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شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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Menoufia University
Faculty of Electronic Engineering-Menouf
Department of Industrial Electronics and Control

Fuzzy Logic Control of Nonlinear Systems with Parametric Uncertainties

A Thesis submitted in partial
Fulfillment for the Master of Science Degree
in Automatic Control Engineering

By
EL-Khatib Kamal Abd EL-Fatah

Supervised By

Prof. Abdul-Azim S. Ibrahim

Prof. of Automatic Control, Industrial
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Faculty of Electronic Engineering,
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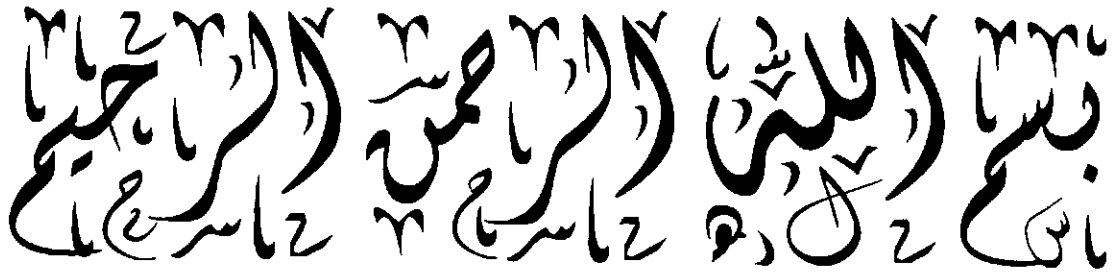
بسم الله الرحمن الرحيم

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ABSTRACT

There are two main difficulties in the controller design for real systems: nonlinearity and parametric uncertainties. In addition, there is no systematic way to find a necessary and sufficient stability conditions. Uncertainties often degrade system performance and may even lead to instability. Fuzzy logic is an effective approach to design nonlinear control system in the presence of incomplete knowledge of the plant parameters.

In this thesis, a modified control algorithm for a class of nonlinear uncertain systems is presented. The algorithm utilizes Takagi-Sugeno (TS) fuzzy models to approximate nonlinear systems. The controller design is based on the concept of three modified approaches, namely, Extended General Design Approach (EGDA), Extended Parallel Design Approach (EPDA), Extended Simplified Design Approach (ESDA) and the linear matrix inequalities (LMI). TS fuzzy models are classified into three families based on how diverse their input matrices, first family when the input matrices are common, second family when the input matrices are not all the same, third family when the input matrices on one-dimensional cone, and a robust controller synthesis is given for each family. The proposed method leads to robust control over a wide range of uncertainties of plant parameters. Four illustrative examples are provided, namely, two-inverted pendulum system, mass-spring-damper system, ball-and-beam system, and unmanned helicopter .

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