85ª DEFESA DE TESE EM ENGENHARIA INDUSTRIAL

PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA INDUSTRIAL - PEI

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Título: "Economic and distributed model predictive control for non-stable processes: stability, feasibility and integration".

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Resumo:

The basic requirements for the implementation of model predictive controllers can be summarized as stability, feasibility, performance, and robustness. One of their main purposes is the plantwide optimization so that different strategies can be applied to achieve it, either in two-layer schemes, as Real-Time Optimization (RTO), or one-layer schemes, as MPC+RTO and Economic Model Predictive Control. These strategies can be implemented in centralized, decentralized, or distributed schemes, but for large-scale systems, the centralized one can be intractable, and distributed control schemes are preferable. Additionally, some controllers design may result in an infeasible optimization problem in some scenarios, e.g. when a small control horizon is applied in design based on terminal invariant sets. In this context, this thesis focuses on stabilizing model predictive controllers with economic objectives, applying solely terminal equality constraints associated with design mechanisms to improve the feasibility of the optimization problem, in addition to their integration into centralized and cooperative-distributed control schemes. The contributions of this thesis are summarized as: (i) a one-layer model predictive controller whose optimization problem is always feasible, suitable for systems with open-loop unstable states, applying slacked terminal equality constraints, (ii) a cooperative-distributed model predictive controller suitable for stable systems, which stabilizing properties are integrated with its tuning, and (iii) a stabilizing cooperative-distributed gradient-based economic predictive control based on terminal equality constraints suitable for non-stable systems, with design mechanisms to enlarge its domain of attraction. The stabilizing properties are guaranteed by Lyapunov arguments, and the feasibility targets the fulfillment of constraints, in addition to the solution of the optimization problem at all time steps even with small control horizons. In order to exemplify the aforementioned features of these strategies, case studies are assessed using scenarios where the controllers have small control horizons and, in the distributed scheme, a short time frame for communication and conflicting objectives among the agents.

Palavras-chaves: Model predictive control, optimizing control, cooperative-distributed control, target calculation, economic model predictive control.