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Robust Adaptive Control

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35.1 Introduction

The design of autopilots for high-performance aircraft was one of the primary motivations for active research in adaptive control in the early 1950s. Aircrafts operate over a wide range of speeds and altitudes, and their dynamics are nonlinear and conceptually time-varying. For a given operating point, specified by the aircraft speed (Mach number) and altitude, the longitudinal nonlinear aircraft dynamics can be approximated by a linear model. As the aircraft goes through different flight conditions, the operating point changes. These changes cannot be handled by constant gain feedback control. Since the output response $y(t)$ carries information about the state as well as the parameters, one may argue that in principle, a sophisticated feedback controller should be able to learn about the plant changes by processing the input/output (I/O) measurements (u, y) and choosing the appropriate controller from a list or design a new one in real-time. The real-time or on-the-fly selection or design of the controller is what distinguishes adaptive from nonadaptive schemes. Figure 35.1 illustrates this general adaptive control structure. The structure covers almost all classes of adaptive control. The idea is to process the I/O and possibly auxiliary measurements and decide what controller to use in real-time. Under this generic structure one can include gain scheduling where the real time controller design block is just a look-up table with a scheduler logic. In identifier-based schemes, this block includes a parameter estimator and the online calculation of the controller whereas in nonidentifier-based schemes, the block may consist of multiple models, stored controllers, and so on and an appropriate logic for selecting the right controller in real-time. Structures such as direct and indirect adaptive control also fall into this general feedback structure.

Robust Adaptive Control

Jing Sun

Robust Adaptive Control:

Robust Adaptive Control Petros A. Ioannou,Jing Sun,2012-12-19 Presented in a tutorial style this text reduces the confusion and difficulty in grasping the design analysis and robustness of a wide class of adaptive controls for continuous time plants The treatment unifies simplifies and explains most of the techniques for designing and analyzing adaptive control systems Excellent text and authoritative reference **Robust and Adaptive Control** Eugene Lavretsky,Kevin A. Wise,2024-02-20 Robust and Adaptive Control second edition shows readers how to produce consistent and accurate controllers that operate in the presence of uncertainties and unforeseen events Driven by aerospace applications the focus of the book is primarily on continuous time dynamical systems The two part text begins with robust and optimal linear control methods and moves on to a self contained presentation of the design and analysis of model reference adaptive control for nonlinear uncertain dynamical systems Features of the second edition include sufficient conditions for closed loop stability under output feedback observer based loop transfer recovery OBLTR with adaptive augmentation OBLTR applications to aerospace systems case studies that demonstrate the benefits of robust and adaptive control for piloted autonomous and experimental aerial platforms realistic examples and simulation data illustrating key featuresof the methods described and problem solutions for instructors and MATLAB code provided electronically The theory and practical applications address real life aerospace problems being based on numerous transitions of control theoretic results into operational systems and airborne vehicles drawn from the authors extensive professional experience with The Boeing Company The systems covered are challenging often open loop unstable with uncertainties in their dynamics and thus require both persistently reliable control and the ability to track commands either from a pilot or a guidance computer Readers should have a basic understanding of root locus Bode diagrams and Nyquist plots as well as linear algebra ordinary differential equations and the use of state space methods in analysis and modeling of dynamical systems The second edition contains a background summary of linear systems and control systems and an introduction to state observers and output feedback control helping to make it self contained Robust and Adaptive Control teaches senior undergraduate and graduate students how to construct stable and predictable control algorithms for realistic industrial applications Practicing engineers and academic researchers will also find the book of great instructional value The solutions manual can be accessed by instructors who have adopted this book for their courses at https sites google com springernature com extramaterial lecturer material To find the electronic supplementary material go to the publisher s website at https link springer com book 10 1007 978 3 031 38314 4 Please go to the Table of contents to the chapter page linked through the title Introduction for ESM related to the chapters in Part I and to the chapter page linked through the title Direct Model Reference Adaptive Control Motivation and Introduction for ESM related to Part II The download link is in the column of links to the right of the page under the book cover thumbnail **Robust Adaptive Control** Iasson Karafyllis,Miroslav Krstic,2025-06-11 This book presents a solution to a problem in

adaptive control design that had been open for 40 years robustification to disturbances without compromising asymptotic performance This original methodology builds on foundational ideas such as the use of a deadzone in the update law and nonlinear damping in the controller and advances the tools for and the theory behind designing robust adaptive controllers thus guaranteeing robustness properties stronger than previously achieved The authors present all stability notions old and new that are useful in adaptive control provide numerous examples and contrast their analysis to landmark approaches to robustification of adaptive controllers in prior literature This book develops the Deadzone Adapted Disturbance Suppression DADS control a novel adaptive control method and constructs a novel robust identifier that can work in parallel with every direct adaptive controller not only DADS it presents a wing rock instability application of DADS and provides ideas for the extension of DADS to cases not studied in the book Robust Adaptive Control Deadzone Adapted Disturbance Suppression will be of interest to mathematicians working on feedback control and stability theory and to control engineers Physicists tackling control problems and biologists with an interest in controlling population dynamics will also find it of interest **Robust Adaptive Control** Jing Sun,1989 *Robust Adaptive Control* ,1996 **Adaptive Robust Control Systems** Anh Tuan Le,2018-03-07 This book focuses on the applications of robust and adaptive control approaches to practical systems The proposed control systems hold two important features 1 The system is robust with the variation in plant parameters and disturbances 2 The system adapts to parametric uncertainties even in the unknown plant structure by self training and self estimating the unknown factors The various kinds of robust adaptive controls represented in this book are composed of sliding mode control model reference adaptive control gain scheduling H infinity model predictive control fuzzy logic neural networks machine learning and so on The control objects are very abundant from cranes aircrafts and wind turbines to automobile medical and sport machines combustion engines and electrical machines *Robust Adaptive Control* ,1991 **Robust Adaptive Control Design Techniques** Gary Allen McGraw,1989 **Robust Adaptive Control** G.C. Goodwin,2014-05-23 The workshop brought together international experts in the field of robust adaptive control to present recent developments in the area These indicated that the theory of adaptive control is moving closer to applications and is beginning to give realistic guidelines useful in practical situations The proceedings also focused on the value of such practical features as filtering normalization deadzones and unification of robust control and adaptation **Robust Adaptive Control** Aniruddha Datta,1991 **Robust Adaptive Control** Petros Ioannou,Jing Sun,2013-09-26 Presented in a tutorial style this comprehensive treatment unifies simplifies and explains most of the techniques for designing and analyzing adaptive control systems Numerous examples clarify procedures and methods 1995 edition *Robust Adaptive Control* Le Quyet Thang,Bořivoj Hanuš,České vysoké učení technické v Praze,1991 *Robust Adaptive Control* Hubert Cantalloube,Ye Fu,1989 Compared with fixed control techniques such as H sp infty optimization the adaptive control is shown to have at least a wider range of use but lower performances *Design of Robust Adaptive Control Systems* Qing Song,1991

Adaptive Control Shankar Sastry,Marc Bodson,2011-01-01 This volume surveys the major results and techniques of analysis in the field of adaptive control Focusing on linear continuous time single input single output systems the authors offer a clear conceptual presentation of adaptive methods enabling a critical evaluation of these techniques and suggesting avenues of further development 1989 edition **Robust Adaptive Control** Ahmad Sanei,2009-10 **Robust Adaptive Control** Morten Bach Lauritsen,1994 *Adaptive Robust Control Systems* Le Anh Tuan,2018 This book focuses on the applications of robust and adaptive control approaches to practical systems The proposed control systems hold two important features 1 The system is robust with the variation in plant parameters and disturbances 2 The system adapts to parametric uncertainties even in the unknown plant structure by self training and self estimating the unknown factors The various kinds of robust adaptive controls represented in this book are composed of sliding mode control model reference adaptive control gain scheduling H infinity model predictive control fuzzy logic neural networks machine learning and so on The control objects are very abundant from cranes aircrafts and wind turbines to automobile medical and sport machines combustion engines and electrical machines **A Class of Adaptive Controllers with Application to Robust Adaptive Control** Mohammed A. Dahleh,Center for Intelligent Control Systems (U.S.),Massachusetts Institute of Technology. Laboratory for Information and Decision Systems,1988 **$ C \infty $ Robust Adaptive Control** Chujen Lin,1996

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