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A combined approach to nonlinear model predictive control of fast systems ☆

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Abstract

A new solution strategy, a combination of the multiple shooting and collocation method, is proposed for nonlinear model predictive control (NMPC) of fast systems. The multiple shooting method is used for discretizing the dynamic model, through which the optimal control problem is transformed to a nonlinear program (NLP) problem. To solve this NLP problem the values of state variables and their gradients at the end of each shooting need to be computed. We use collocation on finite elements (CFE) to carry out this task. Due to its higher numerical accuracy the computation efficiency can be enhanced considerably, in comparison to an ordinary differential equation solver commonly used in the existing multiple shooting approach for integrating the ODEs and the chain-rule for the gradient computation. Therefore, the NMPC algorithm proposed can be applied to the control of fast systems. The performance of the proposed approach is demonstrated with three optimal control problems.

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Keywords

Nonlinear model predictive control; Multiple shooting; Collocation on finite elements

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