Control in Human-Robot Interaction: Assignment 3

Urgent appendix removal training for non-medical personal in unstable environment

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Motivation

- Medical emergencies on offshore facilities are costly and risky (1)
  ~ 10% acute appendicitis (1)
- Strategies to lower these costs (1):
  - Vaccinations
  - Improve screening
  - Improve treatment capabilities
- High cognitive load – **extreme conditions, inexperienced practitioner** (level 3 stationed & level 4 on shore (2)), telemedicine (3)
- Only improving the availability of instruments is not the solution

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Existing solutions

- Emergency evacuation via helicopter
- Send a doctor to the facilities
- Have a permanent medical crew to cope with emergency surgeries
- Have a robotic device that can perform surgeries

BUT

- **Expensive logistics**
- **Lack of trained personnel and doctors**
- **Expensive and sophisticated in use equipment**

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Goal

To design and test a training environment where inexperienced medical practitioners can practice the surgery of acute appendicitis in the same conditions as they would experience on an offshore facility.

Training program should achieve:

- Improvement in the performance to cut a straight line (by a hybrid controller)
- Improve the accuracy for stitching (by an impedance controller)

Hypothesis: Practicing in conditions with perturbations will give a better performance and accuracy compared to practicing without one.

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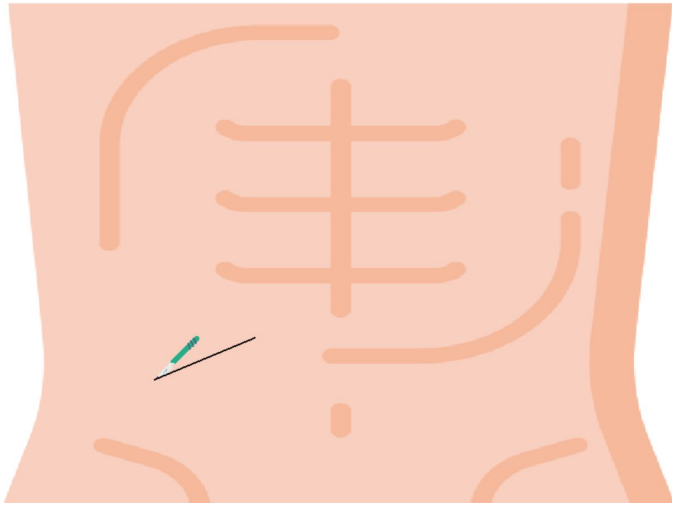
Method

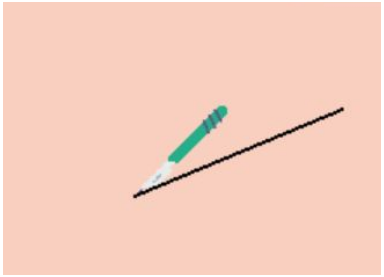
- Use the Haply and interactive 2D environment to train the personal perform two basic procedures in appendix removal surgery
- **Two tasks**

  1) Cutting a straight line is visualized by moving from one point to another

  2) Accurate stitching is visualized by keeping the needle stable in position around points

- **Controller**
  - Hybrid controller for task 1
  - Impedance controller for task 2





Task 1: Cutting **Task 2: Sewing**

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Experiments:

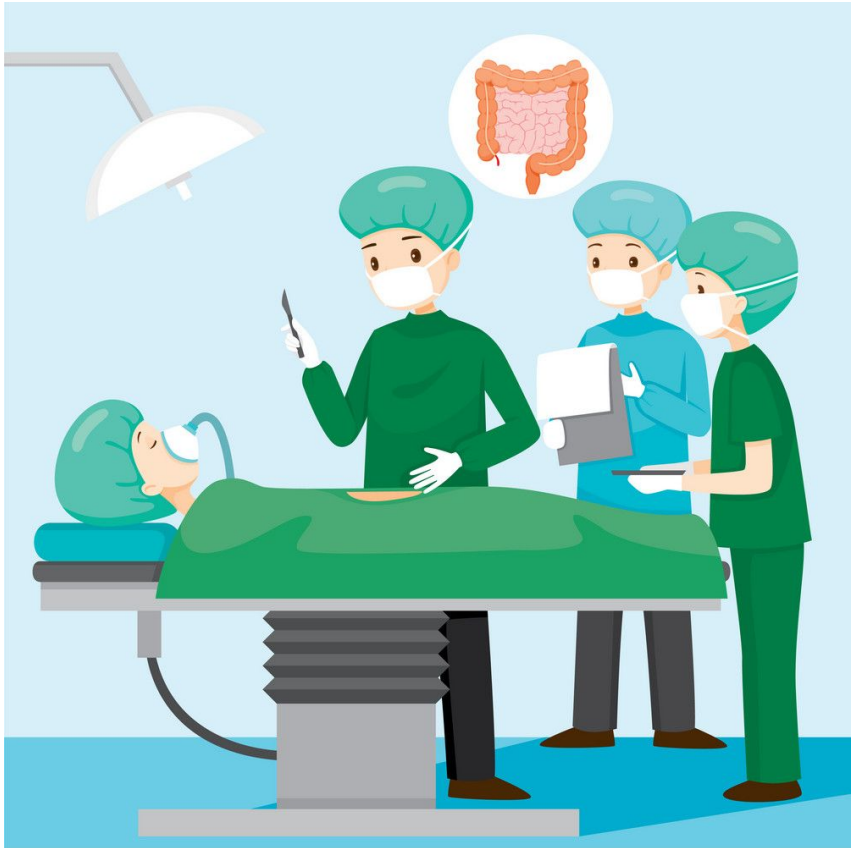
- **Two different conditions**

  C1 = with external perturbations

  C2 = without external perturbations

- **Two different groups:**
  - Group T1: x10 task C1 -> x10 task C2
  - Group T2: x10 task C2 -> x10 task C2

Hypothesis to evaluate: training teleoperated surgery in unstable environment leads to better performance rather than being trained in stable conditions.



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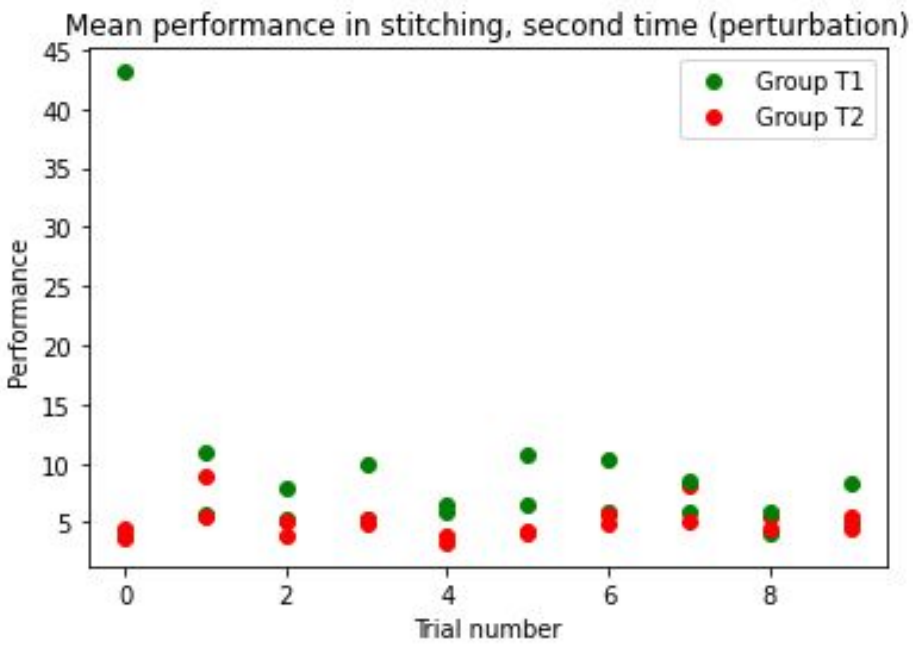
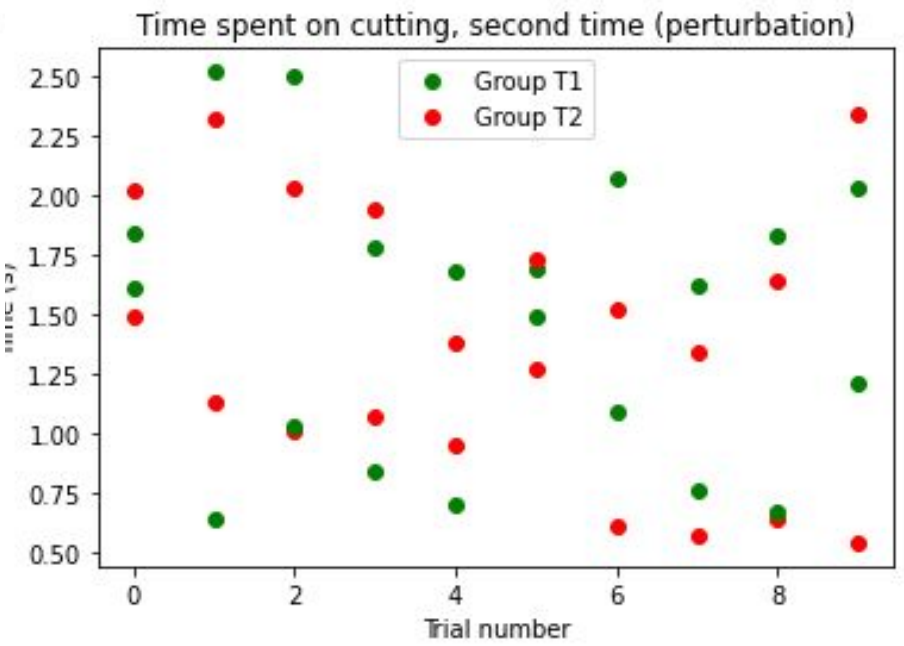
Experimental results: group T1





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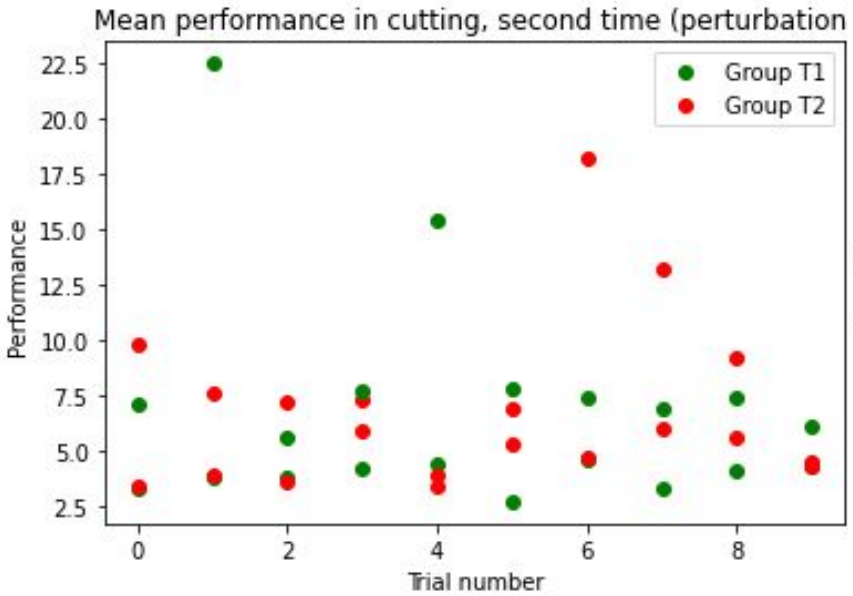
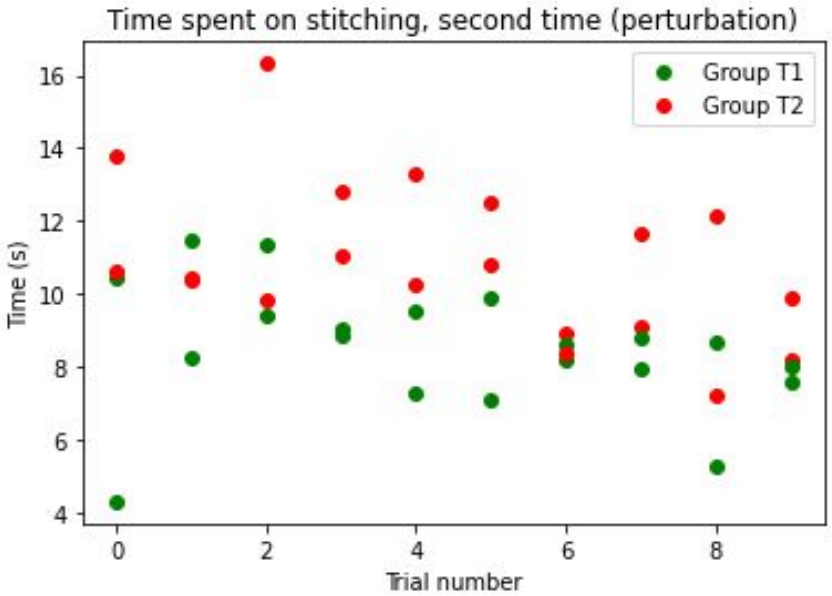
Experimental results: group T2





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Conclusions

Hypothesis: Practicing in conditions with perturbations will give a better performance and accuracy compared to practicing without one.

Results: Group T2 performed the cutting task **faster** than group T1. The accuracy in the cutting task was similar.

Both groups performed the stitching task with **similar speed**. Group T2 had a **higher performance** score.

Discussion: More test-subjects would provide more accurate results.

Conclusion: Practicing in conditions with perturbations appears to slightly improve the time spent on cutting and the accuracy of stitching

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