Report N°3 MSc Thesis: Active Constraints

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Title: *To Be Defined*

General guidelines

Development of surgical training tasks implementing Active Constraints of different nature and with different levels of intervention, in order to evaluate their efficacy and role in Robot-Assisted Minimally Invasive Surgery.

- *Phase 1:* Software Development in a virtual environment (Unity)
- *Phase 2:* Implementing on the dVRK, followed by experimental tests with data gathering, analysis and validation

Work Planned from the previous report

- Implementing the last few remaining virtual fixtures described in "Active Constraints/Virtual Fixtures: A survey" and in the related literature
- Creating at least one functional surgical task in the virtual environment in Unity

Progress

- Learned the Unity Physics Engine with the rigid body physics, collisions and dynamics
- The Unity scene now saves all the relevant data about each task and about the virtual fixtures employed: end-effector position, orientation, velocity, force feedback, distance from trajectory/obstacles, *etc.*
- Built a rudimentary surgical task between Blender (for 3D modelling) and Unity, in order to test the rigid body behavior. The task is complemented with one of the virtual fixtures implemented before, the *Trajectory Guidance Active Constraint.* A screenshot of the task is reported in the following page.

  For this very rudimentary task, the user controls only the orange "scoop" and he has to pick up and carry the blue sphere from the green block to the yellow one. The 4 red points define the reference trajectory (in green) that the user has to follow. The virtual fixture calculates the force that will be provided as haptic feedback (not visible in the picture, the "scoop" stands still while taking the screenshot).

  The simulation is completely functional and data for each "trial" of the task is saved for analysis, plotting and evaluation

Next Steps

- Literature research on surgical tasks: what to aim at and what to focus on when building one
- From the rudimentary task alredy implemented, create more complex ones that will allow to employ the different types of virtual fixtures.
  NOTE: Anywhere possible, the virtual objects employed will be 3D models of organs, and the end-effector will be replaced by the PSM tooltip

Screenshots