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INTELLIGENT DECOUPLING CONTROL SYSTEM INSPIRED FROM MODULATION OF THE GROWTH HORMONE IN NEUROENDOCRINE SYSTEM

Y.S. Ding[1,2], B. Liu[1] and L.H. Ren[1]

[1]College of Information Sciences and Technology
[2]Engineering Research Center of Digitized Textile & Fashion Technology, Ministry of Education
Donghua University, Shanghai 201620, P. R. China.

Abstract. Bio-systems are highly stable with harmonious regulation and accurate control, and have been imitated to develop various novel intelligent control technologies for complex systems. In order to develop more effective decoupling control methods for complex coupling systems, we present a bio-inspired decoupling controller (BDC) from the bi-regulation principle of the growth hormone (GH) in neuroendocrine system. The BDC consists of an identification unit and two or more control units, which can communicate with each other to exchange the control information. The control unit is composed of a control module, a coupling error prediction module (CEP), an inverse control module (INC), and an output module. The CEP is used to predict the coupling error via the coupling mathematical model between two control loops. The INC is used to calculate the corresponding compensation based on the inverse model of the plant. As such, the coupling influences among the multiple control loops can be reduced or removed with the proposed decoupling algorithm. In order to examine the decoupling control effectiveness of the BDC, we apply it to the methanol-water distillation column model which is a two-input-two-output (TITOstrong coupling system. The BDC scheme is also compared with the conventional control scheme and the genetic algorithm-based neural network decoupling control scheme. The simulation results demonstrate that the BDC can completely eliminate the coupling influence with better control performance. Compared with other decoupling control schemes, the BDC can be implemented more easily and practically, and be easily generalized to MIMO systems.

Keywords. decoupling control, neuroendocrine system, growth hormone, bi-regulation, inverse control.

1 Introduction

Coupling is a very common phenomenon in multiple-input-multiple-output (MIMO) systems. For example, during industrial processes, multiple control loops are designed for a process plant to guarantee the product quality. Usually, there are coupling influences among these loops. If the influences cannot be eliminated successfully, these loops will not be auto-controlled or