Constrained Control of a Low Power Industrial Gas Turbine

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Abstract: Gas turbines are important and widely used prime movers in transportation systems. Besides this main application area, gas turbines are found in power systems where they are the main power generators [1]. Therefore the modelling and control of gas turbines is of great practical importance.

Control techniques applied for gas turbines are most often based on locally linearized models. These controllers are mainly variants of linear quadratic (LQ) controllers, e.g. in [2]. An LQ servo controller is applied to track a reference signal in [3]. LQG/LTR technique [4] and robust control system design has also been performed [5] for gas turbines.

A constrained linear optimal control for a low-power industrial gas turbine based on input-output linearization is proposed in this paper. It uses a nonlinear state space model of the gas turbine in input-affine form based on first engineering principles. According to the control aims the nonlinear model is input-output linearized and an LQ servo controller is developed for the I/O linearized model.

We have some additional constraints on the state and input variables of the closed-loop plant fed back by the LQ servo controller. These constraints can be kept in a relatively simple way by designing an MPT-controller [7]. The complete control structure is investigated by simulation studies performed on a validated nonlinear dynamic model described earlier in [6]. The results show excellent time-domain performance and good robustness against parameter uncertainties.

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