

Olivier Sigaud  
Jan Peters (Eds.)

# **From Motor Learning to Interaction Learning in Robots**



Springer

# From Motor Learning To Interaction Learning In Robots Studies In Computational Intelligence

**Lucian Buşoniu, Levente Tamás**



## **From Motor Learning To Interaction Learning In Robots Studies In Computational Intelligence:**

**From Motor Learning to Interaction Learning in Robots** Olivier Sigaud, Jan Peters, 2010-02-04 From an engineering standpoint the increasing complexity of robotic systems and the increasing demand for more autonomously learning robots has become essential This book is largely based on the successful workshop From motor to interaction learning in robots held at the IEEE RSJ International Conference on Intelligent Robot Systems The major aim of the book is to give students interested the topics described above a chance to get started faster and researchers a helpful compendium Man-Machine Interactions 4 Aleksandra Gruca, Agnieszka Brachman, Stanisław Kozielski, Tadeusz Czachórski, 2015-10-01 This book provides an overview of the current state of research on development and application of methods algorithms tools and systems associated with the studies on man machine interaction Modern machines and computer systems are designed not only to process information but also to work in dynamic environment supporting or even replacing human activities in areas such as business industry medicine or military The interdisciplinary field of research on man machine interactions focuses on broad range of aspects related to the ways in which human make or use computational artifacts systems and infrastructure This monograph is the fourth edition in the series and presents new concepts concerning analysis design and evaluation of man machine systems The selection of high quality original papers covers a wide scope of research topics focused on the main problems and challenges encountered within rapidly evolving new forms of human machine relationships The presented material is structured into following sections human computer interfaces robot control embedded and navigation systems bio data analysis and mining biomedical signal processing image and motion data processing decision support and expert systems pattern recognition fuzzy systems algorithms and optimisation computer networks and mobile technologies and data management systems Analysis and Design of Machine Learning Techniques Patrick Stalph, 2014-02-06 Manipulating or grasping objects seems like a trivial task for humans as these are motor skills of everyday life Nevertheless motor skills are not easy to learn for humans and this is also an active research topic in robotics However most solutions are optimized for industrial applications and thus few are plausible explanations for human learning The fundamental challenge that motivates Patrick Stalph originates from the cognitive science How do humans learn their motor skills The author makes a connection between robotics and cognitive sciences by analyzing motor skill learning using implementations that could be found in the human brain at least to some extent Therefore three suitable machine learning algorithms are selected algorithms that are plausible from a cognitive viewpoint and feasible for the roboticist The power and scalability of those algorithms is evaluated in theoretical simulations and more realistic scenarios with the iCub humanoid robot Convincing results confirm the applicability of the approach while the biological plausibility is discussed in retrospect **Handbook of Reinforcement Learning and Control** Kyriakos G. Vamvoudakis, Yan Wan, Frank L. Lewis, Derya Cansever, 2021-06-23 This handbook presents state of the art research in reinforcement learning focusing on its applications in the control and game theory of

dynamic systems and future directions for related research and technology The contributions gathered in this book deal with challenges faced when using learning and adaptation methods to solve academic and industrial problems such as optimization in dynamic environments with single and multiple agents convergence and performance analysis and online implementation They explore means by which these difficulties can be solved and cover a wide range of related topics including deep learning artificial intelligence applications of game theory mixed modality learning and multi agent reinforcement learning Practicing engineers and scholars in the field of machine learning game theory and autonomous control will find the Handbook of Reinforcement Learning and Control to be thought provoking instructive and informative

**Dance Notations and Robot Motion** Jean-Paul Laumond, Naoko Abe, 2015-11-24 How and why to write a movement Who is the writer Who is the reader They may be choreographers working with dancers They may be roboticists programming robots They may be artists designing cartoons in computer animation In all such fields the purpose is to express an intention about a dance a specific motion or an action to perform in terms of intelligible sequences of elementary movements as a music score that would be devoted to motion representation Unfortunately there is no universal language to write a motion Motion languages live together in a Babel tower populated by biomechanists dance notators neuroscientists computer scientists choreographers roboticists Each community handles its own concepts and speaks its own language The book accounts for this diversity Its origin is a unique workshop held at LAAS CNRS in Toulouse in 2014 Worldwide representatives of various communities met there Their challenge was to reach a mutual understanding allowing a choreographer to access robotics concepts or a computer scientist to understand the subtleties of dance notation The liveliness of this multidisciplinary meeting is reflected by the book thank to the willingness of authors to share their own experiences with others

Handling Uncertainty and Networked Structure in Robot Control Lucian Buşoniu, Levente Tamás, 2016-02-06 This book focuses on two challenges posed in robot control by the increasing adoption of robots in the everyday human environment uncertainty and networked communication Part I of the book describes learning control to address environmental uncertainty Part II discusses state estimation active sensing and complex scenario perception to tackle sensing uncertainty Part III completes the book with control of networked robots and multi robot teams Each chapter features in depth technical coverage and case studies highlighting the applicability of the techniques with real robots or in simulation Platforms include mobile ground aerial and underwater robots as well as humanoid robots and robot arms Source code and experimental data are available at <http://extras.springer.com> The text gathers contributions from academic and industry experts and offers a valuable resource for researchers or graduate students in robot control and perception It also benefits researchers in related areas such as computer vision nonlinear and learning control and multi agent systems

**Autonomous Weapons Systems** Nehal Bhuta, Susanne Beck, Hin-Yan Liu, 2016-09 This examination of the implications and regulation of autonomous weapons systems combines contributions from law robotics and philosophy **New Horizons**

**in Evolutionary Robotics** Stéphane Doncieux, Nicolas Bredeche, Jean-Baptiste Mouret, 2011-02-14 Evolutionary Algorithms EAs now provide mature optimization tools that have successfully been applied to many problems from designing antennas to complete robots and provided many human competitive results In robotics the integration of EAs within the engineer's toolbox made tremendous progress in the last 20 years and proposes new methods to address challenging problems in various setups modular robotics swarm robotics robotics with non conventional mechanics e.g. high redundancy dynamic motion multi modality etc This book takes its roots in the workshop on New Horizons in Evolutionary Design of Robots that brought together researchers from Computer Science and Robotics during the IEEE RSJ International Conference on Intelligent Robots and Systems IROS 2009 in Saint Louis USA This book features extended contributions from the workshop thus providing various examples of current problems and applications with a special emphasis on the link between Computer Science and Robotics It also provides a comprehensive and up to date introduction to Evolutionary Robotics after 20 years of maturation as well as thoughts and considerations from several major actors in the field This book offers a comprehensive introduction to the current trends and challenges in Evolutionary Robotics for the next decade Living machines Tony J. Prescott, Nathan Lepora, Paul F. M. J. Verschure, 2018-04-13 Contemporary research in science and engineering is seeking to harness the versatility and sustainability of living organisms By exploiting natural principles researchers hope to create new kinds of technology that are self repairing adaptable and robust and to invent a new class of machines that are perceptive social emotional perhaps even conscious This is the realm of the living machine Living machines can be divided into two types biomimetic systems that harness the principles discovered in nature and embody them in new artifacts and biohybrid systems in which biological entities are coupled with synthetic ones Living Machines A handbook of research in biomimetic and biohybrid systems surveys this flourishing area of research capturing the current state of play and pointing to the opportunities ahead Promising areas in biomimetics include self organization biologically inspired active materials self assembly and self repair learning memory control architectures and self regulation locomotion in air on land or in water perception cognition control and communication Drawing on these advances the potential of biomimetics is revealed in devices that can harvest energy grow or reproduce and in animal like robots that range from synthetic slime molds to artificial fish to humanoids Biohybrid systems is a relatively new field with exciting and largely unknown potential but one that is likely to shape the future of humanity This book surveys progress towards new kinds of biohybrid such as robots that merge electronic neurons with biological tissue micro scale machines made from living cells prosthetic limbs with a sense of touch and brain machine interfaces that allow robotic devices to be controlled by human thought The handbook concludes by exploring some of the impacts that living machine technologies could have on both society and the individual exploring questions about how we will see and understand ourselves in a world in which the line between the natural and the artificial is increasingly blurred With contributions from leading researchers from science engineering and the humanities this

handbook will be of broad interest to undergraduate and postgraduate students Researchers in the areas of computational modeling and engineering including artificial intelligence machine learning artificial life biorobotics neurorobotics and human machine interfaces will find *Living Machines* an invaluable resource Control of Complex Systems Kyriakos Vamvoudakis, Sarangapani Jagannathan, 2016-07-27 In the era of cyber physical systems the area of control of complex systems has grown to be one of the hardest in terms of algorithmic design techniques and analytical tools The 23 chapters written by international specialists in the field cover a variety of interests within the broader field of learning adaptation optimization and networked control The editors have grouped these into the following 5 sections Introduction and Background on Control Theory Adaptive Control and Neuroscience Adaptive Learning Algorithms Cyber Physical Systems and Cooperative Control Applications The diversity of the research presented gives the reader a unique opportunity to explore a comprehensive overview of a field of great interest to control and system theorists This book is intended for researchers and control engineers in machine learning adaptive control optimization and automatic control systems including Electrical Engineers Computer Science Engineers Mechanical Engineers Aerospace Automotive Engineers and Industrial Engineers It could be used as a text or reference for advanced courses in complex control systems Collection of chapters from several well known professors and researchers that will showcase their recent work Presents different state of the art control approaches and theory for complex systems Gives algorithms that take into consideration the presence of modelling uncertainties the unavailability of the model the possibility of cooperative non cooperative goals and malicious attacks compromising the security of networked teams Real system examples and figures throughout make ideas concrete Includes chapters from several well known professors and researchers that showcases their recent work Presents different state of the art control approaches and theory for complex systems Explores the presence of modelling uncertainties the unavailability of the model the possibility of cooperative non cooperative goals and malicious attacks compromising the security of networked teams Serves as a helpful reference for researchers and control engineers working with machine learning adaptive control and automatic control systems Nonlinear Gaussian Filtering : Theory, Algorithms, and Applications Huber, Marco, 2015-03-11 By restricting to Gaussian distributions the optimal Bayesian filtering problem can be transformed into an algebraically simple form which allows for computationally efficient algorithms Three problem settings are discussed in this thesis 1 filtering with Gaussians only 2 Gaussian mixture filtering for strong nonlinearities 3 Gaussian process filtering for purely data driven scenarios For each setting efficient algorithms are derived and applied to real world problems **Neural Information Processing** Long Cheng, Andrew Chi Sing Leung, Seiichi Ozawa, 2018-12-03 The seven volume set of LNCS 11301 11307 constitutes the proceedings of the 25th International Conference on Neural Information Processing ICONIP 2018 held in Siem Reap Cambodia in December 2018 The 401 full papers presented were carefully reviewed and selected from 575 submissions The papers address the emerging topics of theoretical research empirical studies and applications of

neural information processing techniques across different domains The 7th and final volume LNCS 11307 is organized in topical sections on robotics and control biomedical applications and hardware

**Automated Planning and Acting** Malik Ghallab,Dana Nau,Paolo Traverso,2016-08-09 Autonomous AI systems need complex computational techniques for planning and performing actions Planning and acting require significant deliberation because an intelligent system must coordinate and integrate these activities in order to act effectively in the real world This book presents a comprehensive paradigm of planning and acting using the most recent and advanced automated planning techniques It explains the computational deliberation capabilities that allow an actor whether physical or virtual to reason about its actions choose them organize them purposefully and act deliberately to achieve an objective Useful for students practitioners and researchers this book covers state of the art planning techniques acting techniques and their integration which will allow readers to design

intelligent systems that are able to act effectively in the real world

**Biologically Inspired Control of Humanoid Robot Arms** Adam Spiers,Said Ghani Khan,Guido Herrmann,2016-05-19 This book investigates a biologically inspired method of robot arm control developed with the objective of synthesising human like motion dynamically using nonlinear robust and adaptive control techniques in practical robot systems The control method caters to a rising interest in humanoid robots and the need for appropriate control schemes to match these systems Unlike the classic kinematic schemes used in industrial manipulators the dynamic approaches proposed here promote human like motion with better exploitation of the robot s physical structure This also benefits human robot interaction The control schemes proposed in this book are inspired by a wealth of human motion literature that indicates the drivers of motion to be dynamic model based and optimal Such considerations lend themselves nicely to achievement via nonlinear control techniques without the necessity for extensive and complex biological models The operational space method of robot control forms the basis of many of the techniques investigated in this book The method includes attractive features such as the decoupling of motion into task and posture components Various developments are made in each of these elements Simple cost functions inspired by biomechanical effort and discomfort generate realistic posture motion Sliding mode techniques overcome robustness shortcomings for practical implementation Arm compliance is achieved via a method of model free adaptive control that also deals with actuator saturation via anti windup compensation A neural network centered learning by observation scheme generates new task motions based on motion capture data recorded from human volunteers In other parts of the book motion capture is used to test theories of human movement All developed controllers are applied to the reaching motion of a humanoid robot arm and are demonstrated to be practically realisable This book is designed to be of interest to those wishing to achieve dynamics based human like robot arm motion in academic research advanced study or certain industrial environments The book provides motivations extensive reviews research results and detailed explanations It is not only suited to practising control engineers but also applicable for general roboticists who wish to develop control systems expertise in this area

Parallel

and Distributed Computational Intelligence Francisco Fernández de Vega, Erick Cantú-Paz, 2010-09-18 Offering a global snapshot of parallel and distributed computational intelligence today this volume covers ongoing issues as well as recent exploratory work Topics discussed include GPUs Clusters Grids volunteer computing p2p networks and more

*Reinforcement Learning for Optimal Feedback Control* Rushikesh Kamalapurkar, Patrick Walters, Joel Rosenfeld, Warren Dixon, 2018-05-10 Reinforcement Learning for Optimal Feedback Control develops model based and data driven reinforcement learning methods for solving optimal control problems in nonlinear deterministic dynamical systems In order to achieve learning under uncertainty data driven methods for identifying system models in real time are also developed The book illustrates the advantages gained from the use of a model and the use of previous experience in the form of recorded data through simulations and experiments The book's focus on deterministic systems allows for an in depth Lyapunov based analysis of the performance of the methods described during the learning phase and during execution To yield an approximate optimal controller the authors focus on theories and methods that fall under the umbrella of actor critic methods for machine learning They concentrate on establishing stability during the learning phase and the execution phase and adaptive model based and data driven reinforcement learning to assist readers in the learning process which typically relies on instantaneous input output measurements This monograph provides academic researchers with backgrounds in diverse disciplines from aerospace engineering to computer science who are interested in optimal reinforcement learning functional analysis and functional approximation theory with a good introduction to the use of model based methods The thorough treatment of an advanced treatment to control will also interest practitioners working in the chemical process and power supply industry

*Computational Intelligence for Technology Enhanced Learning* Fatos Xhafa, Santi Caballé, Ajith Abraham, Thanasis Daradoumis, Angel A. Juan, 2010-03-10 E Learning has become one of the most wide spread ways of distance teaching and learning Technologies such as Web Grid and Mobile and Wireless networks are pushing teaching and learning communities to find new and intelligent ways of using these technologies to enhance teaching and learning activities Indeed these new technologies can play an important role in increasing the support to teachers and learners to shorten the time to learning and teaching yet it is necessary to use intelligent techniques to take advantage of these new technologies to achieve the desired support to teachers and learners and enhance learners performance in distributed learning environments The chapters of this volume bring advances in using intelligent techniques for technology enhanced learning as well as development of e Learning applications based on such techniques and supported by technology Such intelligent techniques include clustering and classification for personalization of learning intelligent context aware techniques adaptive learning data mining techniques and ontologies in e Learning systems among others Academics scientists software developers teachers and tutors and students interested in e Learning will find this book useful for their academic research and practice activity

The Computational Evolution of Cognitive Architectures Iuliia Kotseruba, John K. Tsotsos, 2025-06-23 What is the



human mind and how does it work These questions have occupied humanity since antiquity but have only recently received rigorous scientific investigation Cognitive architectures are complex software programs whose goal is to approach human like behavior on a wide variety of tasks This is accomplished by employing human like or at least human plausible mechanisms within an integrated framework that is claimed representative of human cognitive perceptual and movement capabilities By examining how close their behavior is to human they help us understand how the human mind and brain work They contribute to our understanding as computational models that can be tested and whose details in turn provide insights on new aspects of the human brain and mind This field of cognitive architectures emerged at the intersection of artificial intelligence and cognitive science and in less than fifty years has spawned hundreds of projects In *The Computational Evolution of Cognitive Architectures* the authors trace the evolution of cognitive architectures their abilities and future prospects from their early logic based beginnings to their recent melding of classic methodologies with deep learning concepts Analyzing over 3000 publications on more than eighty cognitive architectures and hundreds more surveys research papers and opinion pieces spanning philosophy cognitive science computer science and robotics the authors aggregate their findings into broad themes such as common components of the architectures their organization interaction and relation to human cognitive abilities They discuss both theoretical elements of cognitive architectures and their performance before finally considering the future of cognitive architectures and their challenges

**Artificial Intelligence: Methodology, Systems, and Applications** Petia Koprinkova-Hristova, Nikola Kasabov, 2025-01-31 This book constitutes the refereed proceedings of the 19th International Conference on Artificial Intelligence Methodology Systems and Applications AIMSAS 2024 held in Varna Bulgaria during September 18-20, 2024 The 18 revised full papers presented in this book were carefully reviewed and selected from 23 submissions They cover a wide range of topics in AI and its applications natural language processing sentiment analyses image processing optimization reinforcement learning from deep ANNs to spike timing NNs applications in economics medicine and process control

Advances in Multi-Objective Nature Inspired Computing Carlos Coello Coello, Clarisse Dhaenens, Laetitia Jourdan, 2010-02-04 The purpose of this book is to collect contributions that deal with the use of nature inspired metaheuristics for solving multi objective combinatorial optimization problems Such a collection intends to provide an overview of the state of the art developments in this field with the aim of motivating more researchers in operations research engineering and computer science to do research in this area As such this book is expected to become a valuable reference for those wishing to do research on the use of nature inspired metaheuristics for solving multi objective combinatorial optimization problems

## **From Motor Learning To Interaction Learning In Robots Studies In Computational Intelligence** Book Review: Unveiling the Power of Words

In some sort of driven by information and connectivity, the ability of words has be more evident than ever. They have the capacity to inspire, provoke, and ignite change. Such is the essence of the book **From Motor Learning To Interaction Learning In Robots Studies In Computational Intelligence**, a literary masterpiece that delves deep into the significance of words and their impact on our lives. Written by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we shall explore the book is key themes, examine its writing style, and analyze its overall affect readers.

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