Deep Learning-based Model Predictive Control

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Model Predictive Control (MPC) is an advanced process control technique that is implemented in many industrial processes. MPC utilizes a dynamic model for predicting plant responses and computes the optimal control action. More recently, MPC is finding novel applications in building energy management and optimization.

Despite its popularity in industry, solving the underlying optimization problem of MPC is computationally intensive, which can be infeasible for systems with fast dynamics or local devices with limited computing resources.

As a popular machine learning technique, deep neural networks (DNN) exhibit excellent function approximation capability, and can be used to approximate the MPC control law. Since the online implementation of a well-trained DNN only entails simple function evaluation, the DNN controller can be executed efficiently in real-time.

Using techniques from parallel computing and distributed optimization, we solve large-scale nonlinear optimization problems to design MPC control laws via deep learning techniques. These novel DNN-based controllers will allow for real-time implementation of MPC on systems with fast dynamics while maintaining satisfactory control performance.

Our research will enable engineers to efficiently implement advanced process control and optimization strategies such as MPC on non-traditional applications such as building energy management systems, battery management systems or energy production devices.

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