Abstract

A novel approach to reinforcement learning

This paper expands on the theory of integration Model Predictive Control (MPC) with Reinforcement Learning (RL) techniques. The primary issues investigated is that of convexity and stability of the Non-Linear Problem (NLP) in MPC. RL is used to tweak the parameters of the constraints and cost-function, such that it is possible to enforce stability on the NLP. This has previously been an issue with rich parametrizations of cost-functions. The RL algorithm was trained through an iterative process, where at each step k of the NLP, a score was given based on the convexity of the current convexity of the system. The convergence of the RL to a convex problem is proven through the use of dynamic programming with the bellman-equation. It is applied to a small example system of two states in order to keep the number of states and iteration within reasonable levels.

With the stability of the NLP ensured, it is possible to guarantee convergence, and that a solution for the MPC exists. RL can then be applied on stochastic systems, where it may be used to actively generate feasible online constraints and convex objective functions of real-world systems. The resulting NLP is the solvable, and control feedback through a MPC becomes a possible applicable control method of such complex, stochastic systems. Further areas of interests include looking into proper applications of such algorithms, where RL and MPC are combined.

Summary

The paper Investigates into the possibilities of enforcing convexity of Non-Linear Problems (NLP) in Model Predictive Controllers (MPC) through the use of Reinforcement Learning (RL). It is proven that RL is able to force convexity on both rich parametrized cost functions, and of linear constraints.

Keywords

Model predictive Control, Reinforcement Learning, Convexity, Stability, Stochastic Systems.