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International Federation of Automatic Control

**ON-LINE FAULT DETECTION
AND SUPERVISION IN THE
CHEMICAL PROCESS
INDUSTRIES 1998**

*A Proceedings volume from the 3rd IFAC Workshop
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PERGAMON

On Line Fault Detection And Supervision In The Chemical Process Industries 1998

Denis Dochain



On Line Fault Detection And Supervision In The Chemical Process Industries 1998:

On-line Fault Detection and Supervision in the Chemical Process Industries, 1999 *On-Line Fault Detection and Supervision in the Chemical Process Industries 1998* P.S. Dhurjati, Sylvie Cauvin, 1998-10-20 The field of On Line Fault Detection and Supervision in the Chemical Process Industries is relatively young Major activity in this area has taken place only in the last fifteen years The goals of the first workshop in Delaware were to discuss various methodologies necessary for solving industrial problems in fault diagnosis supervision and to encourage interactions between academia and industry This workshop also focused on development and evaluation of methodologies for on line fault detection and supervision in the chemical process industries It addressed theory application validation performance and evaluation of methodologies such as parameter estimation observers parity equations signal analysis methods classification rule based systems with probabilistic approaches fuzzy logic and neural networks There are several trends that make the topic of this workshop especially relevant in today s world The first is the tremendous advances made in automation and information technology that can potentially bring in an ever increasing amount of information on to computer screens in the operating room of a plant Avoiding problems of information overload and converting plant data to on line useful knowledge is a key challenge In some respects one can draw parallels here to biological evolution where over billions of years human beings have evolved mental models to interpret the huge amount of information received through their senses In the absence of the time advantage that evolution has had we have to rely on methodologies such as those presented in this workshop to provide assistance to operators and engineers in interpreting plant information A second trend that makes this field relevant in today s world is the increasing emphasis on environment and safety Community activism and accidents such as those in Bhopal India have caused media spotlights to be turned on the smallest of toxic releases or loss of life due to chemical accidents The negative publicity generated by such events as well as the need to maintain the image of an environmentally conscious company make industry more sensitive to the issues of early detection of faults The third trend that makes this field very relevant is that of the globalization of the world economy Increasing globalization of the chemical process industry puts pressure on economic competitiveness and higher productivity This implies reduced down time due to faults quick and flexible response of production to supply and demand changes increasing reliance on automation and reduced personnel

Process Plant Instrumentation Miguel J. Bagajewicz, 2000-11-27 This is the first in depth presentation in book form of current analytical methods for optimal design selection and evaluation of instrumentation for process plants The presentation is clear concise and systematic providing process engineers with a valuable tool for improving quality costs safety loss prevention and production accounting From Chapter 1 Introduction Instrumentation is needed in process plants to obtain data that are essential to perform several activities Among the most important are control the assessment of the quality of products production accounting and the detection of failures related to safety In addition certain parameters than cannot be measured directly such as heat

exchanger fouling or column deficiencies are of interest Finally new techniques such as on line optimization require the construction of reliable computer models for which the estimation of process parameters is essential This book concentrates on the tasks of determining the optimal set of measured variables and selecting the accuracy and reliability of the corresponding instruments The goal is to obtain sufficiency accurate and reliable estimates of variables of interest while filtering bad data due to possible instrument malfunction An additional goal is to observe and diagnose single and multiple process faults From the Preface There is a vast amount of literature devoted to the selection and good maintenance of instruments This literature covers the selection of the right instrument for a particular range and system but only after the desired accuracy and reliability of measurement have been established Little has been written on how to systematically determine the right accuracy and reliability needed when selecting an instrument much less how much redundancy is needed for a particular system The key variables that needed estimation come from control requirements as well as monitoring needs for safety quality control and production accounting These are the starting points of the design methodology This book concentrates on determining the optimal accuracy and reliability of instruments and their location To determine this certain desired properties of the system of instruments are used as constraints while the cost is minimized These properties among others are variable observability system reliability and precision of certain variables This book is not a textbook Rather it is intended to be an organized collection of the most relevant work in this area It has been written with the intention of making it readable by engineers with some background in linear algebra mathematical optimization and graph theory It is organized so that the complexity of the sensor network design is addressed step by step The information in this new book serves the needs of chemical and other process engineers involved in instrumentation and control maintenance plant operations process design process development quality control safety and loss prevention Illustrations and Tables The text is supplemented with more than 100 flow charts diagrams and other schematics that illustrate procedures systems and instrumentation More than 70 tables provide useful reference data The Author Dr Miguel J Bagajewicz brings to this new book his extensive experience in design data management teaching and writing in the area of process engineering He received his M S and Ph D in Chemical Engineering from the California Institute of Technology He is presently Associate Professor School of Chemical Engineering and Materials Science and Director Center for Engineering Optimization at the University of Oklahoma He is the author or co author of more than 100 journal articles conference presentations and reports and the author of articles on data reconciliation and sensor location in the Instrument Engineers Handbook fourth edition He is a member of the American Institute of Chemical Engineers AIChE and on the executive committee of the Central Oklahoma Chapter

Automatic Control of Bioprocesses Denis Dochain, 2013-03-01 Giving an overview of the challenges in the control of bioprocesses this comprehensive book presents key results in various fields including dynamic modeling dynamic properties of bioprocess models software sensors designed for the on line estimation of parameters and state variables control and supervision of

bioprocesses Fault Detection, Supervision and Safety of Technical Processes 2003 (SAFEPROCESS 2003) Marcel Staroswiecki, Eva Wu, 2004-02-27 A three volume work bringing together papers presented at SAFEPROCESS 2003 including four plenary papers on statistical physical model based and logical model based approaches to fault detection and diagnosis as well as 178 regular papers **On-line Fault Detection and Supervision in the Chemical Process Industries, 1995** A. J. Morris, E. B. Martin, 1996 Paperback These proceedings contain the papers from the IFAC Workshop on On Line Fault Detection and Supervision in the Chemical Process Industries held in Newcastle upon Tyne UK 12-13 June 1995 The Workshop provided an ideal forum for academic and industrial researchers to discuss their experience and research results in this field Topics covered included Multivariate Methods Neural Network Approaches Supervision Control Diagnosis Expert Systems Learning Dependable Systems Performance Fault Detection Model Based Systems and Applications **Intelligent Problem Solving. Methodologies and Approaches** Rasiah Logananthara, Günther Palm, Moonis Ali, 2003-07-31 The focus of the papers presented in these proceedings is on employing various methodologies and approaches for solving real life problems Although the mechanisms that the human brain employs to solve problems are not yet completely known we do have good insight into the functional processing performed by the human mind On the basis of the understanding of these natural processes scientists in the field of applied intelligence have developed multiple types of artificial processes and have employed them successfully in solving real life problems The types of approaches used to solve problems are dependant on both the nature of the problem and the expected outcome While knowledge based systems are useful for solving problems in well understood domains with relatively stable environments the approach may fail when the domain knowledge is either not very well understood or changing rapidly The techniques of data discovery through data mining will help to alleviate some problems faced by knowledge based approaches to solving problems in such domains Research and development in the area of artificial intelligence are influenced by opportunity needs and the availability of resources The rapid advancement of Internet technology and the trend of increasing bandwidths provide an opportunity and a need for intelligent information processing thus creating an excellent opportunity for agent based computations and learning Over 40% of the papers appearing in the conference proceedings focus on the area of machine learning and intelligent agents clear evidence of growing interest in this area **Fault Detection and Diagnosis in Industrial Systems** L.H. Chiang, E.L. Russell, R.D. Braatz, 2012-12-06 Early and accurate fault detection and diagnosis for modern chemical plants can minimise downtime increase the safety of plant operations and reduce manufacturing costs The process monitoring techniques that have been most effective in practice are based on models constructed almost entirely from process data The goal of the book is to present the theoretical background and practical techniques for data driven process monitoring Process monitoring techniques presented include Data driven methods principal component analysis Fisher discriminant analysis partial least squares and canonical variate analysis Analytical Methods parameter estimation observer based methods and parity relations

Knowledge based methods causal analysis expert systems and pattern recognition The text demonstrates the application of all of the data driven process monitoring techniques to the Tennessee Eastman plant simulator demonstrating the strengths and weaknesses of each approach in detail This aids the reader in selecting the right method for his process application Plant simulator and homework problems in which students apply the process monitoring techniques to a non trivial simulated process and can compare their performance with that obtained in the case studies in the text are included A number of additional homework problems encourage the reader to implement and obtain a deeper understanding of the techniques The reader will obtain a background in data driven techniques for fault detection and diagnosis including the ability to implement the techniques and to know how to select the right technique for a particular application

On-line Fault Detection and Supervision in the Chemical Process Industries, 2001 G. Stephanopoulos, José Alberto Romagnoli, En Sup Yoon, 2001 This proceedings contains papers from the IFAC Symposium on On line Fault Detection and Supervision in the Chemical Process Industries CHEMFAS 4 held in Jejudo Island Korea 7 8 June 2001 The proceedings includes theoretical contributions as well as a wide range of industrial applications in process fault diagnosis monitoring and advanced supervision The papers are organized around the following themes fault detection and diagnosis statistical and trend analysis methodologies sensor location and data reconciliation and applications The driving forces for on line fault detection and improved supervision of process operation include human safety environmental safeguards and equipment protection as well as economic considerations such as the improvement of product quality increased production and so on These diverse incentives together with the development and evaluation of novel methodologies for on line process supervision and management form the focus of the symposium and of the papers in this Proceedings Altogether over 60 papers are presented covering strategies including model based and data driven approaches as well as knowledge based systems statistical techniques and AI based pattern recognition techniques All the work presented is at the cutting edge of research in this dynamic field

Fault-Diagnosis Systems Rolf Isermann, 2006-01-16 With increasing demands for efficiency and product quality plus progress in the integration of automatic control systems in high cost mechatronic and safety critical processes the field of supervision or monitoring fault detection and fault diagnosis plays an important role The book gives an introduction into advanced methods of fault detection and diagnosis FDD After definitions of important terms it considers the reliability availability safety and systems integrity of technical processes Then fault detection methods for single signals without models such as limit and trend checking and with harmonic and stochastic models such as Fourier analysis correlation and wavelets are treated This is followed by fault detection with process models using the relationships between signals such as parameter estimation parity equations observers and principal component analysis The treated fault diagnosis methods include classification methods from Bayes classification to neural networks with decision trees and inference methods from approximate reasoning with fuzzy logic to hybrid fuzzy neuro systems Several practical examples for fault detection and

diagnosis of DC motor drives a centrifugal pump automotive suspension and tire demonstrate applications *Advances in Control* Paul M. Frank, 2012-12-06 *Advances in Control* contains keynote contributions and tutorial material from the fifth European Control Conference held in Germany in September 1999 The topics covered are of particular relevance to all academics and practitioners in the field of modern control engineering These include Modern Control Theory Fault Tolerant Control Systems Linear Descriptor Systems Generic Robust Control Design Verification of Hybrid Systems New Industrial Perspectives Nonlinear System Identification Multi Modal Telepresence Systems Advanced Strategies for Process Control Nonlinear Predictive Control Logic Controllers of Continuous Plants Two dimensional Linear Systems This important collection of work is introduced by Professor P M Frank who has almost forty years of experience in the field of automatic control State of the art research expert opinions and future developments in control theory and its industrial applications combine to make this an essential volume for all those involved in control engineering **Proceedings of the 5th International Conference on Electrical Engineering and Control Applications-Volume 1** Salim Ziani, Mohammed Chadli, Sofiane Bououden, Ivan Zelinka, 2024-09-30 This book gathers papers presented during the 5th International Conference on Electrical Engineering and Control Applications ICEECA 2022 held on November 15 17 2022 Khenchela Algeria It covers new control system models troubleshooting tips and complex system requirements such as increased speed precision and remote capabilities Additionally the book discusses not only the engineering aspects of signal processing and various practical issues in the broad field of information transmission but also novel technologies for communication networks and modern antenna design The later part of the book covers important related topics such as fault diagnosis and fault tolerant control strategies for nonlinear systems and alternative energy sources This book is intended for researchers engineers and advanced postgraduate students in the fields of control and electrical engineering computer science signal processing as well as mechanical and chemical engineering **On-line Fault Detection and Supervision in the Chemical Process Industries , Bioreaction Engineering** K. Schügerl, K.-H. Bellgardt, 2012-12-06 The book is intended to present various examples for reactor and process modeling and control as well as for metabolic flux analysis and metabolic design at an advanced level In Part A General principles and techniques with regard to reactor and process models process control and metabolic flux analysis are presented In addition the accuracy precision and reliability of the measured data are discussed which are extremely important for process modeling and control A virtual bioreactor system is presented as well which can be used for the training of students and operators of industrial plants and for the development of advanced automation tools In Part B the General principles are applied for particular bioreactor models It covers the application of the computational fluiddynamic CFD technique to stirred tank and bubble column bioreactors Different solution methods are presented the Reynolds averaging of the turbulent Navier Stokes equations and modeling of the Reynolds stresses with an appropriate turbulence k- ϵ model and the Euler two fluid model as well as the Euler Lagrange approaches **Dynamics**

and Control of Wastewater Systems, Second Edition Michael Barnett, 1998-07-20 FROM THE PREFACE Dynamic modeling computer simulation and modern control systems are valuable tools for use in both the design and operation of dynamic systems From the tools point of view this book is designed to show practicing engineers how to develop models capable of describing dynamic behavior and how to solve these models using computer simulation The basic principles of process control are also presented so that the effects of different control systems on dynamic behavior can be established by computer simulation

Fault Detection, Supervision and Safety of Technical Processes 2006 Hong-Yue Zhang, 2007-03-01 The safe and reliable operation of technical systems is of great significance for the protection of human life and health the environment and of the vested economic value The correct functioning of those systems has a profound impact also on production cost and product quality The early detection of faults is critical in avoiding performance degradation and damage to the machinery or human life Accurate diagnosis then helps to make the right decisions on emergency actions and repairs Fault detection and diagnosis FDD has developed into a major area of research at the intersection of systems and control engineering artificial intelligence applied mathematics and statistics and such application fields as chemical electrical mechanical and aerospace engineering IFAC has recognized the significance of FDD by launching a triennial symposium series dedicated to the subject The SAFEPROCESS Symposium is organized every three years since the first symposium held in Baden Baden in 1991 SAFEPROCESS 2006 the 6th IFAC Symposium on Fault Detection Supervision and Safety of Technical Processes was held in Beijing PR China The program included three plenary papers two semi plenary papers two industrial talks by internationally recognized experts and 258 regular papers which have been selected out of a total of 387 regular and invited papers submitted Discusses the developments and future challenges in all aspects of fault diagnosis and fault tolerant control 8 invited and 36 contributed sessions included with a special session on the demonstration of process monitoring and diagnostic software tools

Diagnosis and Fault-Tolerant Control Mogens Blanke, Michel Kinnaert, Jan Lunze, Marcel Staroswiecki, 2006-09-24 Fault tolerant control aims at a graceful degradation of the behaviour of automated systems in case of faults It satisfies the industrial demand for enhanced availability and safety in contrast to traditional reactions to faults that bring about sudden shutdowns and loss of availability The book presents effective model based analysis and design methods for fault diagnosis and fault tolerant control Architectural and structural models are used to analyse the propagation of the fault through the process to test the fault detectability and to find the redundancies in the process that can be used to ensure fault tolerance Design methods for diagnostic systems and fault tolerant controllers are presented for processes that are described by analytical models by discrete event models or that can be dealt with as quantised systems Five case studies on pilot processes show the applicability of the presented methods The theoretical results are illustrated by two running examples used throughout the book The second edition includes new material about reconfigurable control diagnosis of nonlinear systems and remote

diagnosis The application examples are extended by a steering by wire system and the air path of a diesel engine both of which include experimental results The bibliographical notes at the end of all chapters have been up dated The chapters end with exercises to be used in lectures

Issues of Fault Diagnosis for Dynamic Systems Ron J. Patton,Paul M.

Frank,Robert N. Clark,2013-06-29 Since the time our first book Fault Diagnosis in Dynamic Systems The ory and Applications was published in 1989 by Prentice Hall there has been a surge in interest in research and applications into reliable methods for diag nosing faults in complex systems The first book sold more than 1 200 copies and has become the main text in fault diagnosis for dynamic systems This book will follow on this excellent record by focusing on some of the advances in this subject by introducing new concepts in research and new application topics The work cannot provide an exhaustive discussion of all the recent research in fault diagnosis for dynamic systems but nevertheless serves to sample some of the major issues It has been valuable once again to have the co operation of experts throughout the world working in industry gov emment establishments and academic institutions in writing the individual chapters Sometimes dynamical systems have associated numerical models available in state space or in frequency domain format When model infor mation is available the quantitative model based approach to fault diagnosis can be taken using the mathematical model to generate analytically redun dant alternatives to the measured signals When this approach is used it becomes important to try to understand the limitations of the mathematical models i e the extent to which model parameter variations occur and the effect of changing the systems point of operation

Robust Model-Based Fault Diagnosis for Dynamic Systems Jie Chen,R.J.

Patton,2012-12-06 There is an increasing demand for dynamic systems to become more safe and reliable This requirement extends beyond the normally accepted safety critical systems of nuclear reactors and aircraft where safety is paramount important to systems such as autonomous vehicles and fast railways where the system availability is vital It is clear that fault diagnosis including fault detection and isolation FDI has been becoming an important subject in modern control theory and practice For example the number of papers on FDI presented in many control related conferences has been increasing steadily The subject of fault detection and isolation continues to mature to an established field of research in control engineering A large amount of knowledge on model based fault diagnosis has been ac cumulated through the literature since the beginning of the 1970s However publications are scattered over many papers and a few edited books Up to the end of 1997 there is no any book which presents the subject in an unified framework The consequence of this is the lack of common language dif ferent researchers use different terminology This problem has obstructed the progress of model based FDI techniques and has been causing great concern in research community Many survey papers have been published to tackle this problem However a book which presents the materials in a unified format and provides a comprehensive foundation of model based FDI is urgently needed

Bounded Dynamic Stochastic Systems Hong Wang,2012-12-06 Over the past decades although stochastic system control has been studied intensively within the field of control engineering all the modelling and

control strategies developed so far have concentrated on the performance of one or two output properties of the system such as minimum variance control and mean value control The general assumption used in the formulation of modelling and control strategies is that the distribution of the random signals involved is Gaussian In this book a set of new approaches for the control of the output probability density function of stochastic dynamic systems those subjected to any bounded random inputs has been developed In this context the purpose of control system design becomes the selection of a control signal that makes the shape of the system outputs p d f as close as possible to a given distribution The book contains material on the subjects of Control of single input single output and multiple input multiple output stochastic systems Stable adaptive control of stochastic distributions Model reference adaptive control Control of nonlinear dynamic stochastic systems Condition monitoring of bounded stochastic distributions Control algorithm design Singular stochastic systems A new representation of dynamic stochastic systems is produced by using B spline functions to describe the output p d f Advances in Industrial Control aims to report and encourage 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

Whispering the Techniques of Language: An Psychological Quest through **On Line Fault Detection And Supervision In The Chemical Process Industries 1998**

In a digitally-driven earth wherever screens reign great and instant connection drowns out the subtleties of language, the profound techniques and emotional nuances concealed within words usually go unheard. However, set within the pages of **On Line Fault Detection And Supervision In The Chemical Process Industries 1998** a interesting fictional value pulsating with organic thoughts, lies a fantastic journey waiting to be undertaken. Composed by a talented wordsmith, that charming opus invites readers on an introspective journey, softly unraveling the veiled truths and profound affect resonating within ab muscles cloth of every word. Within the emotional depths of this emotional evaluation, we can embark upon a genuine exploration of the book is key themes, dissect its captivating writing fashion, and succumb to the effective resonance it evokes serious within the recesses of readers hearts.

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