Manipulation of mobile game dynamics with Reinforcement Learning for Motor Learning

Background:

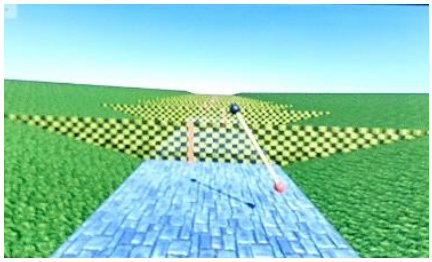

Figure 1: An example task.

The interest in using virtual reality and robotic systems to improve motor skills has significantly increased in the last years (e.g. in sports training and neurorehabilitation). The virtual games and robotic systems can simulate any task with the desired dynamics, which is very interesting to analyze motor learning. However, it is still not known how the dynamics of a task can be manipulated to optimize motor learning.

In this project, we would like to utilize Reinforcement Learning methods to learn how to teach a motor task better by manipulating the task dynamics. In order to overcome the data acquisition limits of the robotic training systems, the aim is to make a mobile game which is still played by subtle motor actions (e.g. using the accelerometer of the phones) but does not require a robot to be played. The fundamentals of the motor learning with a robot or with a mobile device are expected to be similar and transferable to each other.

This game should be designed such that the changes to the degree of the dynamics of the motor task in the game affect the difficulty of the game. Once example to this is changing the gravity level in an inverted pendulum task to make it easier or harder. Once the game is implemented, your task will be to implement an online platform which will collect the motor performance of the people playing the game and change the degree of the dynamics of the motor task according to the optimum policy obtained by Reinforcement Learning methods. The aim is to figure out which degrees of dynamics lead to better learning of the motor task in the game. The second criterion of the game is that the motor task is supposed to make sense to be integrated to a robot as well, since in future the learned policy using the mobile game will be transferred to a robotic version of the game.

Outline:

1. Literature research: Motor tasks and Reinforcement Learning methods.
2. Implementation: Implementation/integration of the task, and the dynamics manipulation methods.
3. Implementation of the online platform that collects data and changes the dynamics of the game.
4. Implementation of Reinforcement Learning methods that learn the optimum game dynamics.
5. Scientific reporting: Scientific reporting of the methods and results.

Materials and Methods:
Virtual game environment (Unity3D, C#) and a mobile device.

Requirements:
Python and basic C# skills. High motivation to learn machine learning (mosty reinforcement learning).

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