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Editors

Deep Learning for Unmanned Systems

 Springer

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Preface

Deep learning (DL) has been applied to a wide range of research areas, such as prediction, classification, image/talk recognition, and vision, and has greatly surpassed conventional methodologies. The main difference between other approaches and in-depth research is the computational simulation of neural network layers by learning and multilevel representation. Therefore, the dynamic nature of large data sets can be easily understood by deep learning. Deep learning models can therefore provide insights into the complex structures of large data sets. Deep learning methods have been shown to outperform previous state-of-the-art techniques in several tasks because of the abundance of complex data from various sources (e.g., visual, audio, medical, social, and sensor).

Objectives of the Book

The main reason of editing this book is the increasing demand for deep learning (DL), unmanned systems (USs), and the exponential growth and evolution of USs in the last couple of years. This book seeks to investigate the latest deep learning applications in theoretical and practical fields of for any unmanned system, robot, drone, underwater, etc. The book discusses different applications of DL in drones and robotics where reinforcement learning methods have excellent potentials for use.

Both novice and expert readers should find this book a useful reference in the field of deep learning and reinforcement learning for unmanned systems.

Organization of the Book

This well-structured book consists of 20 full chapters.

Book Features

- The chapters deal with the recent research problems in the areas of reinforcement learning-based control of UAVs and deep learning for unmanned aerial systems (UASs).

- The chapters present various techniques of deep learning for robotic applications.
- The chapters contain a good literature survey with a long list of references.
- The chapters are well written with a good exposition of the research problem, methodology, block diagrams, and mathematical techniques.
- The chapters are lucidly illustrated with numerical examples and simulations.
- The chapters discuss details of applications and future research areas.

Audience

The book is primarily meant for researchers from academia and industry, who are working on in the research areas such as engineering, control engineering, robotics, mechatronics, biomedical engineering, mechanical engineering, and computer science. The book can also be used at the graduate or advanced undergraduate level and many others.

Acknowledgements

As the editors, we hope that the chapters in this well-structured book will stimulate further research in reinforcement learning-based control and deep learning for UAS and utilize them in real-world applications.

We hope sincerely that this book, covering so many different topics, will be very useful for all readers.

We would like to thank all the reviewers for their diligence in reviewing the chapters.

Special thanks go to Springer, especially the book editorial team.

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Contents

Deep Learning for Unmanned Autonomous Vehicles: A Comprehensive Review	1
Alaa Khamis, Dipkumar Patel, and Khalid Elgazzar	
Deep Learning and Reinforcement Learning for Autonomous Unmanned Aerial Systems: Roadmap for Theory to Deployment	25
Jithin Jagannath, Anu Jagannath, Sean Furman, and Tyler Gwin	
Reactive Obstacle Avoidance Method for a UAV	83
Zhaowei Ma, Jia Hu, Yifeng Niu, and Hongbo Yu	
Guaranteed Performances for Learning-Based Control Systems Using Robust Control Theory	109
Balázs Németh and Péter Gáspár	
A Cascaded Deep Neural Network for Position Estimation of Industrial Robots	143
Weiyang Lin, Chao Ye, Jiaojia Zhou, Xinyang Ren, and Mingsi Tong	
Managing Deep Learning Uncertainty for Unmanned Systems	175
Armando Plasencia Salgueiro, Lynnette González Rodríguez, and Ileana Suárez Blanco	
Uncertainty-Aware Autonomous Mobile Robot Navigation with Deep Reinforcement Learning	225
Lynnette González-Rodríguez and Armando Plasencia-Salgueiro	
Deep Reinforcement Learning for Autonomous Mobile Networks in Micro-grids	259
Marco Miozzo, Nicola Piovesan, Dagnachew Azene Temesgene, and Paolo Dini	
Reinforcement Learning for Autonomous Morphing Control and Cooperative Operations of UAV Cluster	309
Dan Xu and Gang Chen	

Bioinspired Robotic Arm Planning by τ-<i>Jerk</i> Theory and Recurrent Multilayered ANN	355
I. Carvajal, E. A. Martínez-García, R. Torres-Córdoba, and V. M. Carrillo-Saucedo	
Deep Learning Based Formation Control of Drones	383
Kader M. Kabore and Samet Güler	
Image-Based Identification of Animal Breeds Using Deep Learning	415
Pritam Ghosh, Subhranil Mustafi, Kaushik Mukherjee, Sanket Dan, Kunal Roy, Satyendra Nath Mandal, and Santanu Banik	
Image Registration Algorithm for Deep Learning-Based Stereo Visual Control of Mobile Robots	447
Zoran Miljković, Aleksandar Jokić, and Milica Petrović	
Search-Based Planning and Reinforcement Learning for Autonomous Systems and Robotics	481
Than Le, Bui Thanh Hung, and Pham Van Huy	
Playing Doom with Anticipator-A3C Based Agents Using Deep Reinforcement Learning and the ViZDoom Game-AI Research Platform	503
Adil Khan, Muhammad Naeem, Asad Masood Khattak, Muhammad Zubair Asghar, and Abdul Haseeb Malik	
Deep Reinforcement Learning for Quadrotor Path Following and Obstacle Avoidance	563
Bartomeu Rubí, Bernardo Morcego, and Ramon Pérez	
Playing First-Person Perspective Games with Deep Reinforcement Learning Using the State-of-the-Art Game-AI Research Platforms	635
Adil Khan, Asad Masood Khattak, Muhammad Zubair Asghar, Muhammad Naeem, and Aziz Ud Din	
Language Modeling and Text Generation Using Hybrid Recurrent Neural Network	669
Samreen, Muhammad Javed Iqbal, Iftikhar Ahmad, Suleman Khan, and Rizwan Khan	
Detection and Recognition of Vehicle's Headlights Types for Surveillance Using Deep Neural Networks	689
Sikandar Zaheer, Muhammad Javed Iqbal, Iftikhar Ahmad, Suleman Khan, and Rizwan Khan	
Recent Advances of Deep Learning in Biology	709
Muhammad Shahid Iqbal, Iftikhar Ahmad, Tamoor Khan, Suleman Khan, Muneer Ahmad, and Lulu Wang	

Bioinspired Robotic Arm Planning by τ -Jerk Theory and Recurrent Multilayered ANN



I. Carvajal, E. A. Martínez-García, R. Torres-Córdoba,
and V. M. Carrillo-Saucedo

Abstract This work presents a planning model control for a 6-axis robot manipulator simulation assembling task. This work's purpose is to plan trajectories for locking cable harnesses in palettes using nylon ties. This work is motivated by two biologically inspired approaches. The general τ -Jerk theory for trajectory tracking and a recurrent bi-layer Hopfield artificial neural networks (HANN) for visual feedback of multiple palette's elements. Equidistant Cartesian points describing free-collision paths between the robot and target positions are generated. Nonlinear regression-based 3th grade polynomials are obtained by multidimensional least squares as assembling trajectories. The Cartesian paths between robot and target position are chosen based on optimization with derivatives, where the path's height is a criteria to minimize a route. This work validated the proposed method through computer simulations, which showed feasibility and effectiveness for assembling tasks.

Keywords Robotic-arm · Robot-assembling · Model-based-control · Tau-theory · Artificial-vision · Hopfield-neurons · Multi-layer-ANN

1 Introduction

Today's manufacturing systems and organizations strongly depends on the need to use numerous artificial intelligence techniques and computer science tools in order to fulfill their production goals [1]. The work presented in this chapter was motivated by the need to provide an engineering solution at the level of computer simulation for common automatic problems in the assembly industry [2]. Automatic industrial assembly deploys robotic arms for assembling self-locking nylon ties in palettes of cable harnesses. The two main problems are stated. First, redundancy by deploying

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1