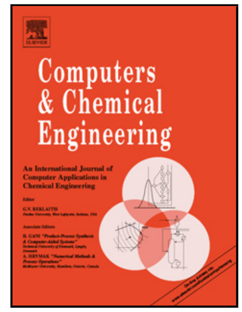
Accepted Manuscript



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PII: S0098-1354(16)30228-9
DOI: http://dx.doi.org/doi:10.1016/j.compchemeng.2016.07.008
Reference: CACE 5509

To appear in: *Computers and Chemical Engineering*

Received date: 23-3-2016
Revised date: 29-6-2016
Accepted date: 3-7-2016

Extension of Modifier Adaptation for Controlled Plants using Static Open-Loop Models

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Abstract

Model-based optimization methods suffer from the limited accuracy of the available process models. Because of plant-model mismatch, model-based optimal inputs may be suboptimal or, worse, unfeasible for the plant. Modifier adaptation (MA) overcomes this obstacle by incorporating measurements in the optimization framework. However, the standard MA formulation requires that (1) the model satisfies adequacy conditions and (2) the model and the plant share the same degrees of freedom. In this article, three extensions of MA to problems where (2) does not hold are proposed. In particular, we consider the case of controlled plants for which the only a model of the open-loop plant is available. These extensions are shown to preserve the ability of MA to converge to the plant optimum despite disturbances and plant-model mismatch. The proposed methods are illustrated in simulation for the optimization of a CSTR.

1. INTRODUCTION

Process optimization consists in determining the values of input variables that maximize a given performance criterion (such as economic profit or product quality), while meeting all the safety, environmental and operational constraints. Although generally bounded, the values of these manipulated variables are typically not fixed at the design stage. The problem can be formulated mathematically as the following nonlinear program (NLP):

$$\mathbf{u}_\mathrm{p}^* := \arg\min_{\mathbf{u}} \phi_\mathrm{p}(\mathbf{u}) \quad \text{subject to} \quad \mathbf{g}_\mathrm{p}(\mathbf{u}) \leq \mathbf{0}, \tag{1.1}$$

where $\mathbf{u}$ is the n_u-dimensional vector of inputs, ϕ_p is the cost function, and $\mathbf{g}_\mathrm{p}$ is the n_g-dimensional vector of process constraints. Here, the subscript $(\cdot)_\mathrm{p}$ indicates a quantity related to the plant, and this problem will be referred to as the *plant optimization* problem.

Preprint submitted to Elsevier *July 4, 2016*