
CHAPTER 1 – FUNDAMENTALS OF ROBOTICS

COMP ENG ELEC 2 – ROBOTICS/MACHINE LEARNING 2

Introduction

In this chapter, robots and robotics is differentiated. The main components of robots are as well discussed along with the laws and principles governing robots and robotics presented in different papers and symposiums. The main purpose of Analog Circuits and its application is further explained. The introduction to creating project proposals were detailed enabling students to develop solid foundation in creating the subject requirement.

Objectives

At the end of the topic, the student should be able to:

- *Discuss the basic principles of robots, robotics and engineering design process*
- *Explain the fundamentals of robotics*
- *Understand analog circuits*
- *Differentiate Analog to Digital circuits*
- *Identify the key principles in creating project proposals*
- *Develop an initial project proposal*

Learning Content

I. What is Robot?

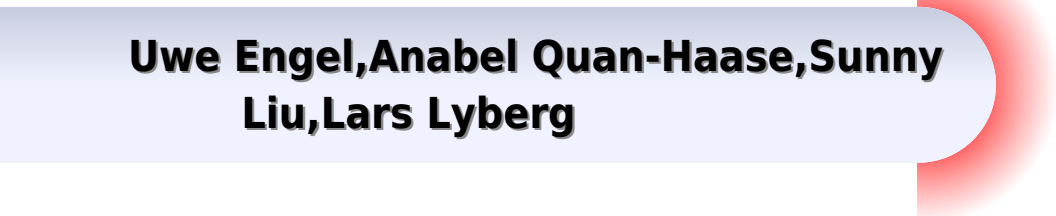
- The word robot was coined by a Czech novelist **Karel Capek** in a 1920 play titled *Rassum's Universal Robots* (RUR)
- In Czech, Robot means worker or servant.
- According to Robot Institute of America, robot is
 - *"Any machine made by one of our members"*
 - *"A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks."* (1979)
- The traditional definition of a robot is a machine that can sense, think, and act. That means it can:
 - Tell what's happening in its physical environment
 - Analyze that information and make a decision based on its programming
 - Move around, flash lights, sound alarms, or otherwise do something that affects the physical world.
- **A robot is a device meant to help humans accomplish tasks.**

II. What are the main components of a robot?

- Robots come in all shapes and sizes all of which require different parts for construction. These are the three general categories of robotics:

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**Uwe Engel, Anabel Quan-Haase, Sunny
Liu, Lars Lyberg**



Scientific Fundamentals Of Robotics Vol 2 Only:

Algorithmic Foundation of Robotics VII Srinivas Akella, Nancy M. Amato, Wesley Huang, Bud Mishra, 2008-07-10 Algorithms are a fundamental component of robotic systems they control or reason about motion and perception in the physical world They receive input from noisy sensors consider geometric and physical constraints and operate on the world through imprecise actuators The design and analysis of robot algorithms therefore raises a unique combination of questions in control theory computational and differential geometry and computer science This book contains the proceedings from the 2006 Workshop on the Algorithmic Foundations of Robotics This biannual workshop is a highly selective meeting of leading researchers in the field of algorithmic issues related to robotics The 32 papers in this book span a wide variety of topics from fundamental motion planning algorithms to applications in medicine and biology but they have in common a foundation in the algorithmic problems of robotic systems

Introduction to Robotics Miomir Vukobratovic, 2012-12-06 This book provides a general introduction to robot technology with an emphasis on robot mechanisms and kinematics It is conceived as a reference book for students in the field of robotics

Robotic Systems S.G. Tzafestas, 2012-12-06 Robotics is a modern interdisciplinary field that has emerged from the marriage of computerized numerical control and remote manipulation Today s robotic systems have intelligence features and are able to perform dexterous and intelligent human like actions through appropriate combination of learning perception planning decision making and control This book presents advanced concepts techniques and applications reflecting the experience of a wide group of specialists in the field Topics include kinematics dynamics path planning and tracking control mobile robotics navigation robot programming and sophisticated applications in the manufacturing medical and other areas

Algorithmic Foundations of Robotics X Emilio Frazzoli, Tomas Lozano-Perez, Nicholas Roy, Daniela Rus, 2013-02-14 Algorithms are a fundamental component of robotic systems Robot algorithms process inputs from sensors that provide noisy and partial data build geometric and physical models of the world plan high and low level actions at different time horizons and execute these actions on actuators with limited precision The design and analysis of robot algorithms raise a unique combination of questions from many elds including control theory computational geometry and topology geometrical and physical modeling reasoning under uncertainty probabilistic algorithms game theory and theoretical computer science The Workshop on Algorithmic Foundations of Robotics WAFR is a single track meeting of leading researchers in the eld of robot algorithms Since its inception in 1994 WAFR has been held every other year and has provided one of the premiere venues for the publication of some of the eld s most important and lasting contributions This books contains the proceedings of the tenth WAFR held on June 13 15 2012 at the Massachusetts Institute of Technology The 37 papers included in this book cover a broad range of topics from fundamental theoretical issues in robot motion planning control and perception to novel applications

Algorithmic Foundations of Robotics XII Ken Goldberg, Pieter Abbeel, Kostas Bekris, Lauren Miller, 2020-05-06 This book presents the outcomes of the 12th International

Workshop on the Algorithmic Foundations of Robotics WAFR 2016 WAFR is a prestigious single track biennial international meeting devoted to recent advances in algorithmic problems in robotics Robot algorithms are an important building block of robotic systems and are used to process inputs from users and sensors perceive and build models of the environment plan low level motions and high level tasks control robotic actuators and coordinate actions across multiple systems However developing and analyzing these algorithms raises complex challenges both theoretical and practical Advances in the algorithmic foundations of robotics have applications to manufacturing medicine distributed robotics human robot interaction intelligent prosthetics computer animation computational biology and many other areas The 2016 edition of WAFR went back to its roots and was held in San Francisco California the city where the very first WAFR was held in 1994 Organized by Pieter Abbeel Kostas Bekris Ken Goldberg and Lauren Miller WAFR 2016 featured keynote talks by John Canny on A Guided Tour of Computer Vision Robotics Algebra and HCI Erik Demaine on Replicators Transformers and Robot Swarms Science Fiction through Geometric Algorithms Dan Halperin on From Piano Movers to Piano Printers Computing and Using Minkowski Sums and by Lydia Kavraki on 20 Years of Sampling Robot Motion Furthermore it included an Open Problems Session organized by Ron Alterovitz Florian Pokorny and Jur van den Berg There were 58 paper presentations during the three day event The organizers would like to thank the authors for their work and contributions the reviewers for ensuring the high quality of the meeting the WAFR Steering Committee led by Nancy Amato as well as WAFR's fiscal sponsor the International Federation of Robotics Research IFRR led by Oussama Khatib and Henrik Christensen WAFR 2016 was an enjoyable and memorable event

Algorithmic Foundations of Robotics VIII Gregory S. Chirikjian, Howie Choset, Marco Morales, Todd Murphey, 2010-02-04 This book contains selected contributions to WAFR the highly competitive meeting on the algorithmic foundations of robotics They address the unique combination of questions that the design and analysis of robot algorithms inspires [Handbook of Computational Social Science, Volume 2](#) Uwe Engel, Anabel Quan-Haase, Sunny Liu, Lars Lyberg, 2021-11-10 The Handbook of Computational Social Science is a comprehensive reference source for scholars across multiple disciplines It outlines key debates in the field showcasing novel statistical modeling and machine learning methods and draws from specific case studies to demonstrate the opportunities and challenges in CSS approaches The Handbook is divided into two volumes written by outstanding internationally renowned scholars in the field This second volume focuses on foundations and advances in data science statistical modeling and machine learning It covers a range of key issues including the management of big data in terms of record linkage streaming and missing data Machine learning agent based and statistical modeling as well as data quality in relation to digital trace and textual data as well as probability non probability and crowdsourced samples represent further foci The volume not only makes major contributions to the consolidation of this growing research field but also encourages growth into new directions With its broad coverage of perspectives theoretical methodological computational international scope and interdisciplinary approach this important resource is integral reading for advanced

undergraduates postgraduates and researchers engaging with computational methods across the social sciences as well as those within the scientific and engineering sectors **Scientific and Technical Aerospace Reports** ,1989

Algorithmic Foundations of Robotics XI H. Levent Akin,Nancy M. Amato,Volkan Isler,A. Frank van der Stappen,2015-04-30 This carefully edited volume is the outcome of the eleventh edition of the Workshop on Algorithmic Foundations of Robotics WAFR which is the premier venue showcasing cutting edge research in algorithmic robotics The eleventh WAFR which was held August 3 5 2014 at Bo azi i University in Istanbul Turkey continued this tradition This volume contains extended versions of the 42 papers presented at WAFR These contributions highlight the cutting edge research in classical robotics problems e g manipulation motion path multi robot and kinodynamic planning geometric and topological computation in robotics as well novel applications such as informative path planning active sensing and surgical planning This book rich by topics and authoritative contributors is a unique reference on the current developments and new directions in the field of algorithmic foundations *Climbing and Walking Robots* Karsten Berns,Rudiger Dillmann,2001-11-28 Recent advances in robot technology from around the world Climbing and Walking Robots From Biology to Industrial Applications is a collection of papers presented at the 2001 CLAWAR conference Featuring current work from leading robotics labs around the globe this book presents the latest in robotics across industries and suggests directions for future research Topics include design methodology bipedal locomotion fluid actuators sensor systems control architecture and simulation and more Relevant to mechanical engineers and robotics specialists in both industry and academia these papers showcase the field s latest technological advances Computing Techniques for Robots Igor Aleksander,2012-12-06 I ALEKSANDER Kobler Unit for Information Technology Management Imperial College of Science and Technology London England It is now over half a decade since Joseph Engelberger wrote Given a six articulation arm of any configuration software can be powerful enough to think only in tool coordinates That is a programmer concerns himself only with the tool on the end of the robot arm He can think of the tool s frame of reference and com puter subroutines automatically make the various articulations move so as to accomplish the desired tool manipulation As is often the case with statements of this kind they are appealing and generally well founded in technological feasibility But in order to turn the prediction into reality it requires the dedication and inventiveness of an international community of researchers The object of this book is to provide a window on to some of the advances made by this community which go towards the fulfilment of Engelberger s predictions A significant factor in the framework within which this work is being pursued is the phenomenal advance in the availability of inexpensive and highly compact computing power It becomes increasingly possible to imagine powerful microprocessors providing local intelligence at key points in a robot arm Joints gripper etc by being connected through a communications network and controlled by some specially designated supervisory microchip **Applied Mechanics Reviews** ,1986 **Advanced Robotics** ,1995

Robotics Research Paolo Dario,Raja Chatila,2005-02-17 ISRR the International Symposium on Robotics Research is one

of robotics pioneering symposia which has established some of the field's most fundamental and lasting contributions over the past two decades. This book presents the results of the eleventh edition of Robotics Research ISRR03 offering a broad range of topics in robotics. The contributions provide a wide coverage of the current state of robotics research, the advances and challenges in its theoretical foundation and technology basis, and the developments in its traditional and new emerging areas of applications. The diversity, novelty, and span of the work unfolding in these areas reveal the field's increased maturity and expanded scope and define the state of the art of robotics and its future direction.

ROMANSY 21 - Robot Design, Dynamics and Control Vincenzo Parenti-Castelli, Werner Schiehlen, 2016-06-29. This proceedings volume contains papers that have been selected after review for oral presentation at ROMANSY 2016, the 21th CISM IFToMM Symposium on Theory and Practice of Robots and Manipulators. These papers cover advances on several aspects of the wide field of Robotics as concerning Theory and Practice of Robots and Manipulators. ROMANSY 2016 is the 21st event in a series that started in 1973 as one of the first conference activities in the world on Robotics. The first event was held at CISM International Centre for Mechanical Science in Udine, Italy, on 5-8 September 1973. It was also the first topic conference of IFToMM International Federation for the Promotion of Mechanism and Machine Science, and it was directed not only to the IFToMM community.

Advances in Mechanism and Machine Science Tadeusz Uhl, 2019-06-13. This book gathers the proceedings of the 15th IFToMM World Congress, which was held in Krakow, Poland, from June 30 to July 4, 2019. Having been organized every four years since 1965, the Congress represents the world's largest scientific event on mechanism and machine science. MMS. The contributions cover an extremely diverse range of topics, including biomechanical engineering, computational kinematics, design methodologies, dynamics of machinery, multibody dynamics, gearing and transmissions, history of MMS, linkage and mechanical controls, robotics and mechatronics, micro mechanisms, reliability of machines and mechanisms, rotor dynamics, standardization of terminology, sustainable energy systems, transportation machinery, tribology, and vibration. Selected by means of a rigorous international peer review process, they highlight numerous exciting advances and ideas that will spur novel research directions and foster new multidisciplinary collaborations.

Smart Agritech Santosh Kumar Srivastava, Durgesh Srivastava, Korhan Cengiz, Pramod Gaur, 2024-10-08. Agriculture has always been a vital sector of the global economy, providing food and raw materials for industries and households. However, with the growing population, changing climate conditions, and limited resources, the agriculture sector is facing numerous challenges. To address these challenges, farmers and agricultural companies are turning to advanced technologies such as Robotics, Artificial Intelligence (AI), and the Internet of Things (IoT). This exciting new volume provides a comprehensive overview of the latest technological advances in agriculture, focusing on the use of these three cutting-edge technologies. The book will explore the potential benefits of these technologies in improving agricultural efficiency, productivity, and sustainability. Whether for the veteran engineer/scientist in the lab, student, or faculty, this groundbreaking new volume is a valuable resource for researchers and

other industry professionals interested in the intersection of technology and agriculture **Encyclopedia of Information Science and Technology, Fourth Edition** Khosrow-Pour, D.B.A., Mehdi, 2017-06-20 In recent years our world has experienced a profound shift and progression in available computing and knowledge sharing innovations These emerging advancements have developed at a rapid pace disseminating into and affecting numerous aspects of contemporary society This has created a pivotal need for an innovative compendium encompassing the latest trends concepts and issues surrounding this relevant discipline area During the past 15 years the Encyclopedia of Information Science and Technology has become recognized as one of the landmark sources of the latest knowledge and discoveries in this discipline The Encyclopedia of Information Science and Technology Fourth Edition is a 10 volume set which includes 705 original and previously unpublished research articles covering a full range of perspectives applications and techniques contributed by thousands of experts and researchers from around the globe This authoritative encyclopedia is an all encompassing well established reference source that is ideally designed to disseminate the most forward thinking and diverse research findings With critical perspectives on the impact of information science management and new technologies in modern settings including but not limited to computer science education healthcare government engineering business and natural and physical sciences it is a pivotal and relevant source of knowledge that will benefit every professional within the field of information science and technology and is an invaluable addition to every academic and corporate library **Foundations of Computer Science** Wilfried Brauer, 1997-10-24 Content Description Dedicated to Wilfried Brauer Includes bibliographical references and index **Essentials of Machine Olfaction and Taste** Takamichi Nakamoto, 2016-05-03 Essentials of Machine Olfaction and Taste This book provides a valuable information source for olfaction and taste which includes a comprehensive and timely overview of the current state of knowledge of use for olfaction and taste machines Presents original latest research in the field with an emphasis on the recent development of human interfacing Covers the full range of artificial chemical senses including olfaction and taste from basic through to advanced level Timely project in that mobile robots olfactory displays and odour recorders are currently under research driven by commercial demand

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