

Implementation of Matching Stimulus-Movement Experiment on a Humanoid Robot

Implementing cognitive tasks on robots using models inspired from neuroscience and developed in computational neuroscience would enlarge our understanding of the mechanisms behind such tasks and also help us to develop intelligent autonomous systems. In this study, we considered a temporal sequence task performed by macaca monkeys where it is expected to match a stimulus with an appropriate movement [1]. To realize this experiment on humanoid robot, we utilized a Basal ganglia-Thalamus-Cortex (BTC) model to realize action selection. To select appropriate action, reinforcement learning rules are used to update BTC model parameters using temporal difference method [2]. This working memory task is realized on an open source humanoid robot, Darwin-Op. The results conveyed that the model considered is suitable to be implemented on such a robot and it is possible to train robot online to realize a cognitive task.

During the task, the robot learns matching three different stimuli-different colours, with three different predefined movements. The robot differentiates colours using its camera, and the colour recognized is the input of the BTC model, where action selection is done. When, a colour is presented to robot, it is expected to select an action in the first place. With the BTC model implemented, the robot tries to decide on an action, if it cannot, the decision is based on random selection. Green colour is shown to represent reward, to indicate that the action realized is a proper one. Once robot rewarded due to right choice, an expectation error arises, which updates the parameters of BTC model in charge of action selection. Once the update is completed, the colour is shown again and the correct action is rewarded each time until robot learns to match the appropriate movement with the colour.

The work done is inspired from [2] and [3], and learning is implemented on a humanoid robot with the ability to sense colour differences and complex actions are conveyed.

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References:

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