Master Thesis / Research Internship

Shared Autonomy based Teleoperation for Tight-Clearance Insertion Tasks

Background

Shared autonomy refers to a collaborative control paradigm wherein both a human operator and an autonomous robotic system share the responsibility of executing a task [1]. This approach leverages the strengths of human intelligence—such as intuition, adaptability, and decision-making—alongside the precision, repeatability, and computational power of robots. Consequently, this system is capable of managing complex tasks while enhancing efficiency, safety, and usability.

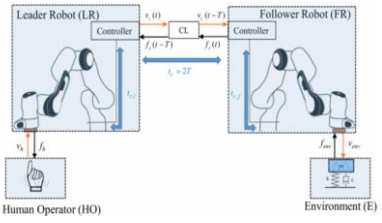
In this study, we focus on addressing the industrial assembly task through teleoperation skills. However, due to low transparency of the system and human-interaction manner, tackling contact-rich manipulation tasks, particularly those involving tight-clearance manipulation, remains a significant challenge. To remedy this gap, we propose integrating the knowledge gained from robotic assembly tasks into teleoperation within a shared-autonomy framework.

Your Tasks

1. Understand our previous solution(code) for solving the shared autonomy teleoperation work [2] and tight-clearance industrial insertion tasks with for force domain wiggle motion [3,4].
2. Propose the autonomy allocation method in our application.
3. Integrate the force domain wiggle motion into our teleoperation system based on the shared autonomy under our guidance.
4. Make experiments to demonstrate the feasibility and superiority of this method.

Requirement

- Highly self-motivated;
- Experiences or knowledge from related Robotics courses;
- C++ and python programming experience.



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Reference:

[1] Selvaggio, M., Cognetti, M., Nikolaidis, S., Ivaldi, S., & Siciliano, B. (2021). Autonomy in physical human-robot interaction: A brief survey. IEEE Robotics and Automation Letters, 6(4), 7989-7996.

[2] Chen X, Michel Y, Sadeghian H, et al. Network-aware Shared Autonomy in Bilateral Teleoperation[J].

[3] 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.

[4] Wu Y, Wu F, Chen L, et al. 1 khz behavior tree for self-adaptable tactile insertion[C]//2024 IEEE International Conference on Robotics and Automation (ICRA). IEEE, 2024: 16002-16008.