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Optimal feedback stabilization via deep neural network approximation

A learning approach for optimal feedback gains to nonlinear continuous time control systems is proposed and analysed. The goal is to establish a rigorous framework for computing approximating optimal feedback gains using neural networks. The approach rests on two main ingredients. First, an optimal control formulation involving an ensemble of state trajectories with control variable given by the feedback gain functions. Second, an approximation to the set of admissible feedback laws by neural networks. Based on universal approximation properties we prove the existence of optimal stabilizing neural network feedback controllers and characterize them through first order necessary optimality conditions. Qualitative convergence results towards optimal feedback gains are discussed. The talk is completed by numerical examples highlighting the practical applicability of the presented approach. This is joint work with Karl Kunisch.