Effects of time delay on the performance of a deep sea welding task

Group 11

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Introduction

- Deep sea welding is dangerous
  - Workers exposed to dangerous pressure changes [1]
- Make use of teleoperated robot
  - Safer option
  - Motion from user is mapped to welding robot
- Problem teleoperated robot
  - Time delay

Research question

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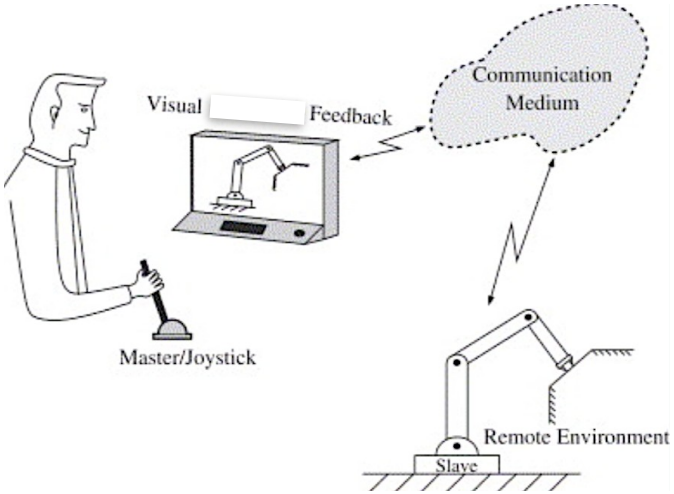
How does time delay affect performance of a teleoperated robot arm in a 2D environment simulating deep sea welding tasks?

Methods

- Unilateral system [2]



- Participants should follow a reference trajectory
  - Reference trajectory resembles welding motion

- Sea wave perturbations
  - No haptic feedback included
  - Participants are visually perturbated

Methods

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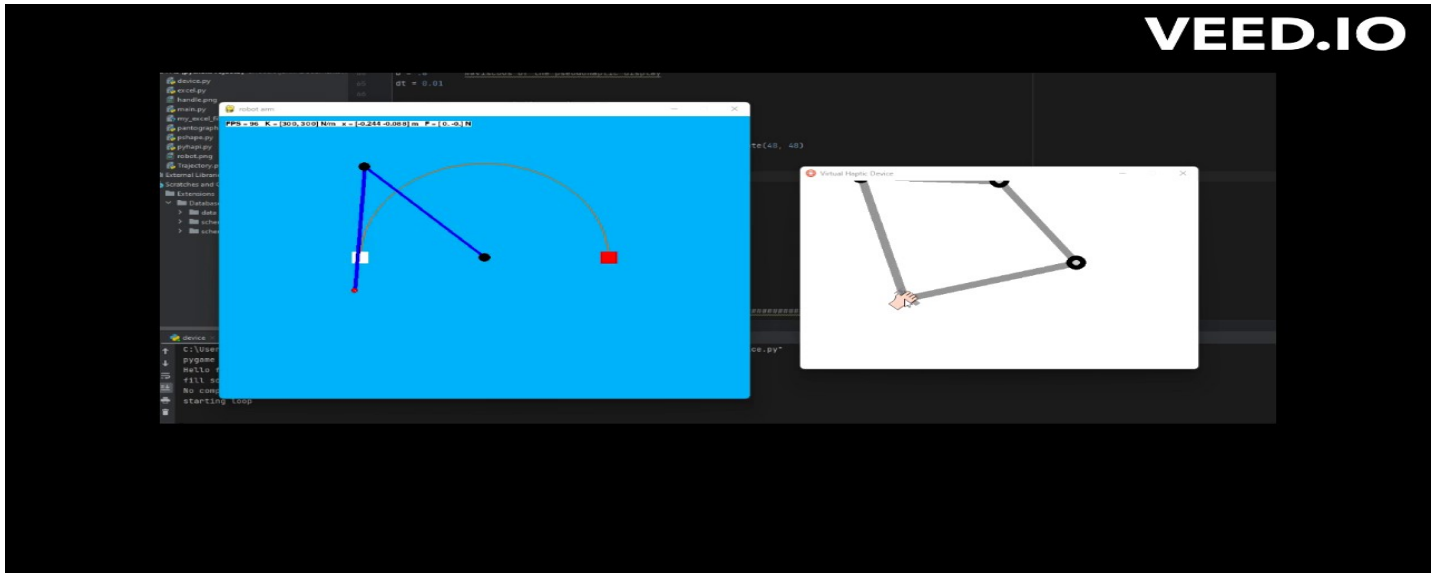

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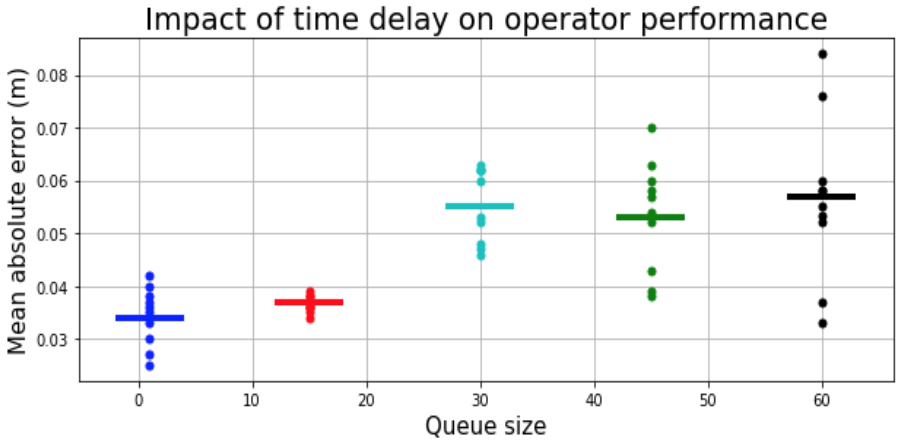
Methods

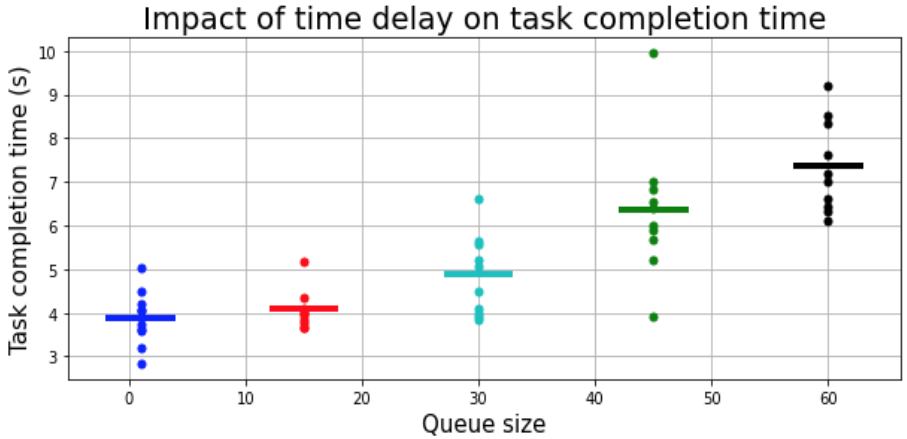
- 10 participants
- Time delay induced by queue size
  - FIFO
  - Queue size: 1, 15, 30, 45, 60
- Trials are repeated 5 times
- Use performance metric
  - Mean absolute error
  - Task completion time

Results

- Mean absolute error



- Task completion time



Results

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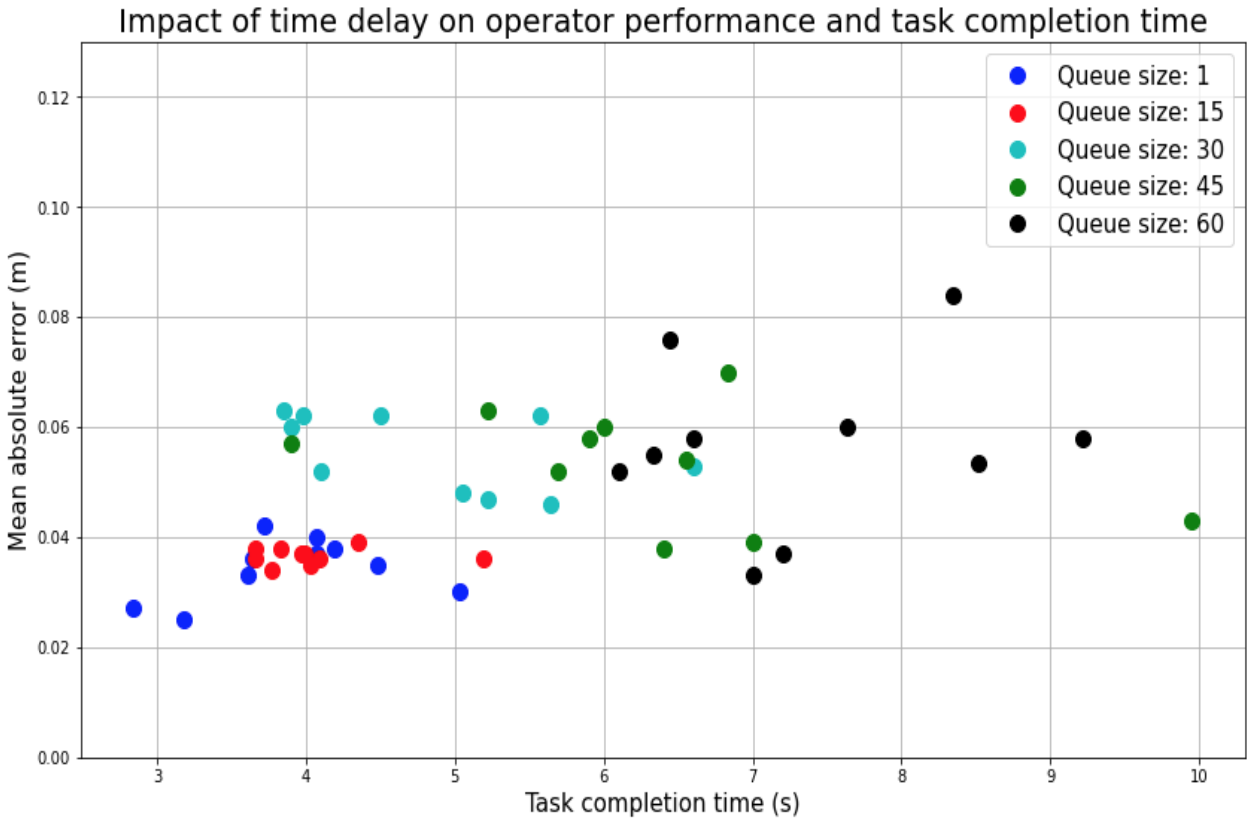

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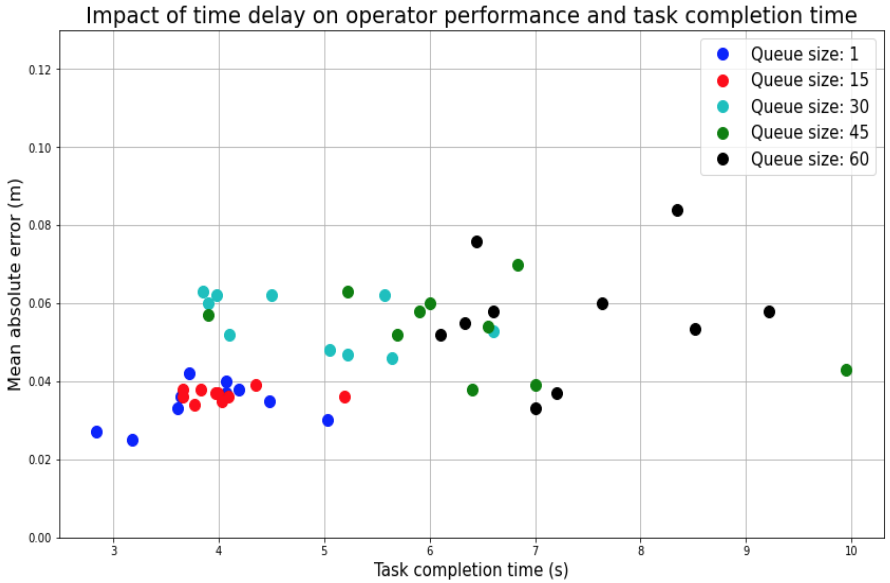

- Combination of completion time and mean absolute error increases with time delay

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Discussion

- Include more participants
  - Identify outliers
- Explore effects of training
  - Look at learning curves
  - Look at transfer
- Explore effects of reference trajectory shape
  - Shape may be learned by participants

Bibliography

1. Barker, A. (2023, February 09). The dangers of underwater welding. Retrieved March 30, 2023, from https://www.getgordon.com/blog/underwater-welding-dangers/

2. Peter F. Hokayem, AbstractThis survey addresses the subject of bilateral teleoperation, Anderson, R., Desoer, C., Eusebi, A., Ferrell, W., . . . Imaida, T. (2006, September 18). Bilateral teleoperation: An historical survey. Retrieved March 31, 2023, from https://www.sciencedirect.com/science/article/abs/pii/S0005109806002871

Questions