

Master Thesis / Research Internship

Active Perception based Robot Manipulation

Background

Assembly is a crucial skill for robots in both modern manufacturing and service robotics. Robot assembly is generally considered as a vision-tactile contact-rich manipulation task. While prior studies have improved task performance by naively combining force/torque data with vision information through the whole manipulation process, ignoring the fact that the importance of the vision and tactile signals are different in the multiple phases [1]. For instance, an assembly task involves three phases, i.e., “move to approach”, “move to contact” and “insertion”. Among these phases, vision perception only plays a key role in “move to approach”. While, the “move to contact” and “insertion” phrases relies on more the force feedback during the manipulation.

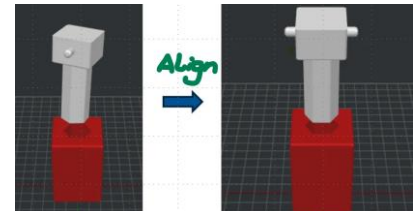
In our previous works [2][3][4], we have developed a novel full-fledged for robotic systems to effectively solved the “move to contact” and “insertion” phases based on an approximated random approaching pose. To further complete the entire manipulation process, this works aims at solving the “move to approach” process by guiding the robot to an approximated aligned pose. By the active perception (proactive selection of camera views), the system gathers more data regarding the relative pose relationship between the male part and female part and utilized the information to guide the robot to align the male part to the female part [5][6].

Your Tasks

1. Propose the autonomy allocation method in our application.
2. Estimate the relative pose and generate corresponding robot motion command.
3. Make experiments to demonstrate the feasibility and superiority of this method.

Requirement

- Highly self-motivated;
- Python programming experience;
- Basic computer vision or machine learning background;



Active perception system

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Reference:

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- [2] Johannsmeier L, Gerchow M, Haddadin S. A framework for robot manipulation: Skill formalism, meta learning and adaptive control[C]//2019 International Conference on Robotics and Automation (ICRA). IEEE, 2019: 5844-5850.
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- [4] Wu Y, Chen Z, Wu F, et al. TacDiffusion: Force-domain Diffusion Policy for Precise Tactile Manipulation[J]. arXiv preprint arXiv:2409.11047, 2024.
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- [6] Zhao Z, Haldar S, Cui J, et al. Touch begins where vision ends: Generalizable policies for contact-rich manipulation[J]. arXiv preprint arXiv:2506.13762, 2025.