# SEMINAR PRESENTATION: DESIGN AND EVALUATION OF A TRILATERAL SHARED-CONTROL ARCHITECTURE FOR TELEOPERATED TRAINING ROBOTS

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PROJECT BACKGROUND

- Implementing shared/collateral control systems to be used in the AMBF simulator.

- Testing the effectiveness of shared control systems with the use of different puzzles.

- Using a script to collect data on these shared control systems.
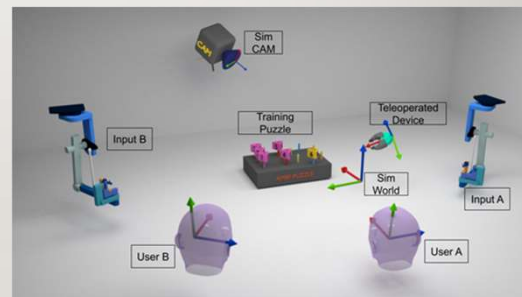

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GOAL

- Design and test a trilateral control architecture in order to facilitate training using two master consoles(trainer and novice) and one slave robot.

- Test the effectiveness of the system by training a subject to do a task.
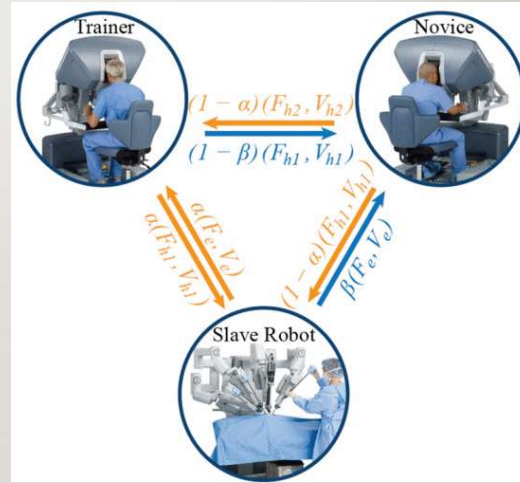

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SHARED CONTROL SYSTEM

- Dominance Factor (α)

- Observability Factor (β)

- $0 \leq \alpha \leq 1$

- $1- \alpha \leq \beta \leq 1$

- It is assumed that these values can be changed as needed while operating.
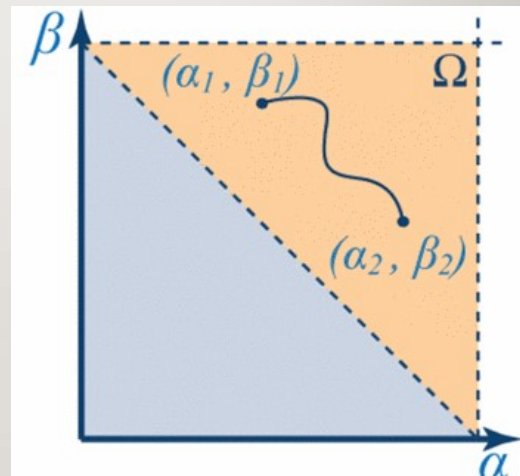

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SHARED CONTROL SYSTEM

- "Observing Novice" Case ($\alpha = 1$)

- Trainer has full control over and receives full feedback from the slave robot.

- The novice can choose to observe the movements of the trainer($\beta = 0$), the movements of the slave robot($\beta = 1$), or some combination in between.

Observing Novice, $\{\alpha = 1, 0 \leq \beta \leq 1\}$
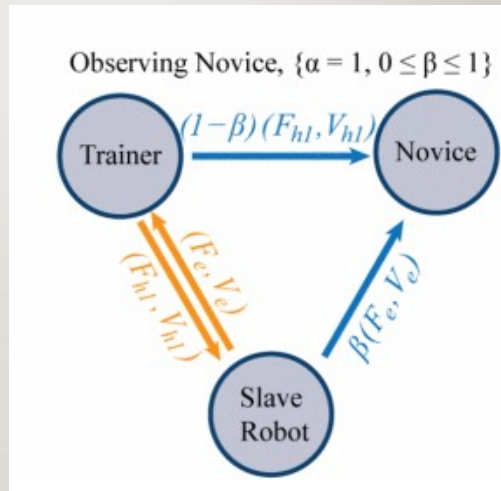
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SHARED CONTROL SYSTEM

- "Performing Novice" Case ($\alpha = 0, \beta = 1$)

- Novice has full control over and receives full feedback from the slave robot.

- Trainer fully observes observes the movements of the novice.

Performing Novice, $\{\alpha = 0, \beta = 1\}$
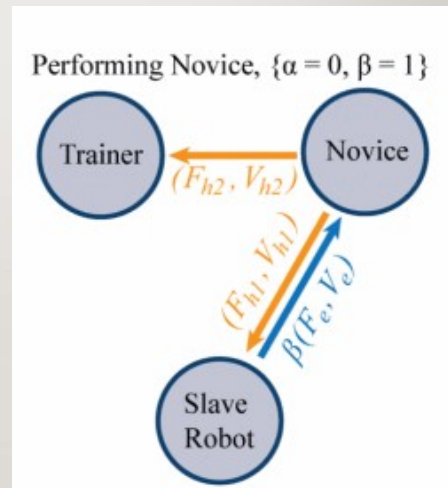
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EXPERIMENT

- "Trainer" and "Novice" subjects were asked to control the slave robot to follow a star shaped path.

- Values of α, β ={0,.25,.5,.75,1}

- Each (α, β) combination was tested in a random order. (25 total trials)

- Concern: (α, β) combinations that are outside the already defined space
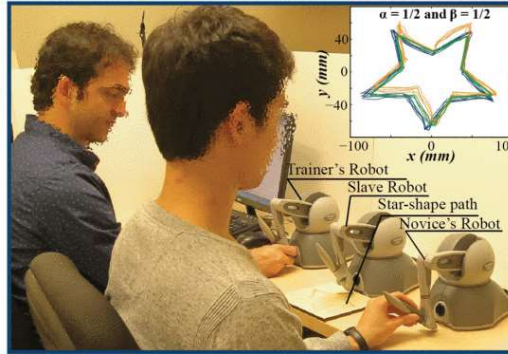
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EXPERIMENT

Average completion time and Sum of Position error seems to suggest that the given task was completed most efficiently when the trainer and novice were fully collaborating.(α = .5, β = .5)
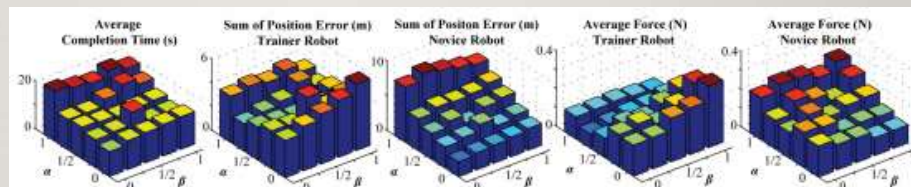
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CONCERNS/AVENUES FOR FURTHER RESEARCH

- Although the paper discusses the possible uses of trilateral control for task training, the experiment performed examines the shared control system in more of a collaborative context.

- Different tasks like moving or stacking objects could also be examined.

- Analyzing the progress of the novice over time.(reduction in completion time, reduction of error)

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RELATION TO OUR PROJECT

- The trilateral control architecture could be a valid shared-control architecture to be implemented in AMBF as a training method to be tested.

- It could also be valid to test if varying levels of collaboration between two experts or two novices could influence task/puzzle completion time.

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REFERENCE

- K. Shamaei, L. H. Kim and A. M. Okamura, "Design and evaluation of a trilateral shared-control architecture for teleoperated training robots," *2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, Milan, 2015, pp. 4887-4893.

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