Anticipative Motion Planning for Robots. Application to RoboCup Soccer.

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RoboCup Robot Soccer is an annual international competition that brings together researchers in robotics and artificial intelligence towards a common goal of obtaining robots that will play the game of soccer against humans by the year 2050. The competition poses a range of challenges, notably tasks that require efficient perception models, motion generation and planning.

In this context, robots can greatly benefit from a predictive sense of the physical reality of the game, such as predicting the trajectory of the ball as well as possible movement of players from the opposing team. Based on such anticipations, a goalkeeper could select the correct movement to perform to stop an incoming ball, or attackers could take other robots' positions into account when trying to score.

Fig. 1. Nao Robot, complete team available for research use at CERV.

Humans solve these tasks using a predictive mental model (or forward model, which is continually learned since infancy) of physical phenomena that allows to anticipate the consequences of actions that are performed in the environment [2, 1].

Recent advances in machine learning, generative models [4] and model-based reinforcement learning [6] in particular, have shown that the automatic learning of forward models is increasingly feasible [8]. As importantly, recurrent neural networks [3] are natural extensions to account for sequences and have been successfully used for various temporal prediction tasks [7, 5].

The objective of this thesis is to obtain an agent that can adapt to the changing conditions in its environment and that can do so in a timely manner, while considering the limited computational resources. More precisely, the robot should be able to anticipate events and interactions that happen in its world, and take the necessary actions depending on the context.

As provisional schedule, the candidate will first spend time studying the current state of research in the topic as well as implement and test and potentially adapt various models to arrive at an initial proof of concept. Incremental novel improvements of the approach are expected afterwards and application on the robot. Participation in the RoboCup Soccer SPL competition is envisioned when the proposed model matures. The research should result in at least two peer-reviewed publication in respectable international conferences.

References

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