



Adaptive Fuzzy Control System

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Research Adaptive fuzzy control system
Fields : Fuzzy information system
Keywords : Fuzzy control, adaptive control, disturbance
observer, T-S fuzzy model, polynomial fuzzy
model, LMIs, SOS

● Research Topics

Plant model is a mathematical expression that describes the dynamics of plant to be controlled, and modeling error is the error between the plant and its model. Generally, a controller is designed on the basis of the plant model. It is obvious that the control performance by the controller based the plant model with modeling error cannot be achieved satisfyingly. Therefore, our research topics roughly fall into two categories: plant modeling and control system design in consideration with the modeling error.

1) T-S/polynomial fuzzy modeling

T-S fuzzy model is a set of fuzzy rules, each of which has an antecedent part corresponding with a fuzzy division, and a consequent part in accordance with a state-space representation. Polynomial fuzzy model is a version of T-S fuzzy model, in which the state-space representation in the consequent part is replaced by a polynomial expression that is basically nonlinear. In this study, we focus our attention on how to get the T-S/polynomial fuzzy model with higher precision in the context of control system design.

2) Adaptive fuzzy control system design in consideration of modeling error

A regular procedure involving the T-S/polynomial fuzzy model for system design consists of two steps: a) formulize all conditions ensuring system stability and other control requirements into the form of the

Linear Matrix Inequalities (LMIs, for the T-S one) or the Sum of Squares (SOS, for the polynomial one); b) solve the LMIs/SOS to get the controller's feedback gains. The modeling error considered here is a lumped one including external disturbance, parameter perturbation, and unmodeled dynamics, which, in general, does not admit the mathematical expressions. In this study, we focus our attention on how to tune all parameters involved by adaptive law in order to construct an adaptive fuzzy controller.

3) Fuzzy control system design using disturbance observer

Observer is usually used to estimate control state. In this study, the so-called lumped disturbance is viewed as part of state, and observer is introduced to estimate all the state. At the end, the estimate is of benefit to the system design.

● Research Themes in the future

1) Smart robot and intelligent vehicle control system development;

2) Systemization of a diversity of databases and information retrieval.

● Research Themes for Collaboration

We would like to perform some real objects control using the approaches proposed so far in the near future. For example, 1) vehicle modeling and steering control; 2) modeling of a large scale system such as effects of air pollution on the environment.

● Results in Collaboration with Society

A project called Fuzzy Guiding and Collecting Tourists System was developed in collaboration with a local partner in support of the Hiroshima Industrial Promotion Organization.