

PID Advances in Industrial Control

Terrence L. Blevins

*Emerson Process Management, 12301 Research Blvd., Austin, TX 78759
USA (Tel: 512-418-7475; e-mail: terry.blevins@emerson.com).*

Abstract: Major advances that improve control in the process industry have been made over the last ten years in the basic PID technology of modern distributed control systems. This paper addresses the impact that international standards have on control implementation and the tools utilized in industry for monitoring and commissioning PID control. Examples are used to illustrate how new technologies, such as model switching for process identification, have allowed manufacturers to introduce a new level of ease-of-use in tools developed for on-demand and adaptive tuning. This paper discusses PID modifications that improve the speed of recovery from process saturation conditions that are common in industrial applications. Also, details are provided on PID modifications that enable effective control with non-periodic measurement updates by wireless transmitters. Finally, prospective future directions for industrial PID controllers are sketched.

Keywords: Process Saturation, Wireless Transmitters, Control, PID, Monitoring, IEC61804, Fieldbus, Function Block

1. INTRODUCTION

Within the process industry the PID remains the dominant technique for feedback control. Thus, there is continued interest by the academic community and control system manufacturers in PID modifications that may improve control performance and in tools that make it easier to commission control and monitor its performance. Much of the basic PID research published in the literature focuses on control performance for unconstrained operation of linear and stationary processes. In contrast, work within the process control industry focuses on increasing utilization of single loop and multi-loop control based on PID taking into account process non-linearity and operating constraints.

The IEC61804 standard for function blocks in the process industry and the Fieldbus Foundation function block specification define the structure and parameters that are used in PID control. Adoption of these standards allows process control manufacturers to provide a consistent means of implementing process control in controllers and field devices. Having a consistent representation of the PID and consistency in block parameter names and structures makes it easier for manufacturers to provide tools for PID control. A new generation of performance monitoring tools allows a process or control engineer or an instrumentation technician to easily identify any issues in control loop performance.

Technology for on-demand loop tuning is available in most control systems. The challenge is to structure the user interface in a manner that allows a control loop to be tuned with little or no knowledge of process control. To minimize the user involvement with control, adaptive tuning based on model switching is available in commercial control systems.

Within the process industry, various techniques have traditionally been used to speed the response of the PID recovery from a process saturation condition. New work in this area demonstrates how the PID may be modified to speed recovery from process saturation. Such enhancements benefit process saturation applications such as compressor anti-surge control.

The recent introduction of wireless transmitters and wireless actuators in the process industry has sparked new interest in PID modifications that allow effective control using non-periodic information updates. The underlying assumption in process control has always been that control is executed on a periodic basis and that a new measurement value is available each execution. However, to minimize power consumption a wireless transmitter may transmit a new measurement infrequently and only if the measurement has changed a significant amount. Thus, to effectively utilize a wireless measurement such as that provided by WirelessHART transmitters, it is necessary to modify the PID to work with non-periodic measurement updates. Details on how the PID has been modified in a commercial control system are intended to demonstrate how non-periodic measurement updates can be used in control.

The paper is structured as follows – section 2 outlines the state of process automation, section 3 discusses performance monitoring tools, section 4 and 5 addresses on-demand and adaptive tuning, section 6 presents PID design for process saturation, section 7 demonstrates PID modifications for wireless control and finally section 8 provides conclusions and some thoughts on future PID direction.

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Antonio Vissoli

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Advances in PID Control Valery D. Yurkevich,2011-09-06 Since the foundation and up to the current state of the art in control engineering the problems of PID control steadily attract great attention of numerous researchers and remain inexhaustible source of new ideas for process of control system design and industrial applications PID control effectiveness is usually caused by the nature of dynamical processes conditioned that the majority of the industrial dynamical processes are well described by simple dynamic model of the first or second order The efficacy of PID controllers vastly falls in case of complicated dynamics nonlinearities and varying parameters of the plant This gives a pulse to further researches in the field of PID control Consequently the problems of advanced PID control system design methodologies rules of adaptive PID control self tuning procedures and particularly robustness and transient performance for nonlinear systems still remain as the areas of the lively interests for many scientists and researchers at the present time The recent research results presented in this book provide new ideas for improved performance of PID control applications [Advances in PID Control](#) Kok K.

Tan,Qing-Guo Wang,Chang C. Hang,2012-12-06 Recently a great deal of effort has been dedicated to capitalising on advances in mathematical control theory in conjunction with tried and tested classical control structures particularly with regard to the enhanced robustness and tighter control of modern PID controllers Much of the research in this field and that of the operational autonomy of PID controllers has already been translated into useful new functions for industrial controllers This book covers the important knowledge relating to the background application and design of and advances in PID controllers in a unified and comprehensive treatment including Evolution and components of PID controllers Classical and Modern PID controller design Automatic Tuning Multi loop Control Practical issues concerned with PID control The book is intended to be useful to a wide spectrum of readers interested in PID control ranging from practising technicians and engineers to graduate and undergraduate students [Advances in PID Control](#) Valery D. Yurkevich,2011 Since the foundation and up to the current state of the art in control engineering the problems of PID control steadily attract great attention of numerous researchers and remain inexhaustible source of new ideas for process of control system design and industrial applications PID control effectiveness is usually caused by the nature of dynamical processes conditioned that the majority of the industrial dynamical processes are well described by simple dynamic model of the first or second order The efficacy of PID controllers vastly falls in case of complicated dynamics nonlinearities and varying parameters of the plant This gives a pulse to further researches in the field of PID control Consequently the problems of advanced PID control system design methodologies rules of adaptive PID control self tuning procedures and particularly robustness and transient performance for nonlinear systems still remain as the areas of the lively interests for many scientists and researchers at the present time The recent research results presented in this book provide new ideas for improved performance of PID control applications [PID Control in the Third Millennium](#) Ramon Vilanova, Antonio Visioli,2012-02-05 The early 21st century has

seen a renewed interest in research in the widely adopted proportional integral differential PID form of control PID Control in the Third Millennium provides an overview of the advances made as a result. Featuring new approaches for controller tuning control structures and configurations for more efficient control practical issues in PID implementation and non standard approaches to PID including fractional order event based nonlinear data driven and predictive control the nearly twenty chapters provide a state of the art resum of PID controller theory design and realization. Each chapter has specialist authorship and ideas clearly characterized from both academic and industrial viewpoints. PID Control in the Third Millennium is of interest to academics requiring a reference for the current state of PID related research and a stimulus for further inquiry. Industrial practitioners and manufacturers of control systems with application problems relating to PID will find this to be a practical source of appropriate and advanced solutions.

Advances in Systems, Control and Automation Avinash Konkani, Rabindranath Bera, Samrat Paul, 2017-12-11. This book comprises the select proceedings of the ETAEERE 2016 conference. The book aims to shed light on different systems or machines along with their complex operation behaviors and linear nonlinear relationship in different environments. It covers problems of multivariable control systems and provides the necessary background for performing research in the field of control and automation. Aimed at helping readers understand the classical and modern design of different intelligent automated systems the book presents coverage on the control of linear and nonlinear systems intelligent systems stochastic control knowledge based systems applications fault diagnosis and tolerant control real time control applications etc. The contents of this volume will prove useful to researchers and professionals alike.

Structured Controllers for Uncertain Systems Rosario Toscano, 2013-05-29. Structured Controllers for Uncertain Systems focuses on the development of easy to use design strategies for robust low order or fixed structure controllers particularly the industrially ubiquitous PID controller. These strategies are based on a recently developed stochastic optimization method termed the Heuristic Kalman Algorithm HKA the use of which results in a simplified methodology that enables the solution of the structured control problem without a profusion of user defined parameters. An overview of the main stochastic methods employable in the context of continuous non convex optimization problems is also provided and various optimization criteria for the design of a structured controller are considered H H2 and mixed H2 H each merits a chapter to itself. Time domain performance specifications can be easily incorporated in the design.

Sustainable Energy and Technological Advancements Gayadhar Panda, Hassan Haes Alhelou, Ritula Thakur, 2023-09-15. This book contains selected papers presented at Second International Symposium on Sustainable Energy and Technological Advancements ISSETA 2023 organized by the Department of Electrical Engineering NIT Meghalaya Shillong India during February 24 25 2023. The topics covered in the book are the cutting edge research involved in sustainable energy technologies smart building technology integration and application of multiple energy sources advanced power converter topologies and their modulation techniques and information and communication technologies for smart

micro grids Control of Integral Processes with Dead Time Antonio Visioli,Qingchang Zhong,2010-11-18 Control of Integral Processes with Dead Time provides a unified and coherent review of the various approaches devised for the control of integral processes addressing the problem from different standpoints In particular the book treats the following topics How to tune a PID controller and assess its performance How to design a two degree of freedom control scheme in order to deal with both the set point following and load disturbance rejection tasks How to modify the basic Smith predictor control scheme in order to cope with the presence of an integrator in the process and how to address the presence of large process dead times The methods are presented sequentially highlighting the evolution of their rationale and implementation and thus clearly characterising them from both academic and industrial perspectives *Practical PID Control* Antonio Visioli,2006-11-03 This book focuses on those functionalities that can provide significant improvements in Proportional integral derivative PID performance in combination with parameter tuning In particular the choice of filter to make the controller proper the use of a feedforward action and the selection of an anti windup strategy are addressed The book gives the reader new methods for improving the performance of the most widely applied form of control in industry

Event-Based Control and Signal Processing Marek Miskowicz,2018-09-03 Event based systems are a class of reactive systems deployed in a wide spectrum of engineering disciplines including control communication signal processing and electronic instrumentation Activities in event based systems are triggered in response to events usually representing a significant change of the state of controlled or monitored physical variables Event based systems adopt a model of calls for resources only if it is necessary and therefore they are characterized by efficient utilization of communication bandwidth computation capability and energy budget Currently the economical use of constrained technical resources is a critical issue in various application domains because many systems become increasingly networked wireless and spatially distributed Event Based Control and Signal Processing examines the event based paradigm in control communication and signal processing with a focus on implementation in networked sensor and control systems Featuring 23 chapters contributed by more than 60 leading researchers from around the world this book covers Methods of analysis and design of event based control and signal processing Event driven control and optimization of hybrid systems Decentralized event triggered control Periodic event triggered control Model based event triggered control and event triggered generalized predictive control Event based intermittent control in man and machine Event based PID controllers Event based state estimation Self triggered and team triggered control Event triggered and time triggered real time architectures for embedded systems Event based continuous time signal acquisition and DSP Statistical event based signal processing in distributed detection and estimation Asynchronous spike event coding technique with address event representation Event based processing of non stationary signals Event based digital FIR and IIR filters Event based local bandwidth estimation and signal reconstruction Event Based Control and Signal Processing is the first extensive study on both event based control and event based signal

processing presenting scientific contributions at the cutting edge of modern science and engineering Recent Advancements in System Modelling Applications R Malathi,J Krishnan,2013-03-12 The book is a collection of peer reviewed scientific papers submitted by active researchers in the 36th National System Conference NSC 2012 NSC is an annual event of the Systems Society of India SSI primarily oriented to strengthen the systems movement and its applications for the welfare of humanity A galaxy of academicians professionals scientists statesman and researchers from different parts of the country and abroad are invited to attend the Conference The book presents various research articles in the area of system modelling in all disciplines of engineering sciences as well as socio economic systems The book can be used as a tool for further research **Applied Predictive Control** Sunan Huang,Tong Heng Lee,2013-03-09 The series Advances in Industrial Control aims to report and encourage technology transfer in control engineering The rapid development of control technology has an impact on all areas of the control discipline New theory new controllers actuators sensors new industrial processes computer methods new applications new philosophies new challenges Much of this development work resides in industrial reports feasibility study papers and the reports of advanced collaborative projects The series offers an opportunity for researchers to present an extended exposition of such new work in all aspects of industrial control for wider and rapid dissemination The Advances in Industrial Control series promotes control techniques which are used by industry The series has useful volumes in various aspects of proportional integral derivative PID control because of the widespread use of PID in applications Predictive control is another technique that quickly became essential in some sectors of the petro chemical and process control industries It was the ability of the method to incorporate operational constraints that lead to this take up by industry The wider industrial applications of predictive control has been slower to develop indeed some practitioners might argue that this technology transfer step is still active or had only just begun in some industrial sectors Advances in Instrumentation ,1988 Proceedings of the ISA Conference and Exhibit **Irish Signals and Systems Conference** ,2006 Advances in Instrumentation Instrument Society of America,1983 **Advances in Process Control II.** ,1988 **Advances in PID Control** Hidenori Kimura,Kok-Kiong Tan,2002 Intelligent Systems and Automation Hichem Arioui,Rochdi Merzouki,Hadj Ahmed Abbassi,2008-06-17 All papers have been peer reviewed The Intelligent Systems and Automation conference will be organized for its first edition between June 30th and July 02nd 2008 where it will be held at Annaba in Algeria Africa CISA encourages the diverse research actors and the industrial one to present the last headways in Robotics and Automation fields notably the experimental demonstration of prototypes CISA tries to give to the unsupported researchers a significant access to the new technologies and theories around the topics of Robotics Automation The organizers want to give the necessary scientific documents to disposal of the PhD students and researchers of the Mediterranean region CISA wants to offer to the youth researchers from the south Mediterranean region the opportunities to exchange and to discuss their scientific contributions with the other researchers from all over the world **Proceedings of**

the International Conference on Advances in Surface Treatment : Research & Applications (ASTRA) ,2004

American Book Publishing Record ,2000

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