Maxwell's Demon Algorithm Human Subject Protocol

August 20, 2015

1. Go over consent form with subject, explaining study protocol and goals as outlined on the form.

2. Demonstration and introduction to software only MDA on phone.

No MDA: The phone approximates and acceleration based on the position of the finger on the touchscreen. This is used to drive the cart-pendulum simulation.

MDA: The phone uses the same acceleration approxiation, but filters this input signal. The algorithm will either accept, reject, or saturate this input signal based on the output and saturation limits of the Sequential Action Control(SAC) algorithm.

3. Demonstration and introduction to the mechanical MDA on Phantom Omni Haptic device(Sensable Technologies). Subjects will be asked to hold the stylus in a firm cylindrical grasp.

No MDA: The left-right position of the stylus is in put to a trep model, which uses a variational integrator to step the system forward in time. The position of the stylus is represented by a box marker in rviz. The position of the pendulum is calculated using trep and is also visualized in rviz. There is **no force rendering**.

MDA: The simulation and visualization is update in the same way as when the MDA is not running. However, the user will experience two types of feedback force from the Omni, such that the algorithm will mechanically either accept, reject, or saturate this input signal based on the output and saturation limits of the Sequential Action Control(SAC) algorithm.

Saturation: Saturation is experienced as a drag force. The force will increase if the stylus is moved to quickly or it is approaching the saturation velocity. It is designed to feel as though the stylus is being moved through a heavy fluid.

Rejection: This type of feedback is designed to feel like a wall which is changing based on the SAC signal. If the stylus is moved in the direction opposite of the direction that SAC has prescribed, the algorithm will put up a 'wall'. When the wall is hit a very high force is generated by the Omni feeling like a sudden jolt.

4. Generate a randomly ordered list of test conditions. Save with name *subjectcode*_order.txt

5. (For Omni only) Start the ROS package:
   `$ roslaunch trep_omni_cart cart_pend.launch vis:=true replay:=false`
   Set up recording of the ROS topics by navigating to the `trep_omni_cart` directory and executing the command:
   `$ ./record.sh data/`*subjectcode*`-trial`*trialnumber*

6. Complete each trial according to the schedule generated. Each trial will be stopped automatically by the software when

$$-0.15 < \theta < 0.15 \ and \ -0.6 < \dot{\theta} < 0.6$$

   or after 50 seconds have elapsed.

7. The time to task completion and SAC score will be recorded at this time.