

MODEL-BASED CONTROL OF PARTICULATE PROCESSES

Panagiotis D. Christofides

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Modelbased Control Of Particulate Processes:

Model-Based Control of Particulate Processes Panagiotis D. Christofides, 2013-04-17 Particulate processes are characterized by the co presence of a continuous phase and a dispersed particulate phase and are widely used in industry for the manufacturing of many high value products Examples include the crystallization of proteins for pharmaceutical applications the emulsion polymerization reactors for the production of latex the aerosol synthesis of titania powder used in the production of white pigments and the thermal spray processing of nanostructured coatings It is now well understood that the physico chemical and mechanical properties of materials made with particulates depend heavily on the characteristics of the corresponding particle size distribution This fact together with recent advances in dynamics of infinite dimensional systems and nonlinear control theory has motivated extensive research on model based control of particulate processes using population balances to achieve tight control of particle size distributions This book the first of its kind presents general methods for the synthesis of nonlinear robust and constrained feedback controllers for broad classes of particulate process models and illustrates their applications to industrially important crystallization aerosol and thermal spray processes The controllers use a finite number of measurement sensors and control actuators to achieve stabilization of the closed loop system output tracking attenuation of the effect of model uncertainty and handling of actuator saturation

Model-Based Control of Particulate Processes Panagiotis D. Christofides, 2002-10-31 The interest in control of particulate processes has been triggered by the need to achieve tight distributed control of size distributions that greatly influence particulate product properties and quality Drawing from recent advances in dynamics of infinite dimensional systems and nonlinear control theory control of particulate processes using population balances has evolved into a very active research area within the field of process control This book the first of its kind presents general methods for the synthesis of nonlinear robust and constrained feedback controllers for broad classes of particulate process models and illustrates their applications to industrially important crystallization aerosol and thermal spray processes The controllers use a finite number of measurement sensors and control actuators to achieve stabilization of the closed loop system output tracking attenuation of the effect of model uncertainty and handling of actuator saturation Beginning with an introduction to control of particulate processes the book discusses nonlinear order reduction and nonlinear robust and constrained control of particulate spatially homogeneous processes and nonlinear control of spatially homogeneous particulate processes The synthesis of the controllers is performed by using geometric and Lyapunov based control techniques The book includes comparisons of the methods followed for controller synthesis with other approaches and discussions of practical implementation issues that can help researchers and engineers understand the development and application of the methods in greater depth The methods are applied to continuous and batch crystallization processes a titania aerosol reactor and a thermal spray process to regulate product size distribution The resulting benefits in closed loop performance robustness and actuator saturation

handling compared to other techniques for control of particulate processes are demonstrated through computer simulations. The book assumes a basic knowledge about population balances and nonlinear control. Researchers and graduate students in process control, particle technology, and control systems theory, applied mathematicians, and process control engineers will find this book a useful resource.

The Control Handbook William S. Levine, 2018-10-08. At publication, *The Control Handbook* immediately became the definitive resource that engineers working with modern control systems required. Among its many accolades, that first edition was cited by the AAP as the Best Engineering Handbook of 1996. Now 15 years later, William Levine has once again compiled the most comprehensive and authoritative resource on control engineering. He has fully reorganized the text to reflect the technical advances achieved since the last edition and has expanded its contents to include the multidisciplinary perspective that is making control engineering a critical component in so many fields. Now expanded from one to three volumes, *The Control Handbook* Second Edition organizes cutting edge contributions from more than 200 leading experts. The second volume, *Control System Applications*, includes 35 entirely new applications organized by subject area. Covering the design and use of control systems, this volume includes applications for automobiles including PEM fuel cells, Aerospace, Industrial control of machines and processes, Biomedical uses including robotic surgery and drug discovery and development, Electronics and communication networks. Other applications are included in a section that reflects the multidisciplinary nature of control system work. These include applications for the construction of financial portfolios, earthquake response control for civil structures, quantum estimation and control, and the modeling and control of air conditioning and refrigeration systems. As with the first edition, the new edition not only stands as a record of accomplishment in control engineering but provides researchers with the means to make further advances. Progressively organized, the other two volumes in the set include *Control System Fundamentals* and *Control System Advanced Methods*.

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Control of MEMS to Atoms Jason J. Gorman,Benjamin Shapiro,2011-12-16 Control from MEMS to Atoms illustrates the use of control and control systems as an essential part of functioning integrated systems The book is organized according to the dimensional scale of the problem starting with micro scale systems and ending with atomic scale systems Similar to macro scale machines and processes control systems can play a major role in improving the performance of micro and nano scale systems and in enabling new capabilities that would otherwise not be possible However the majority of problems at these scales present many new challenges that go beyond the current state of the art in control engineering This is a result of the multidisciplinary nature of micro nanotechnology which requires the merging of control engineering with physics biology and chemistry Model-Based Control: Paul M.J. van den Hof,Carsten Scherer,Peter S.C. Heuberger,2009-08-05 Model Based

Control will be a collection of state of the art contributions in the field of modelling identification robust control and optimization of dynamical systems with particular attention to the application domains of motion control systems high accuracy positioning systems and large scale industrial process control systems The book will be directed to academic and industrial people involved in research in systems and control industrial process control and mechatronics Modeling and Control of Batch Processes Prashant Mhaskar,Abhinav Garg,Brandon Corbett,2018-11-28 Modeling and Control of Batch Processes presents state of the art techniques ranging from mechanistic to data driven models These methods are specifically tailored to handle issues pertinent to batch processes such as nonlinear dynamics and lack of online quality measurements In particular the book proposes a novel batch control design with well characterized feasibility properties a modeling approach that unites multi model and partial least squares techniques a generalization of the subspace identification approach for batch processes and applications to several detailed case studies ranging from a complex simulation test bed to industrial data The book s proposed methodology employs statistical tools such as partial least squares and subspace identification and couples them with notions from state space based models to provide solutions to the quality control problem for batch processes Practical implementation issues are discussed to help readers understand the application of the methods in greater depth The book includes numerous comments and remarks providing insight and fundamental understanding into the modeling and control of batch processes Modeling and Control of Batch Processes includes many detailed examples of industrial relevance that can be tailored by process control engineers or researchers to a specific application The book is also of interest to graduate students studying control systems as it contains new research topics and references to significant recent work Advances in Industrial Control reports and encourages the transfer of

technology in control engineering The rapid development of control technology has an impact on all areas of the control discipline The series offers an opportunity for researchers to present an extended exposition of new work in all aspects of industrial control **Nonlinear Model-based Control of Particulate Processes** Timothy Yeechung Chiu,2000

Handbook of Continuous Crystallization Nima Yazdanpanah,Zoltan K Nagy,2020-02-04 Continuous crystallization is an area of intense research with particular respect to the pharmaceutical industry and fine chemicals Improvements in continuous crystallization technologies offer chemical industries significant financial gains through reduced expenditure and operational costs and consistent product quality Written by well known leaders in the field The Handbook of Continuous Crystallization presents fundamental and applied knowledge with attention paid to application and scaling up and the burgeoning area of process intensification Beginning with concepts around crystallization techniques and control strategies the reader will learn about experimental methods and computational tools Case studies spanning fine and bulk chemicals the pharmaceutical industry and employing new mathematical tools put theory into context *Fault-Tolerant Process Control* Prashant Mhaskar,Jinfeng Liu,Panagiotis D. Christofides,2012-11-27 Fault Tolerant Process Control focuses on the development of general yet practical methods for the design of advanced fault tolerant control systems these ensure an efficient fault detection and a timely response to enhance fault recovery prevent faults from propagating or developing into total failures and reduce the risk of safety hazards To this end methods are presented for the design of advanced fault tolerant control systems for chemical processes which explicitly deal with actuator controller failures and sensor faults and data losses Specifically the book puts forward A framework for detection isolation and diagnosis of actuator and sensor faults for nonlinear systems Controller reconfiguration and safe parking based fault handling methodologies Integrated data and model based fault detection and isolation and fault tolerant control methods Methods for handling sensor faults and data losses and Methods for monitoring the performance of low level PID loops The methodologies proposed employ nonlinear systems analysis Lyapunov techniques optimization statistical methods and hybrid systems theory and are predicated upon the idea of integrating fault detection local feedback control and supervisory control The applicability and performance of the methods are demonstrated through a number of chemical process examples Fault Tolerant Process Control is a valuable resource for academic researchers industrial practitioners as well as graduate students pursuing research in this area

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