SELF OPTIMIZING CONTROL OF AN EVAPORATION PROCESS UNDER NOISY MEASUREMENTS

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Abstract: Recently, Cao (2004) presented a decentralized cascade self-optimizing control strategy and implemented on an evaporation process. In this method, the local optimal condition of a self optimizing control system is derived and this optimal condition is expressed as a gradient function in terms of the existing process measurements. This gradient function can then be used as a controlled variable to achieve local self optimization. Good results were obtained subject to noise free measurements but the performance deteriorates when measurement noise presents. This paper presents a method to overcome the detrimental effect of measurement noises on self-optimising control. Filtering the process measurements in conjunction with self-optimising control can reduce the effect of measurement noise on the process performance. The benefit of this method is quantified in terms of the total operating cost reduction compared to non-filtered gradient control. Operating cost comparison of a 10 hour period for various cases subject to the same disturbances clearly shows that the implementation of the proposed strategy reduces the operating cost.

Keywords: Plantwide Control, Process Control, Self-Optimizing Control, Measurement Noise, Filtering.

1. INTRODUCTION

Up to this moment no unified theory for the design of plantwide control systems exists. As Ogunnaike noted (Ogunnaike, 1996), industrial approaches to date on plantwide control still have not deviated far from those laid down in (Buckley, 1964).

Several factors which influence operating performance of process plant are related to process understanding, selection of suitable sets of controlled and manipulated variables, tuning parameters determination and further efforts in eliminating or reducing the effect of noise and disturbances.

Methods for the selection of suitable sets of controlled and manipulated variables range from heuristic method in nature to the mathematical optimization based method (Wang *et al*., 2001). Tuning parameters determinations in practice also range from trial-error approaches to optimization based approaches. While further improvement might be achieved by exploring the possibility of advanced control strategy (model predictive control etc) implementation and signal conditioning, generally speaking concise but robust design is preferred. Unfortunately in some cases robust control structures are difficult to obtain due to the complexity of the plant, nonlinearity of the process, strong interactions among variables, process constraints and also measurements noises.

A stepwise procedure for variable pairing that leads to self-optimizing control is presented in (Skogestad, 2000). The main issue in self-optimizing control structure is to find the right variables to keep constant which will achieve an acceptable loss. Several plantwide control problems had been used as case studies for this method, which include distillation column control (Skogestad, 2000), Tennesse Eastman (Larsson *et al*., 2001) and reactor-recycle process (Larsson *et al*., 2003).