Trajectory Generation

As described in section 1.2.2, in the current version of the MyPAM the game generates equidistant intermediate positions between the start position and the final position of each reaching movement and passes these one at a time to the low-level controller. This leads to a number of issues:

1. A linear trajectory of this nature is not reflective of natural human motion, although there is no evidence that normative trajectories which mimic human motion promote neurofunctional plasticity (Marchal-Crespo and Reinkensmeyer, 2009).

2. The game does not operate at 30 Hz reliably as a result of being dependant of the non-deterministic Microsoft Windows Operating System (OS). There may be instances where the game rate will drop, resulting in incorrect intermediate position data being sent to the controller.

3. There are occasions where no intermediate points are generated and the final target position is sent to the controller as the next target, for example during some game types and during transitions between different games. This leads to a large difference between the current position and the target position, and large motor demands are generated. This leads to aggressive accelerations and potentially dangerous interaction forces between the patient and the robot.

1 Generating a Smooth Trajectory

A smooth trajectory is desirable when assisting the user to reach a target. This is because smooth trajectories are necessary to ensure safe interaction between the robot and the patient (Amirabdollahian et al, 2002) and movement smoothness is an indicator of increased motor control after stroke according to Balasubramanian et al (2015), though there is no evidence to suggest that assisting a smooth movement increases neurofunctional plasticity. Mathematically, a smooth trajectory translates to minimising the rate of change of an input, where the input corresponds to the order of the system. For example, a 1^{st} order system corresponds to a kinematic model where velocities may be arbitrarily specified. This is summarised in the table 3.1 below:

Order of the system	**Input to the system**
1^{st}	10
2^{nd}	10
3^{rd}	10
4^{th}	10
5^{th}	10
6^{th}	10

Table 1: Table to test captions and labels