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Modifier Adaptation with Guaranteed Feasibility in the Presence of Gradient Uncertainty

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Abstract

In the context of real-time optimization, modifier-adaptation schemes use estimates of the plant gradients to achieve plant optimality despite plant-model mismatch. Plant feasibility is guaranteed upon convergence, but not at the successive operating points computed by the algorithm prior to convergence. This paper presents a strategy for guaranteeing rigorous constraint satisfaction of all iterates in the presence of plant-model mismatch and uncertainty in the gradient estimates. The proposed strategy relies on constructing constraint upper-bounding functions that are robust to the gradient uncertainty that results when the gradients are estimated by finite differences from noisy measurements. The performance of the approach is illustrated for the optimization of a continuous stirred-tank reactor.

Keywords: Real-time optimization, Modifier adaptation, Feasible operation, Gradient uncertainty

1. Introduction

The optimization of process operations is key to the economic success of continuous and batch industrial processes, for which the goal is to maximize profit or minimize cost subject to a number of operating constraints. An optimal operating point is typically found by solving a model-based optimization problem. Unfortunately, due to plant-model mismatch, the optimal solution obtained

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