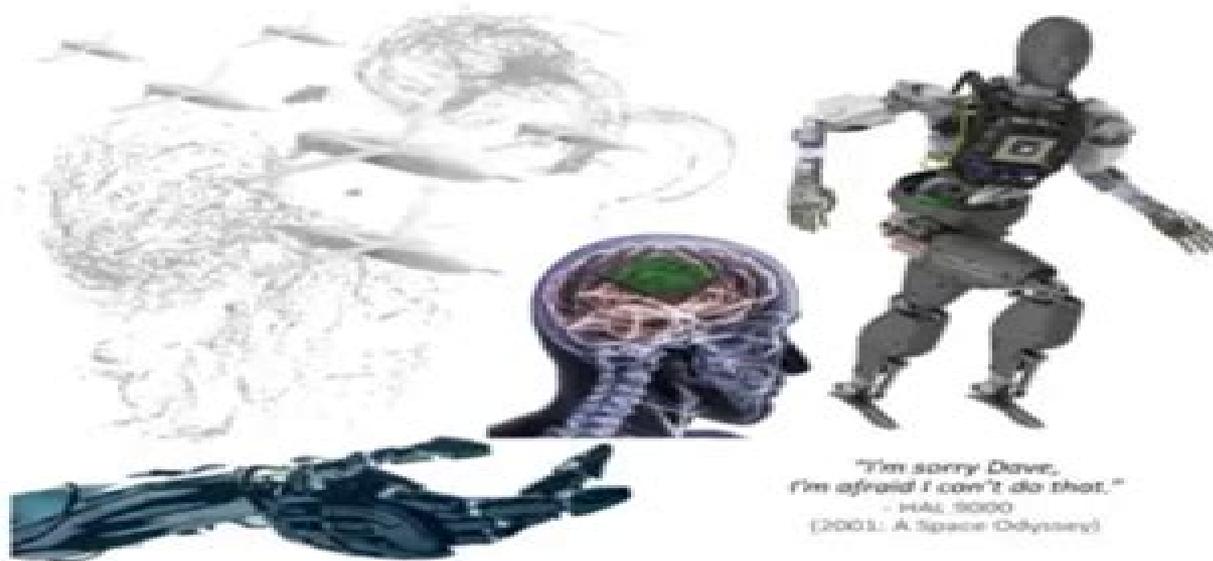


AI, Robots, and Swarms

Issues, Questions, and Recommended Studies

Andrew Bachinski

January 2017



*"I'm sorry Dave,
I'm afraid I can't do that."*
- HAL 9000
(2001: A Space Odyssey)

Ai Robots And Swarms Issues Questions And Cna

**Lionel Beehner, Risa Brooks, Daniel
Maurer (Major)**

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Research Handbook on Warfare and Artificial Intelligence Robin Geiß, Henning Lahmann, 2024-07-05 The Research Handbook on Warfare and Artificial Intelligence provides a multi disciplinary exploration of the urgent issues emerging from the increasing use of AI supported technologies in military operations Bringing together scholarship from leading experts in the fields of technology and security from across the globe it sheds light on the wide spectrum of existing and prospective cases of AI in armed conflict *AI and the Bomb* James Johnson, 2023 This book provides a coherent innovative and multidisciplinary examination of the potential effects of AI technology on nuclear strategy and escalation risk Its findings have significant theoretical and policy ramifications as well as contributing to the literature on the impact of military force and technological change *Proliferation of Weapons- and Dual-Use Technologies* Margaret E. Kosal, 2021-07-26 This book explores and analyzes the rapid pace of technological evolution in diplomatic information military and economic sectors which has contributed to a dynamic international policy environment Global political stability is greatly influenced by innovations originating from numerous sources including university labs the technology sector and military research Collectively these innovations guide the movement of people ideas and technology that in turn affect the international balance of power The objective of this volume is to develop new insights into how the proliferation of innovative ideas low cost weapons and dual use technologies impact the changing global security landscape Innovative and dual use technologies can be used for beneficial purposes or defensive purposes Alternatively they may be appropriated or employed for nefarious purposes by hostile military powers and non state actors alike Such actions can threaten global security and stability As the complexity of technological innovations continues to increase existing control mechanisms such as international regulations and security arrangements may be insufficient to stem the tide of proliferation over time As such this work seeks to assess and present policy solutions to curtail the threat to global stability posed by the proliferation of weapons and dual use technology **Artificial Intelligence and Global Security** Yvonne R. Masakowski, 2020-07-15 Artificial Intelligence and Global Security Future Trends Threats and Considerations brings a much needed perspective on the impact of the integration of Artificial Intelligence AI technologies in military affairs Experts forecast that AI will shape future military operations in ways that will revolutionize warfare **De Gruyter Handbook of Drone Warfare** James Patton Rogers, 2024-09-02 In 2010 60 states had a military drone program Today at least 113 countries and 65 non state actors now have access to weaponized drone technologies Alongside this established drone powers the U S China Turkey and Iran have expanded their own use of military drones increasing the sale and deployment of drones around the world In the De Gruyter Handbook of Drone Warfare drone expert policy adviser and historian Dr James Patton Rogers brings together 37 of the world s leading voices on the growing issues of commercial and military drone technologies From the origins of military drones in the early 1900s and the resurgence of drone use during the War on Terror through to the global proliferation of drones across Europe Africa and

the Middle East this handbook explores the moral ethical technological legal military geopolitical social and strategic issues at the heart of drone warfare The first handbook of its kind the volume also addresses Russia s offensive war against Ukraine the rise of Iranian and Houthi drones and provides a focused analysis of the future of drone warfare and the opportunities and perils of AI autonomy and swarming technologies in the coming Third Drone Age *Reconsidering American Civil-military Relations* Lionel Beehner,Risa Brooks,Daniel Maurer (Major),2021 This book explores contemporary civil military relations in the United States Much of the canonical literature on civil military relations was either written during or references the Cold War while other major research focuses on the post Cold War era or the first decade of the twenty first century A great deal has changed since then This book considers the implications for civil military relations of many of these changes Specifically it focuses on factors such as breakdowns in democratic and civil military norms and conventions intensifying partisanship and deepening political divisions in American society as well as new technology and the evolving character of armed conflict Chapters are organized around the principal actors in civil military relations and the book includes sections on the military civilian leadership and the public It explores the roles and obligations of each The book also examines how changes in contemporary armed conflict influence civil military relations Chapters in this section examine the cyber domain grey zone operations asymmetric warfare and emerging technology The book thus brings the study of civil military relations into the contemporary era in which new geopolitical realities and the changing character of armed conflict combine with domestic political tensions to test if not potentially redefine those relations **The Inheritance** Mara E. Karlin,2021-12-14 Exploring how the U S military can move beyond Iraq and Afghanistan Since the September 11 2001 attacks the U S military has been fighting incessantly in conflicts around the globe often with inconclusive results The legacies of these conflicts have serious implications for how the United States will wage war in the future Yet there is a stunning lack of introspection about these conflicts Never in modern U S history has the military been at war for so long And never in U S history have such long wars demanded so much of so few The legacy of wars without end include a military that feels the painful effects of war but often feels alone The public is less connected to the military now than at any point in modern U S history The national security apparatus seeks to pivot away from these engagements and to move on to the next threats notably those emanating from China and Russia Many young Americans question whether it even makes sense to invest in the military At best there are ad hoc unstructured debates about Iraq or Afghanistan Simply put there has been no serious organized stock taking by the public politicians opinion leaders or the military itself of this inheritance Despite being at war for the longest continuous period in its history the military is woefully unprepared for future wars But the United States cannot simply hit the reset button This book explores this inheritance by examining how nearly two decades of war have influenced civil military relations how the military goes to war how the military wages war who leads the military and who serves in it how the military thinks about war and above all the enduring impact of these wars on those who waged them

If the U S military seeks to win in the future it must acknowledge and reconcile with the inheritance of its long and inconclusive wars This book seeks to help them do so **AI, Robots, and Swarms** Andrew Ilachinski,2017 The military is on the cusp of a major technological revolution in which warfare is conducted by unmanned and increasingly autonomous weapon systems However unlike the last sea change during the Cold War when advanced technologies were developed primarily by the Department of Defense DoD the key technology enablers today are being developed mostly in the commercial world This study looks at the state of the art of AI machine learning and robot technologies and their potential future military implications for autonomous and semi autonomous weapon systems While no one can predict how AI will evolve or predict its impact on the development of military autonomous systems it is possible to anticipate many of the conceptual technical and operational challenges that DoD will face as it increasingly turns to AI based technologies This study examines key issues identifies analysis gaps and provides a roadmap of opportunities and challenges It concludes with a list of recommended future studies

Physicomimetics William M. Spears,Diana F. Spears,2012-01-05 Standard approaches to understanding swarms rely on inspiration from biology and are generally covered by the term biomimetics This book focuses on a different complementary inspiration namely physics The editors have introduced the term physicomimetics to refer to physics based swarm approaches which offer two advantages First they capture the notion that nature is lazy meaning that physics based systems always perform the minimal amount of work necessary which is an especially important advantage in swarm robotics Second physics is the most predictive science and can reduce complex systems to simple concepts and equations that codify emergent behavior and help us to design and understand swarms The editors consolidated over a decade of work on swarm intelligence and swarm robotics organizing the book into 19 chapters as follows Part I introduces the concept of swarms and offers the reader a physics tutorial Part II deals with applications of physicomimetics in order of increased complexity Part III examines the hardware requirements of the presented algorithms and demonstrates real robot implementations Part IV demonstrates how the theory can be used to design swarms from first principles and provides a novel algorithm that handles changing environments finally Part V shows that physicomimetics can be used for function optimization moving the reader from issues of swarm robotics to swarm intelligence The text is supported with a downloadable package containing simulation code and videos of working robots This book is suitable for talented high school and undergraduate students as well as researchers and graduate students in the areas of artificial intelligence and robotics

Swarm Robotics Erol Sahin,2005-01-24 Swarm robotics can be defined as the study of how a swarm of relatively simple physically embodied agents can be constructed to collectively accomplish tasks that are beyond the capabilities of a single one Unlike other studies on multi robot systems swarm robotics emphasizes self organization and emergence while keeping in mind the issues of scalability and robustness These emphases promote the use of relatively simple robots equipped with localized sensing ability scalable communication mechanisms and the exploration of

decentralized control strategies This state of the art survey is the first book devoted to swarm robotics It is based on the First International Workshop on Swarm Robotics held in Santa Monica CA USA in July 2004 as part of SAB 2004 *Swarm Intelligence* Christian Blum, Daniel Merkle, 2010-11-23 The book's contributing authors are among the top researchers in swarm intelligence The book is intended to provide an overview of the subject to novices and to offer researchers an update on interesting recent developments Introductory chapters deal with the biological foundations optimization swarm robotics and applications in new generation telecommunication networks while the second part contains chapters on more specific topics of swarm intelligence research Physicomimetics William M. Spears, Diana F. Spears, 2012-01-26 Standard approaches to understanding swarms rely on inspiration from biology and are generally covered by the term biomimetics This book focuses on a different complementary inspiration namely physics The editors have introduced the term physicomimetics to refer to physics based swarm approaches which offer two advantages First they capture the notion that nature is lazy meaning that physics based systems always perform the minimal amount of work necessary which is an especially important advantage in swarm robotics Second physics is the most predictive science and can reduce complex systems to simple concepts and equations that codify emergent behavior and help us to design and understand swarms The editors consolidated over a decade of work on swarm intelligence and swarm robotics organizing the book into 19 chapters as follows Part I introduces the concept of swarms and offers the reader a physics tutorial Part II deals with applications of physicomimetics in order of increased complexity Part III examines the hardware requirements of the presented algorithms and demonstrates real robot implementations Part IV demonstrates how the theory can be used to design swarms from first principles and provides a novel algorithm that handles changing environments finally Part V shows that physicomimetics can be used for function optimization moving the reader from issues of swarm robotics to swarm intelligence The text is supported with a downloadable package containing simulation code and videos of working robots This book is suitable for talented high school and undergraduate students as well as researchers and graduate students in the areas of artificial intelligence and robotics *From AI to Robotics* Arkapravo Bhaumik, 2018-02-28 *From AI to Robotics Mobile Social and Sentient Robots* is a journey into the world of agent based robotics and it covers a number of interesting topics both in the theory and practice of the discipline The book traces the earliest ideas for autonomous machines to the mythical lore of ancient Greece and ends the last chapter with a debate on a prophecy set in the apparent future where human beings and robots technology may merge to create superior beings the era of transhumanism Throughout the text the work of leading researchers is presented in depth which helps to paint the socio economic picture of how robots are transforming our world and will continue to do so This work is presented along with the influences and ideas from futurists such as Asimov Moravec Lem Vinge and of course Kurzweil The book furthers the discussion with concepts of Artificial Intelligence and how it manifests in robotic agents Discussions across various topics are presented in the book including control paradigm

navigation software multi robot systems swarm robotics robots in social roles and artificial consciousness in robots These discussions help to provide an overall picture of current day agent based robotics and its prospects for the future Examples of software and implementation in hardware are covered in Chapter 5 to encourage the imagination and creativity of budding robot enthusiasts The book addresses several broad themes such as AI in theory versus applied AI for robots concepts of anthropomorphism embodiment and situatedness extending theory of psychology and animal behavior to robots and the proposal that in the future AI may be the new definition of science Behavior based robotics is covered in Chapter 2 and retells the debate between deliberative and reactive approaches The text reiterates that the effort of modern day robotics is to replicate human like intelligence and behavior and the tools that a roboticist has at his or her disposal are open source software which is often powered by crowd sourcing Open source meta projects such as Robot Operating System ROS etc are briefly discussed in Chapter 5 The ideas and themes presented in the book are supplemented with cartoons images schematics and a number of special sections to make the material engaging for the reader Designed for robot enthusiasts researchers students or the hobbyist this comprehensive book will entertain and inspire anyone interested in the exciting world of robots

Swarm Robotics Erol Sahin,William M. Spears,2005-01-28 Swarm robotics can be defined as the study of how a swarm of relatively simple physically embodied agents can be constructed to collectively accomplish tasks that are beyond the capabilities of a single one Unlike other studies on multi robot systems swarm robotics emphasizes self organization and emergence while keeping in mind the issues of scalability and robustness These emphases promote the use of relatively simple robots equipped with localized sensing ability scalable communication mechanisms and the exploration of decentralized control strategies This state of the art survey is the first book devoted to swarm robotics It is based on the First International Workshop on Swarm Robotics held in Santa Monica CA USA in July 2004 as part of SAB 2004

Swarm Robotics: A Formal Approach Heiko Hamann,2018-02-10 This book provides an introduction to Swarm Robotics which is the application of methods from swarm intelligence to robotics It goes on to present methods that allow readers to understand how to design large scale robot systems by going through many example scenarios on topics such as aggregation coordinated motion flocking task allocation self assembly collective construction and environmental monitoring The author explains the methodology behind building multiple simple robots and how the complexity emerges from the multiple interactions between these robots such that they are able to solve difficult tasks The book can be used as a short textbook for specialized courses or as an introduction to Swarm Robotics for graduate students researchers and professionals who want a concise introduction to the field

Distributed Autonomous Robotic Systems Fumitoshi Matsuno,Shun-ichi Azuma,Masahito Yamamoto,2022-01-04 This book presents the state of the art in distributed autonomous systems composed of multiple robots robotic modules or robotic agents Swarms in nature can not only adapt to their environments but can also construct suitable habitats to their own advantage Distributed autonomous robotic systems can do many things that its individuals cannot do

alone As the global pandemic was still ongoing the 15th International Symposium on Distributed Autonomous Robotic Systems DARS2021 was held on June 14 2021 as an online meeting The scope of DARS2021 was to create a bridge between biologists and engineers interested in the distributed intelligence of living things and to establish a new academic field by integrating knowledge from both disciplines Topics of DARS2021 were swarm intelligence swarm robotics multi agent system modular robotics decentralized control distributed system etc The papers in this book provide a very good overview of the state of the art in distributed autonomous robotic systems DARS They reflect current research themes in DARS with important contributions We hope that this book helps to sustain the interest in DARS and triggers new research

Space-Time Continuous Models of Swarm Robotic Systems Heiko Hamann,2010-05-18 In this book a generic model in as far as possible mathematical closed form is developed that predicts the behavior of large self organizing robot groups robot swarms based on their control algorithm In addition an extensive subsumption of the relatively young and distinctive interdisciplinary research field of swarm robotics is emphasized The connection to many related fields is highlighted and the concepts and methods borrowed from these fields are described shortly

Achieving Consensus in Robot Swarms Gabriele Valentini,2017-02-14 This book focuses on the design and analysis of collective decision making strategies for the best of n problem After providing a formalization of the structure of the best of n problem supported by a comprehensive survey of the swarm robotics literature it introduces the functioning of a collective decision making strategy and identifies a set of mechanisms that are essential for a strategy to solve the best of n problem The best of n problem is an abstraction that captures the frequent requirement of a robot swarm to choose one option from of a finite set when optimizing benefits and costs The book leverages the identification of these mechanisms to develop a modular and model driven methodology to design collective decision making strategies and to analyze their performance at different level of abstractions Lastly the author provides a series of case studies in which the proposed methodology is used to design different strategies using robot experiments to show how the designed strategies can be ported to different application scenarios

Robot Colonies Ronald C. Arkin,George A. Bekey,2013-03-14 Robots in groups or colonies can exhibit an enormous variety and richness of behaviors which cannot be observed with singly autonomous systems Of course this is analogous to the amazing variety of group animal behaviors which can be observed in nature In recent years more and more investigators have started to study these behaviors The studies range from classifications and taxonomies of behaviors to development of architectures which cause such group activities as flocking or swarming and from emphasis on the role of intelligent agents in such groups to studies of learning and obstacle avoidance There used to be a time when many robotics researchers would question those who were interested in working with teams of robots Why are you worried about robotic teams when it s hard enough to just get one to work This issue responds to that question Robot Colonies provides a new approach to task problem solving that is similar in many ways to distributed computing Multiagent robotic teams offer the possibility of spatially distributed parallel

and concurrent perception and action A paradigm shift results when using multiple robots providing a different perspective on how to carry out complex tasks New issues such as interagent communications spatial task distribution heterogeneous or homogeneous societies and interference management are now central to achieving coordinated and productive activity within a colony Fortunately mobile robot hardware has evolved sufficiently in terms of both cost and robustness to enable these issues to be studied on actual robots and not merely in simulation Robot Colonies presents a sampling of the research in this field While capturing a reasonable representation of the most important work within this area its objective is not to be a comprehensive survey but rather to stimulate new research by exposing readers to the principles of robot group behaviors architectures and theories Robot Colonies is an edited volume of peer reviewed original research comprising eight invited contributions by leading researchers This research work has also been published as a special issue of Autonomous Robots Volume 4 Number 1

Swarm Robotics Suranga Hettiarachchi and William M. Spears, 2009 The nine papers in this special issue provide original research findings with an in depth analysis of different areas of swarm robotics how simply embodied robots can be designed controlled to collectively accomplish tasks beyond the capabilities of a single robot

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