Invited Session Proposal for ICAMechS2011

Adaptive and Advanced Control Systems - Theory and Applications -

Organizers:

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Session Theme and Objective:

During the last two decades, a great deal of attention has been attracted to advanced control system design for uncertain and complex systems due to several kind of requirement for capability of the control. With this in mind, several novel and advanced ideas in control methodology including adaptive, self-tuning and predictive controls have been proposed.

The aim of this session is to present the new research results on adaptive and advanced controls which deal with control problems for uncertain and/or complex controlled systems. The results on theory and applications of adaptive and advanced control methods will be shown in order to demonstrate the applicability and efficiency of the proposed advanced control strategies. Moreover, future research interests in adaptive and advanced controls will be promoted through discussions among the attendants of this session.

Session papers:

Paper #1

Paper title:
Design of a Self-Adjusting Controller using Multiple Local Linear Models for Nonlinear Systems

Authors:
Shinichi Imai* and Toru Yamamoto**
Affiliation:
* Hiroshima National College of Maritime Technology
** Hiroshima University

Abstract:

Almost real-world plants are represented by nonlinear systems. Therefore, it is important to consider control schemes to cope with such systems. In this paper, a control method for nonlinear systems is newly proposed. Some local linear models on typical equilibrium points are first designed, followed by linear controllers corresponding to these models. The distances between the query and these local models are calculated, and the weights are computed in proportion to the distances. These weights are put for local controllers, and the controller corresponding to the query can be designed. According to the proposed scheme, the good control performance can be easily obtained. The effectiveness of the control scheme is illustrated by some simulation examples.

Paper #2

Paper title:

A Nonlinear Model Predictive Control Using a Continuation Method and a Step Input Constraint

Authors:

Kota Kogiso*, Shiro Masuda*, Takao Sato**

Affiliation:

*Tokyo Metropolitan University

**Universty of Hyogo

Abstract:

The nonlinear model predictive control needs to solve a two-point boundary-value problem (TP-BVP) at every sample time based on the receding horizon control strategy. However, solving a nonlinear algebraic equation for the TP-BVP requires high computational load, so computing the control law in real-time is a significant issue on the nonlinear model predictive control. This paper, therefore, proposes a design method for nonlinear model predictive control with a step-type input constraint and a continuation method. The effectiveness of the proposed method is demonstrated through a numerical simulation.

Paper #3

Paper title:

Disturbance Attenuation Property for Random Disturbances in Two-degree-of Freedom Optimal Servo Control Systems

Authors:

Yusuke Kishimoto*, Shiro Masuda*, Akira Yano**

Affiliation:
*Tokyo Metropolitan University
**Okayama University
Abstract:
The two-degrees-of-freedom optimal servo control systems have advantages that the integral gain can be tuned for improving feedback properties such as disturbance attenuation properties, while tracking property is independently designed of feedback properties using nominal controlled process model. However, the earlier works have not given the way how the integral gain should be designed. This paper considers the design method for the integral gain in the two-degrees-of-freedom optimal servo control systems in the presence of random disturbances. The proposed method gives a design method for integral gain based on another performance index evaluating disturbance attenuation properties. The efficiency of the proposed method is demonstrated using numerical example.

Paper #4

Paper title:
Adaptive Control Scheme for MI-MO Systems with Input Saturations
Authors:
Jinxin Zhuo, Qiang Wang and Masahiro Oya
Affiliation:
Kyushu Institute of Technology
Abstract:
In all actual systems, there exist input saturations. If an adaptive adjusting law is designed in disregard of input saturations, the designed adaptive controller may give poor performance or lead instability of the closed loop system. To overcome the problem, many schemes have been proposed. However, there ware the following problems. Almost all proposed controllers can not assure asymptotic stability of the tracking error between the controlled object and a reference model. Some controllers can assure asymptotic stability of the tracking error but controlled objects are restricted to asymptotically stable systems. To struggle against these problems, the authors proposed an adaptive control scheme for SI-SO systems with an input saturation. In this paper, we propose an adaptive control scheme for MI-MO systems with input saturations. We assume that the high frequency gain matrix of the controlled object is nonsingular and the signs of principal leading minors of the high frequency gain matrix are known. Under the assumptions, even for unstable systems, the proposed adaptive controller can assure asymptotic stability of the tracking error.

Paper #5

Paper title:

Performance-Driven Adaptive Output Feedback Control System with a PFC designed via FRIT Approach

Authors:

Ikuro Mizumoto*, Sota Fukui*, Kenshi Yamanaka* and Sirish L. Shah**

Affiliation:

* Kumamoto University

** University of Alberta

Abstract:

This paper deals with a design problem of a performance-driven adaptive output feedback control system with a parallel feedforward compensator (PFC) designed for making the augmented controlled system ASPR. In the proposed adaptive control system, for systems in which the properties are changing during the operation, the PFC will be redesigned through FRIT approach and the output feedback gain will be readjusted according to a performance index.

Paper #6

Paper title:

Stable Fault-Tolerant Control Based on Fuzzy Performance Evaluation

Authors:

Masanori Takahashi and Taro Takagi

Affiliation:

Tokai University

Abstract:

This paper proposes a new design method for a fault-tolerant control system (FTCS) based on performance evaluation. The FTCS utilizes the two actuators against faults, and has an adjusting law for the activation ratios of the actuators which is designed based on the tracking performance and the fuzzy inference from {¥it a priori} input-historical-data in the healthy condition. The stability of the FTCS can be guaranteed by switching to the extra control-mode with static redundancy. To confirm the effectiveness of the proposed method, several numerical simulation results are shown in this paper.