

Kevin M. Passino

Biomimicry for Optimization, Control, and Automation



Springer

Biomimicry For Optimization Control And Automation

**Ajith Abraham, Crina Grosan, Vitorino
Ramos**



Biomimicry For Optimization Control And Automation:

Biomimicry for Optimization, Control, and Automation Kevin M. Passino, 2004-08-27 There are many highly effective optimization feedback control and automation systems embedded in living organisms and nature Evolution persistently seeks optimal robust designs for biological feedback control systems and decision making processes From this comprehensive text you will gain knowledge of how mimicry of such biological processes can be used to solve optimization control and automation problems encountered in the construction of high technology systems Mathematical stability analysis is treated for a number of cases from attentional systems to social foraging swarm cohesion properties Bio inspired optimization and control methods are compared to conventional techniques with an objective to provide a balanced viewpoint A companion web site continually updated by the author will provide you with further examples and design problems solution hints lecture slides a running lab and ongoing self study problems and resources MATLAB code is provided to solve a number of key problems Focus lies on verifying correct operation of technologies via a process of mathematical modelling and analysis complimented by computer simulations Written from an engineering perspective methods are applied to extensive real world applications from ship steering to cooperative control of a group of autonomous robots Aimed primarily at graduate courses and research much of the material has been successfully used for undergraduate courses This dynamic textbook sends an injection of new ideas into engineering technology and the academic community

Biomimicry and Sustainable Building Performance Olusegun Aanuoluwapo Oguntona, Clinton Ohis Aigbavboa, 2024-02-01 This book on biomimicry assessment tools studies the concepts of sustainability sustainable construction practices and the evaluation categories that constitute a sustainability assessment tool By exploring and drawing lessons from biomimicry principles the book provides a nature inspired assessment tool to aid and guide the sustainable transformation of the built environment The book encapsulates the attributes of the conceptualised biomimicry assessment tool which is aimed at helping practitioners regulatory bodies and governmental and non governmental agencies in greening the built environment Owing to the dire need for country specific and tailor made tools that address developing countries needs this book serves as a practical reference and theoretical springboard for the development of sustainability assessment tools for the built environment Furthermore the book serves as a guide in navigating the path towards achieving the greening agendas of the built environment and other sectors and seeks to align the new biomimicry assessment tool with the UN Sustainable Development Goals SDGs It is important reading for academics professionals and advanced students in the built environment engineering and sustainable development

Springer Handbook of Automation Shimon Y. Nof, 2023-06-16 This handbook incorporates new developments in automation It also presents a widespread and well structured conglomeration of new emerging application areas such as medical systems and health transportation security and maintenance service construction and retail as well as production or logistics The handbook is not only an ideal resource for automation experts but also for

people new to this expanding field *Stigmergic Optimization* Ajith Abraham, Crina Grosan, Vitorino Ramos, 2006-07-18 First studied in social insects like ants indirect self organizing interactions known as stigmergy occur when one individual modifies the environment and another subsequently responds to the new environment The implications of self organizing behavior extend to robotics and beyond This book explores the application of stigmergy for a variety of optimization problems The volume comprises 12 chapters including an introductory chapter conveying the fundamental definitions inspirations and research challenges **Swarm Stability and Optimization** Veysel Gazi, Kevin M. Passino, 2011-02-01 Swarming species such as flocks of birds or schools of fish exhibit fascinating collective behaviors during migration and predator avoidance Similarly engineered multi agent dynamic systems such as groups of autonomous ground underwater or air vehicles vehicle swarms exhibit sophisticated collective behaviors while maneuvering In this book we show how to model and control a wide range of such multi agent dynamic systems and analyze their collective behavior using both stability theoretic and simulation based approaches In particular we investigate problems such as group aggregation social foraging formation control swarm tracking distributed agreement and engineering optimization inspired by swarm behavior *Metamaterial Inspired Electromagnetic Applications* Balamati Choudhury, 2017-05-04 This book focuses on the role of soft computing based electromagnetic computational engines in design and optimization of a wide range of electromagnetic applications In addition to the theoretical background of metamaterials and soft computing techniques the book discusses novel electromagnetic applications such as tensor analysis for invisibility cloaking metamaterial structures for cloaking applications broadband radar absorbers and antennas The book will prove to be a valuable resource for academics and professionals as well as military researchers working in the area of metamaterials **Adaptive Control Strategies for the Production of Thermo-Mechanically Tailored Products** Clobes, Jörg, 2014-01-01 Within the rapidly growing field of hot sheet metal forming and metal bulk forming the demand arises for fully three dimensionally tailored properties at the microstructural level nevertheless reaching a predefined geometry with such tailored properties puts high requirements on the control mechanisms utilized in the process chain for combined heating metal forming and cooling processes Therefore the underlying control architecture needs to be freely configurable with respect to a predefined database being extendible to new geometries microstructural distributions and materials The combined control of locally and temporally differential thermo mechanical effects during the process flow needs to be based on an adaptive algorithm adjusting the process flow in real time according to predefined parameters delivered by the aforementioned material geometry and microstructure property database The interplay between measurement techniques and adaptive control processes for hot metal forming of functionally graded materials is to be investigated in order to achieve the predefined fully three dimensional microstructure in complex geometries and optimize the process cycle time in a freely configurable control architecture being customizable to new requirements and materials resulting in a precision manufacturing process The emphasis within the given thesis will be

on adaptive control strategies embedded within a flexible control architecture for an innovative thermo mechanical production process embracing induction heating to predefined spatial and temporal temperature distributions transfer and combined metal forming as well as heat extraction processes The flexible control architecture assures an invariant quality for the highly dynamic processes and moreover yields extendibility to new materials geometries and microstructural distributions

Bioinspiration and Biomimicry in Chemistry Gerhard Swiegers, 2012-09-17 Can we emulate nature's technology in chemistry Through billions of years of evolution Nature has generated some remarkable systems and substances that have made life on earth what it is today Increasingly scientists are seeking to mimic Nature's systems and processes in the lab in order to harness the power of Nature for the benefit of society Bioinspiration and Biomimicry in Chemistry explores the chemistry of Nature and how we can replicate what Nature does in abiological settings Specifically the book focuses on wholly artificial man made systems that employ or are inspired by principles of Nature but which do not use materials of biological origin Beginning with a general overview of the concept of bioinspiration and biomimicry in chemistry the book tackles such topics as Bioinspired molecular machines Bioinspired catalysis Biomimetic amphiphiles and vesicles Biomimetic principles in macromolecular science Biomimetic cavities and bioinspired receptors Biomimicry in organic synthesis Written by a team of leading international experts the contributed chapters collectively lay the groundwork for a new generation of environmentally friendly and sustainable materials pharmaceuticals and technologies Readers will discover the latest advances in our ability to replicate natural systems and materials as well as the many impediments that remain proving how much we still need to learn about how Nature works Bioinspiration and Biomimicry in Chemistry is recommended for students and researchers in all realms of chemistry Addressing how scientists are working to reverse engineer Nature in all areas of chemical research the book is designed to stimulate new discussion and research in this exciting and promising field

Clever Algorithms Jason Brownlee, 2011 This book provides a handbook of algorithmic recipes from the fields of Metaheuristics Biologically Inspired Computation and Computational Intelligence that have been described in a complete consistent and centralized manner These standardized descriptions were carefully designed to be accessible usable and understandable Most of the algorithms described in this book were originally inspired by biological and natural systems such as the adaptive capabilities of genetic evolution and the acquired immune system and the foraging behaviors of birds bees ants and bacteria An encyclopedic algorithm reference this book is intended for research scientists engineers students and interested amateurs Each algorithm description provides a working code example in the Ruby Programming Language

Mathematical Modelling of Aerospace Dynamic Systems with Practical Applications Jitendra R. Raol, V.P.S. Naidu, 2025-03-18 Mathematical Modelling of Aerospace Dynamic Systems with Practical Applications provides mathematical models for several aerospace dynamic systems aircraft rotorcraft missiles unmanned aerial vehicles UAVs mini air vehicles MAVs autonomous underwater vehicles AUUVs and satellite coordinate systems Presenting the use of

mathematical models for analysis prediction and control of these systems this book discusses numerous applications in aircraft helicopter parameter estimation guidance and navigation of these vehicles underwater object search aerial terrain mapping and satellite orbit determination It explains path planning with obstacle avoidance object occlusion detection and tracking and multisensory target tracking and sensor data fusion This book is intended for senior undergraduate mechanical and aerospace engineering students taking courses in aerospace systems and dynamics flight dynamics and control and dynamical systems and estimation Instructors will be able to utilize a Solutions Manual and Figure Slides for their course

Adaptive Approximation Based Control Jay A. Farrell, Marios M. Polycarpou, 2006-04-20 A highly accessible and unified approach to the design and analysis of intelligent control systems Adaptive Approximation Based Control is a tool every control designer should have in his or her control toolbox Mixing approximation theory parameter estimation and feedback control this book presents a unified approach designed to enable readers to apply adaptive approximation based control to existing systems and more importantly to gain enough intuition and understanding to manipulate and combine it with other control tools for applications that have not been encountered before The authors provide readers with a thought provoking framework for rigorously considering such questions as What properties should the function approximator have Are certain families of approximators superior to others Can the stability and the convergence of the approximator parameters be guaranteed Can control systems be designed to be robust in the face of noise disturbances and unmodeled effects Can this approach handle significant changes in the dynamics due to such disruptions as system failure What types of nonlinear dynamic systems are amenable to this approach What are the limitations of adaptive approximation based control Combining theoretical formulation and design techniques with extensive use of simulation examples this book is a stimulating text for researchers and graduate students and a valuable resource for practicing engineers

Sustainable Design from Vision to Action Jeremy Faludi, 2025-08-22 This book offers a comprehensive guide to the sustainable design of products services or related systems It goes beyond concept explanations to provide you with practical instructions on how to apply the tools and methods to your own designs The world is finally waking up to the necessity of sustainability especially in the design and engineering of all the physical products that surround us every day Sustainable Design from Vision to Action not only provides a thorough understanding of the high level values and goals of sustainable design but also gives readers actionable step by step guides for how to implement them on the ground in daily practice This includes quick reference tables and other resources for practical design with lists of resources for greater depth The activities can be used by designers and engineers in classrooms or in industry This innovative textbook focuses primarily on physical product development but also applies to services systems and digital products It includes a thorough range of quantitative and qualitative methods across the whole product life cycle including material choice energy use systems thinking design for recycling user behavior change business models equity and inclusion and more The book aims to change your design practice

to help build a world that is healthy abundant beautiful and fulfilling for all species for all time This highly illustrated text will provide an excellent introduction to sustainable design in practice for industrial design and mechanical engineering students It will also be useful for professional designers engineers and managers in industry *Advances in Aerospace Guidance, Navigation and Control* Florian Holzapfel,Stephan Theil,2011-03-15 Over the last few decades both the aeronautics and space disciplines have greatly influenced advances in controls sensors data fusion and navigation Many of those achievements that made the word aerospace synonymous with high tech were enabled by innovations in guidance navigation and control Europe has seen a strong trans national consolidation process in aerospace over the last few decades Most of the visible products like commercial aircraft fighters helicopters satellites launchers or missiles are not made by a single country they are the fruits of cooperation No European country by itself hosts a specialized guidance navigation and controls community large enough to cover the whole spectrum of disciplines However on a European scale mutual exchange of ideas concepts and solutions is enriching for all The 1st CEAS Specialist Conference on Guidance Navigation and Control is an attempt to bring this community together This book is a selection of papers presented at the conference All submitted papers have gone through a formal review process in compliance with good journal practices The best papers have been recommended by the reviewers to be published in this book *Sequential Intelligent Dynamic System Modeling and Control* Hai-Jun Rong,Zhao-Xu Yang,2024-07-05 The book offers novel research results of sequential intelligent dynamic system modeling and control in a unified framework from theory proposals to real applications It covers an in depth study of various learning algorithms for the permanent adaptation of intelligent model parameters as well as of structural parts of the model The comprehensive researches on sequential fuzzy and neural controller design schemes for some complex real applications are included This is particularly suited for readers who are interested to learn practical solutions for controlling nonlinear systems that are uncertain and varied at any time In addition the organization of the book from addressing fundamental concepts and presenting novel intelligent models to solving real applications is one of the major features of the book which makes it a valuable resource for both beginners and researchers wanting to further their understanding and study about realtime online intelligent modeling and control of nonlinear dynamic systems The book can benefit researchers engineers and graduate students in the fields of control engineering artificial intelligence computational intelligence intelligent control nonlinear system modeling and control etc **Sustainable Pharmaceutical Product Development and Optimization Processes** Bancha Yingngam,Muhammad Shahzad Aslam,A. K. Haghi,2025-01-30 This book offers unparalleled insight into the convergence of sustainability and pharmaceutical product development with a specific focus on optimization processes By addressing the urgent demand for more environmentally conscious and efficient strategies in the drug development industry particularly in an era where the world faces the mounting challenges posed by climate change the book provides a comprehensive guide for integrating sustainability principles throughout the pharmaceutical product lifecycle directly

contributing to the United Nations Sustainable Development Goals SDGs such as SDG 12 Responsible Consumption and Production and SDG 13 Climate Action The chapters cover key topics including the application of green chemistry eco design principles sustainable sourcing of raw materials waste reduction strategies and the use of renewable energy in pharmaceutical manufacturing processes Throughout the book case studies are integrated offering practical insights and concurrently highlighting the economic and environmental advantages of sustainable practices thereby addressing skepticism regarding the feasibility and profitability of such initiatives The book also discusses regulatory considerations ethical implications and the challenges and opportunities associated with moving toward more sustainable practices in pharmaceutical development Importantly this book seeks to solve the problem of the knowledge gap and lack of practical resources for professionals in the pharmaceutical industry who aspire to implement sustainable and optimized processes This work consolidates a network of professionals and scholars keenly focused on future sustainability challenges developing enhancement methodologies and sharing successful strategies for implementing eco friendly practices in pharmaceutical sectors worldwide ultimately contributing to the global effort to achieve the SDGs by 2030 With a focus on pharmaceutical professionals researchers academicians and students the book serves as a valuable reference for those involved in drug development and process optimization Policymakers and regulatory bodies might also find it insightful as it addresses current landscapes challenges and future directions in sustainable pharmaceutical product development

The Control Handbook (three volume set) 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 brilliantly organizes cutting edge contributions from more than 200 leading experts representing every corner of the globe They cover everything from basic closed loop systems to multi agent adaptive systems and from the control of electric motors to the control of complex networks Progressively organized the three volume set includes Control System Fundamentals Control System Applications Control System Advanced Methods Any practicing engineer student or researcher working in fields as diverse as electronics aeronautics or biomedicine will find this handbook to be a time saving resource filled with invaluable formulas models methods and innovative thinking In fact any physicist biologist mathematician or researcher in any number of fields developing or improving products and systems will find the answers and ideas they need 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

Mobile Intelligent

Autonomous Systems Jitendra R. Raol,Ajith K. Gopal,2016-04-19 Going beyond the traditional field of robotics to include other mobile vehicles this reference and recipe book describes important theoretical concepts techniques and applications that can be used to build truly mobile intelligent autonomous systems MIAS With the infusion of neural networks fuzzy logic and genetic algorithm paradigms for MIAS it blends modeling sensors control estimation optimization signal processing and heuristic methods in MIAS and robotics and includes examples and applications throughout Offering a comprehensive view of important topics it helps readers understand the subject from a system theoretic and practical point of view

Bio-Inspired Computing and Communication Pietro Liò,Eiko Yoneki,Jon Crowcroft,Dinesh Chandra Verma,2008-12-18 The book constitutes the thoroughly refereed post workshop proceedings of the First Workshop on Bio Inspired Design of Networks BIONET 2007 held in Cambridge UK in April 2007 The 35 revised full papers presented were carefully reviewed and selected from many high quality submissions All recent developments in the field of bio inspired design of networks are addressed with particular regard to wireless networks and the self organizing properties of biological networks The papers are organized in topical sections on biological networks network epidemics complex networks bio inspired network mode network protocol in wireless communication data management distributed computing and security

UAV Cooperative Decision and Control Tal Shima,Steven J. Rasmussen,2009-01-01 Unmanned aerial vehicles UAVs are increasingly used in military missions because they have the advantages of not placing human life at risk and of lowering operation costs via decreased vehicle weight These benefits can be fully realized only if UAVs work cooperatively in groups with an efficient exchange of information This book provides an authoritative reference on cooperative decision and control of UAVs and the means available to solve problems involving them

Thermal Power Plants Xingrang Liu,Ramesh Bansal,2016-08-19 Thermal Power Plants Modeling Control and Efficiency Improvement explains how to solve highly complex industry problems regarding identification control and optimization through integrating conventional technologies such as modern control technology computational intelligence based multiobjective identification and optimization distributed computing and cloud computing with computational fluid dynamics CFD technology Introducing innovative methods utilized in industrial applications explored in scientific research and taught at leading academic universities this book Discusses thermal power plant processes and process modeling energy conservation performance audits efficiency improvement modeling and efficiency optimization supported by high performance computing integrated with cloud computing Shows how to simulate fossil fuel power plant real time processes including boiler turbine and generator systems Provides downloadable source codes for use in CORBA C MATLAB Simulink VisSim Comsol ANSYS and ANSYS Fluent modeling software Although the projects in the text focus on industry automation in electrical power engineering the methods can be applied in other industries such as concrete and steel production for real time process identification control and optimization

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