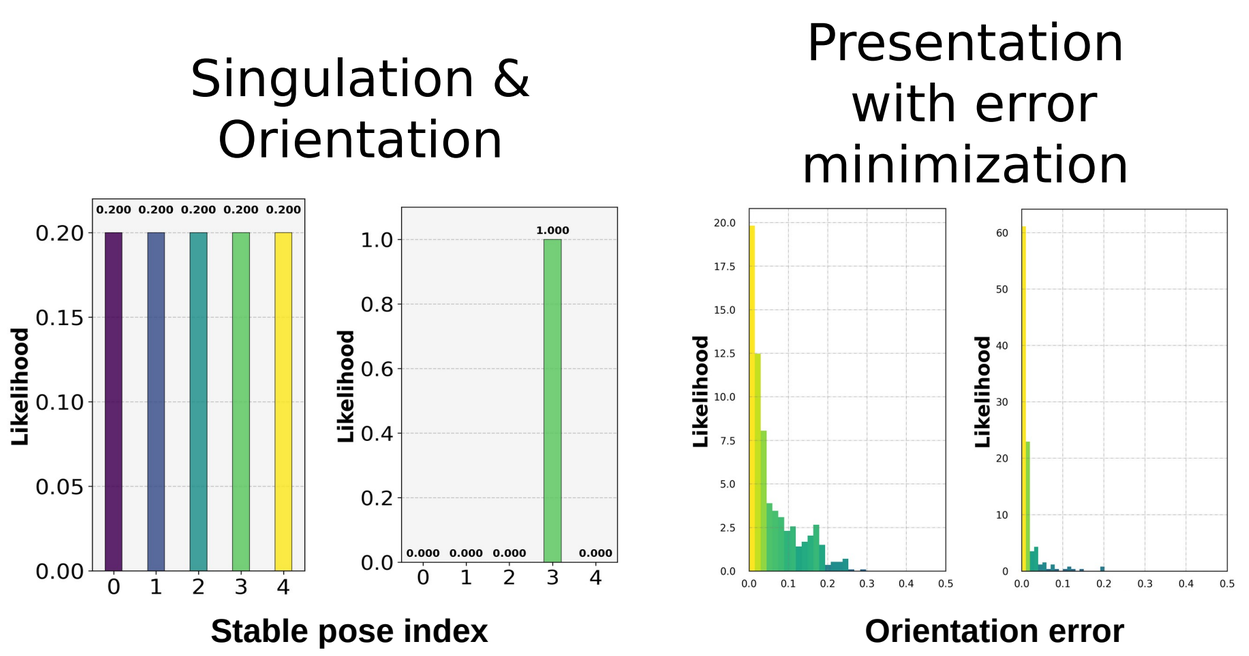

Fig 2: (*Left two graphs*) Effects of singulation & orientation on part pose distribution (*Right two graphs*) Example of pose error minimization

Methods

- Research and experiment with uncertainty propagation and 6D pose estimation methods.
- Research simulation methods for accurate feeder representation.
- Investigate methods within production feeding, machine learning, computer vision, graph optimization, and statistics.

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