(1)

Wind turbine control based on a modified model predictive control scheme for linear parameter-varying systems

Abdelrahman Morsi , Hossam S. Abbas, Abdelfatah M. Mohamed

Abstract:

This study presents a successful application of a model predictive control (MPC) design approach based on linear parameter-varying (LPV) models subject to input/output constraints to control a utility-scale wind turbine. The control objectives are to allow the wind turbine to extract from the wind the rated power taking into account the wind speed variation, to reduce mechanical loads and power fluctuations and to guarantee the stability of the system for the whole range of operation. A modified min□max MPC-LPV scheme is proposed to compute online the optimal control input at each sampling instant by solving an optimisation problem subject to linear matrix inequality constraints. To reduce the conservatism of the original MPC scheme due to the overbounding associated with affine parameter-dependence, the full block S-procedure with a linear fractional transformation formulation is used. The performance and the efficiency of the proposed MPC-LPV algorithm is validated via simulation and compared with the original scheme and other conventional controllers.

Keywords:

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(2)

Model Predictive Control of a Wind Turbine Based on Linear Parameter-Varying Models

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Abstract:

This paper demonstrates the application of a low conservative model predictive control (MPC) scheme based on linear parameter-varying (LPV) models to control a utility scale wind turbine. The main objective of the controller is to allow the wind turbine to extract from the wind a prespecified desired amount of power according to the wind speed and to guarantee the stability of the closed-loop system during the whole range of operation. An LPV representation for a nonlinear model of a 225 KW wind turbine is developed using the Jacobian linearization based technique. A tight parameter set is considered to reduce the conservatism of the LPV model. Then a quasi min-max MPC-LPV algorithm is used to compute online the optimal control input at each sampling instant. The performance and the efficiency of the MPCLPV scheme is validated via simulation and it is compared with another MPC scheme based on linearized models of the system.

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(3)

CONTROL OF A WIND TURBINE USING MODEL-BASED PREDICTIVE CONTROL

Abdelrahman Morsi Hossam S. Abbas Abdelfatah M. Mohamed

Abstract:

This paper presents as application of discrete-time model predictive control (MPC) to control a utility scale wind turbine based on linearized models. The main objective of the controller is to allow the wind turbine to extract from the wind a prespecified desired amount of power according to the wind speed during the whole range of operation. A nonlinear model of a 225 kW wind turbine is considered; at each sampling instant, a linearized model of the corresponding operating point is computed and used to obtain the optimal control input by solving an infinite horizon MPC problem. The procedure is repeated in the subsequent samples to control the nonlinear model. This MPC scheme can guarantee the stability of the closed-loop system at the operating point and its neaighborhood and it demonstrates high control performance.

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