Model-free adaptive control strategy for the temperature tracking control of Single-Effect LiBr/H2O Absorption Chiller

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Abstract. In industrial processes, we are often confronted with large variations of some complex system conditions, strong nonlinearity and time-lag. In this work we propose an improved model-free adaptive control method. Firstly, output error rate is added to the objective function and new control laws have been deducted through an exhaustive convergence analysis. As a practical application, the lithium bromide unit model is used in our simulations. Finally, a dynamic model of the absorption chiller is given, and the effectiveness and practicability of the improved control strategy are validated by numerical simulations and experiments.

Introduction

Since model-free adaptive control(MFAC) was proposed by Hou Zhongsheng [1], after more than 20 years of research and improvement, MFAC theory has been applied to industrial processes [2]. At the same time, many scholars have proposed improved algorithms based on the MFAC method. For example, a model-free adaptive integral terminal sliding mode control method was proposed in [3]; a model-free adaptive predictive control method was proposed by combining MFAC and predictive control in [4]; and a new MFAC method is proposed by linearizing dynamically the controller in [5]. The MFAC method has attracted much attention due to its strong robustness and anti-interference ability. However, the tracking speed of MFAC needs to be further improved. Aiming at this, this work proposes the new control law based on MFAC method. In order to improve the tracking speed, the new algorithm not only utilizes the output error, but also introduces the output error rate. The two terms are weighted to eliminate the influence of the output error. The control structure is given in fig.1.

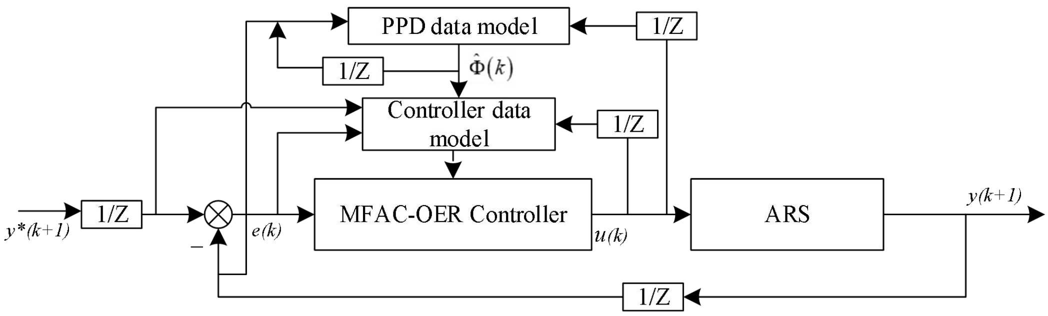

Figure 1: Temperature tracking control system

Results and discussion

In this work, an improved model-free adaptive control algorithm is introduced, which includes the output error rate into control input criterion function. The new algorithm is applied to the lithium bromide refrigeration system. Finally, a simplified sixth order dynamic model of a single-effect absorption chiller driven by hot water is developed for control system verification and optimization.

References

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