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# A Novel Radar Signal Recognition Method Based On Deep Learning

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Micro-Doppler Characteristics of Radar Targets

Recent Advances in Computational Intelligence in Defense and Security

Detecting and Classifying Low Probability of Intercept Radar

Communications, Signal Processing, and Systems

Radar Signal Processing for Autonomous Driving

Chinese Journal of Electronics

Proceedings of the 2018 CSPA Volume II: Signal Processing

Compressed Sensing in Radar Signal Processing

Fractal Analysis

4th International Conference, RSCTC 2004, Uppsala, Sweden, June 1-5, 2004,

Proceedings

Artificial Intelligence in China

Short-Range Micro-Motion Sensing with Radar Technology

4th International Conference, ICCSIP 2018, Beijing, China, November 29 - December

1, 2018, Revised Selected Papers, Part II

Application in Radar Countermeasure

MIMO Radar Signal Processing

Proceedings of the International Conference on Artificial Intelligence and Computer

Vision (AICV2021)

Detection, Classification, and Assessment

Knowledge Engineering and Management

Cognitive Systems and Signal Processing

Chongqing, China, 29-31 August 2006

Information Processing

Information Engineering and Applications

AI 2004: Advances in Artificial Intelligence

Proceedings of the 3rd International Conference on Artificial Intelligence in China

Wavelet Analysis and Its Applications, and Active Media Technology

International Conference on Information Engineering and Applications (IEA 2011)

International Conference on Intelligent Computing, ICIC 2006, Kunming, China,

August, 2006

Multidimensional Radar Imaging

Millimeter Wave Radar

Proceedings of the Seventh International Conference on Intelligent Systems and

Knowledge Engineering, Beijing, China, Dec 2012 (ISKE 2012)

17th Australian Joint Conference on Artificial Intelligence, Cairns, Australia,

December 4-6, 2004, Proceedings

International Conference, ICSC 2012, Shanghai, China, October 27-30, 2012.

Proceedings, Part II

Radar Systems, Peak Detection and Tracking

System Simulation and Scientific Computing, Part II  
(In 2 Volumes)

Intelligent Computing in Signal Processing and Pattern Recognition

Wavelet Analysis and Its Applications, and Active Media Technology 2004

Bispectral Methods of Signal Processing

Proceedings of the International Computer Conference 2006 on Wavelet Active

Media Technology and Information Processing

Radar Signal Analysis and Processing Using MATLAB

*A Novel Radar Signal  
Recognition Method  
Based On Deep  
Learning*

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## **HORTON BRAYLON**

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*Micro-Doppler Characteristics of Radar  
Targets* World Scientific

This book aims to capture recent advances and breakthroughs in in-home radar monitoring of human motions and activities. It addresses three key attributes of radar for in-door human monitoring, namely: motion classification including fall, detection of vital signs, and categorization of human gait for risk assessment and progression of physical impairments and disabilities. It explores recent developments in radar technology for human monitoring inside homes and residences. The reader will learn enhanced detection and classification techniques of radar signals associated with human micro- and macro-motions. Furthermore, the book includes examples using real data collected from healthy individuals, patients, and retirement communities based on the subject Doppler and range information, and using different single and multi-antenna radar system configurations. Results are also presented using modeled data based on biomechanics and kinematics. Indoor monitoring is further demonstrated using alternative technologies of infrared sensors and RF signals of opportunities.

**Recent Advances in Computational**

## **Intelligence in Defense and Security**

Springer

This 1179-page book assembles the complete contributions to the International Conference on Intelligent Computing, ICIC 2006: one volume of Lecture Notes in Computer Science (LNCS); one of Lecture Notes in Artificial Intelligence (LNAI); one of Lecture Notes in Bioinformatics (LNBI); and two volumes of Lecture Notes in Control and Information Sciences (LNCIS). Include are 149 revised full papers, and a Special Session on Computing for Searching Strategies to Control Dynamic Processes.

**Detecting and Classifying Low  
Probability of Intercept Radar** BoD –  
Books on Demand

Radar-related technology is mainly processed within the time and frequency domains but, at the same time, is a multi-dimensional integrated system including a spatial domain for transmitting and receiving electromagnetic waves. As a result of the enormous technological advancements of the pioneers actively discussed in this book, research and development in multi-dimensional undeveloped areas is expected to continue. This book contains state-of-the-art work that should guide your research.

Communications, Signal Processing, and  
Systems Springer

This book covers the latest

developments in radar micro-Doppler signatures and non-cooperative recognition of moving targets, for researchers and advanced students of radar systems. Micro-Doppler signatures is a very broad topic with applications in healthcare, security and surveillance. Edited by leading researchers in the field, the book consists of a series of chapters with contributions from different groups of authors who are international experts on their topics. The following topics are covered: multistatic radar micro-Doppler; passive radar approaches for healthcare; sparsity-driven methods for micro-Doppler detection and classification; deep neural networks for radar micro-Doppler signature classification; classification of personnel for ground-based surveillance; multimodal sensing for assisted living using radar; micro-Doppler analysis of ballistic targets; small drones and bird signatures as emerging targets; hardware development and applications of portable FMCW radars; digital-IF CW Doppler radar and its contactless healthcare sensing; L1-norm principal component and discriminant analyses of micro-Doppler signatures for indoor human activity recognition; and micro-Doppler signature extraction and analysis for automotive application. Finally, the editors have written a concluding short chapter that brings together an overview of the field and discusses likely future trends.

[Radar Signal Processing for Autonomous Driving](#) CRC Press

These proceedings present technical papers selected from the 2012 International Conference on Intelligent Systems and Knowledge Engineering (ISKE 2012), held on December 15-17 in Beijing. The aim of this conference is to bring together experts from different

fields of expertise to discuss the state-of-the-art in Intelligent Systems and Knowledge Engineering, and to present new findings and perspectives on future developments. The proceedings introduce current scientific and technical advances in the fields of artificial intelligence, machine learning, pattern recognition, data mining, knowledge engineering, information retrieval, information theory, knowledge-based systems, knowledge representation and reasoning, multi-agent systems, and natural-language processing, etc.

Furthermore they include papers on new intelligent computing paradigms, which combine new computing methodologies, e.g., cloud computing, service computing and pervasive computing with traditional intelligent methods. By presenting new methodologies and practices, the proceedings will benefit both researchers and practitioners who want to utilize intelligent methods in their specific fields. Dr. Fuchun Sun is a professor at the Department of Computer Science & Technology, Tsinghua University, China. Dr. Tianrui Li is a professor at the School of Information Science & Technology, Southwest Jiaotong University, Chengdu, China. Dr. Hongbo Li also works at the Department of Computer Science & Technology, Tsinghua University, China.

**Chinese Journal of Electronics** Artech House

This book text provides an overview of the radar target recognition process and covers the key techniques being developed for operational systems. It is based on the fundamental scientific principles of high resolution radar, and explains how the underlying techniques can be used in real systems, taking into account the characteristics of practical radar system designs and component

limitations. It also addresses operational aspects, such as how high resolution modes would fit in with other functions such as detection and tracking.

*Proceedings of the 2018 CSPA Volume II: Signal Processing* Springer Science & Business Media

This authoritative resource presents a comprehensive illustration of modern Artificial Intelligence / Machine Learning (AI/ML) technology for radio frequency (RF) data exploitation. It identifies technical challenges, benefits, and directions of deep learning (DL) based object classification using radar data, including synthetic aperture radar (SAR) and high range resolution (HRR) radar. The performance of AI/ML algorithms is provided from an overview of machine learning (ML) theory that includes history, background primer, and examples. Radar data issues of collection, application, and examples for SAR/HRR data and communication signals analysis are discussed. In addition, this book presents practical considerations of deploying such techniques, including performance evaluation, energy-efficient computing, and the future unresolved issues.

**Compressed Sensing in Radar Signal Processing** Artech House

Wavelet analysis and its applications have been one of the fastest-growing research areas in the past several years. Wavelet theory has been employed in numerous fields and applications, such as signal and image processing, communication systems, biomedical imaging, radar, and air acoustics. Active media technology is concerned with the development of autonomous computational or physical entities capable of perceiving, reasoning, adapting, learning, cooperating, and delegating in a dynamic

environment. This book captures the essence of the state of the art in wavelet analysis and its applications and active media technology. At the Congress, invited talks were delivered by distinguished researchers, namely Prof John Daugman of Cambridge University, UK; Prof Bruno Torresani of INRIA, France; Prof Victor Wickerhauser of Washington University, USA, Prof Ning Zhong of the Maebashi Institute of Technology, Japan; Prof John Yen of Pennsylvania State University, USA; and Prof Sankar K Pal of the Indian Statistical Institute, India.

**Fractal Analysis** Springer

Radar networks are increasingly regarded as an efficient approach to enhancing radar capabilities in the face of popular anti-radar techniques and hostile operating environments. Reader-friendly and self-contained, this book provides a comprehensive overview of the latest radar networking technologies. The text addresses basic, relevant aspects of radar signal processing and statistical theories, including both civilian and military radar applications. It also discusses emerging topics that directly relate to networks, such as multiple-input-multiple-output (MIMO) radars, waveform design, and diversity via multiple transmitters. Other topics covered include target recognition and imaging using radar networks. Features Gives a comprehensive view of the latest radar network technologies Covers both civilian and military applications of radar Provides basic statistics and signal processing necessary for understanding radar networks Includes up-to-date information on MIMO radars Presents waveform design and diversity for radar networks with multiple transmitters

**4th International Conference, RSCTC 2004, Uppsala, Sweden, June 1-5,**

**2004, Proceedings** Springer

This exciting new resource covers various emerging applications of short range radars, including people counting and tracking, gesture sensing, human activity recognition, air-drawing, material classification, object classification, vital sensing by extracting features such as range-Doppler Images (RDI), range-cross range images, Doppler Spectrogram or directly feeding raw ADC data to the classifiers. The book also presents how deep learning architectures are replacing conventional radar signal processing pipelines enabling new applications and results. It describes how deep convolutional neural networks (DCNN), long-short term memory (LSTM), feedforward networks, regularization, optimization algorithms, connectionist This exciting new resource presents emerging applications of artificial intelligence and deep learning in short-range radar. The book covers applications ranging from industrial, consumer space to emerging automotive applications. The book presents several human-machine interface (HMI) applications, such as gesture recognition and sensing, human activity classification, air-writing, material classification, vital sensing, people sensing, people counting, people localization and in-cabin automotive occupancy and smart trunk opening. The underpinnings of deep learning are explored, outlining the history of neural networks and the optimization algorithms to train them. Modern deep convolutional neural network (DCNN), popular DCNN architectures for computer vision and their features are also introduced. The book presents other deep learning architectures, such as long-short term memory (LSTM), auto-encoders, variational auto-encoders

(VAE), and generative adversarial networks (GAN). The application of human activity recognition as well as the application of air-writing using a network of short-range radars are outlined. This book demonstrates and highlights how deep learning is enabling several advanced industrial, consumer and in-cabin applications of short-range radars, which weren't otherwise possible. It illustrates various advanced applications, their respective challenges, and how they are been addressed using different deep learning architectures and algorithms.

*Artificial Intelligence in China* de Gruyter This book presents the 2nd International Conference on Artificial Intelligence and Computer Visions (AICV 2021) proceeding, which took place in Settat, Morocco, from June 28- to 30, 2021. AICV 2021 is organized by the Scientific Research Group in Egypt (SRGE) and the Computer, Networks, Mobility and Modeling Laboratory (IR2M), Hassan 1st University, Faculty of Sciences Techniques, Settat, Morocco. This international conference highlighted essential research and developments in the fields of artificial intelligence and computer visions. The book is divided into sections, covering the following topics: Deep Learning and Applications; Smart Grid, Internet of Things, and Mobil Applications; Machine Learning and Metaheuristics Optimization; Business Intelligence and Applications; Machine Vision, Robotics, and Speech Recognition; Advanced Machine Learning Technologies; Big Data, Digital Transformation, AI and Network Analysis; Cybersecurity; Feature Selection, Classification, and Applications. *Short-Range Micro-Motion Sensing with Radar Technology* SciTech Publishing This book defines and illustrates key

concepts in radar countermeasure, such as PDW generation, signal sorting and recognition, characteristic analysis of intra-pulse radar signal, and radar emitter location. Written in a practical way, the book focuses on the implementation of signal processing principles in radar countermeasure and is an essential reference for engineers in radar, electronic countermeasure system and signal processing research.

*4th International Conference, ICCSIP 2018, Beijing, China, November 29 - December 1, 2018, Revised Selected Papers, Part II* World Scientific

By studying applications in radar, telecommunications and digital image restoration, this monograph discusses signal processing techniques based on bispectral methods. Improved robustness against different forms of noise as well as preservation of phase information render this method a valuable alternative to common power-spectrum analysis used in radar object recognition, digital wireless communications, and jitter removal in images.

Application in Radar Countermeasure MDPI

Radar Signal Processing and Its Applications brings together in one place important contributions and up-to-date research results in this fast-moving area. In twelve selected chapters, it describes the latest advances in architectures, design methods, and applications of radar signal processing. The contributors to this work were selected from the leading researchers and practitioners in the field. This work, originally published as Volume 14, Numbers 1-3 of the journal, *Multidimensional Systems and Signal Processing*, will be valuable to anyone working or researching in the field of radar signal processing. It serves

as an excellent reference, providing insight into some of the most challenging issues being examined today.

MIMO Radar Signal Processing Springer

This book brings together papers from the 2018 International Conference on Communications, Signal Processing, and Systems, which was held in Dalian, China on July 14–16, 2018. Presenting the latest developments and discussing the interactions and links between these multidisciplinary fields, the book spans topics ranging from communications, signal processing and systems. It is aimed at undergraduate and graduate electrical engineering, computer science and mathematics students, researchers and engineers from academia and industry as well as government employees.

Proceedings of the International Conference on Artificial Intelligence and Computer Vision (AICV2021) Cambridge University Press

This book constitutes the refereed proceedings of the 17th Australian Conference on Artificial Intelligence, AI 2004, held in Cairns, Australia, in December 2004. The 78 revised full papers and 62 revised short papers presented were carefully reviewed and selected from 340 submissions. The papers are organized in topical sections on agents; biomedical applications; computer vision, image processing, and pattern recognition; ontologies, knowledge discovery and data mining; natural language and speech processing; problem solving and reasoning; robotics; and soft computing.

Detection, Classification, and Assessment Elsevier

Micro-Doppler Characteristics of Radar Targets is a monograph on radar target's micro-Doppler effect theory and micro-

Doppler feature extraction techniques. The micro-Doppler effect is presented from two aspects, including micro-Doppler effect analysis and micro-Doppler feature extraction, with micro-Doppler effects induced by different micro-motional targets in different radar systems analyzed and several methods of micro-Doppler feature extraction and three-dimensional micro-motion feature reconstruction presented. The main contents of this book include micro-Doppler effect in narrowband radar, micro-Doppler effect in wideband radar, micro-Doppler effect in bistatic radar, micro-Doppler feature analysis and extraction, and three-dimensional micro-motion feature reconstruction, etc. This book can be used as a reference for scientific and technical personnel engaged in radar signal processing and automatic target recognition, etc. It is especially suitable for beginners who are interested in research on micro-Doppler effect in radar. Presents new views on micro-Doppler effects, analyzing and discussing micro-Doppler effect in wideband radar rather than focusing on narrowband Provides several new methods for micro-Doppler feature extraction which are very helpful and practical for readers Includes practical cases that align with main MATLAB codes in each chapter, with detailed program annotations

### **Knowledge Engineering and Management**

John Wiley & Sons  
Synthetic aperture radar and inverse synthetic aperture radar (SAR/ISAR) images have been largely used for monitoring small to large areas and more specifically for target recognition/identification. However, the technology has limitations due to the use of classical monostatic, single channel, single frequency and single

polarization systems. To overcome these limitations, solutions have been proposed that show the benefit of using multiple frequencies, spatial channels, polarisations and perspective, in one word multi-dimensional radar imaging systems when dealing with non-cooperative targets. Multidimensional Radar Imaging introduces a new framework within which to address the problem of radar imaging and target recognition as it jointly looks at optimising the use of multiple channels to significantly outperform classical radar imaging systems. It has been used in the military within NATO for the last few years and the technology is now declassified. Topics covered include three-dimensional ISAR; STAP-ISAR; wide-band multi-look passive ISAR; radar tomography; multistatic PCL-SAR; fusion of multistatic ISAR images with large angular separation; rotor blade parameter estimation with multichannel passive radar; multistatic 3D ISAR imaging of maritime targets; challenges of semi-cooperative bi/multistatic SAR using Cosmo SkyMED as an illuminator; and lessons learnt from the NATO SET-196 RTG on multi-channel/multistatic radar imaging of non-cooperative targets.

### **Cognitive Systems and Signal Processing**

Artech House  
The set comprises: Volume 1: Novel Radar Techniques and Applications  
Volume 2: Novel Radar Techniques and Applications

*Chongqing, China, 29-31 August 2006*  
Springer

In recent years rough set theory has attracted the attention of many researchers and practitioners all over the world, who have contributed essentially to its development and applications.

We are observing a growing research interest in the foundations of rough sets, including the various logical, mathematical and philosophical aspects of rough sets. Some relationships have already been established between rough sets and other approaches, and also with a wide range of hybrid systems. As a result, rough sets are linked with decision system modeling and analysis of complex systems, fuzzy sets, neural networks, evolutionary computing, data mining and knowledge discovery, pattern recognition, machine learning, and approximate reasoning. In particular, rough sets are used in probabilistic reasoning, granular computing (including information granule calculi based on rough mereology), intelligent control, intelligent agent modeling, identification

of autonomous systems, and process specification. Methods based on rough set theory alone or in combination with other approaches have been discovered with a wide range of applications in such areas as: acoustics, bioinformatics, business and finance, chemistry, computer engineering (e.g., data compression, digital image processing, digital signal processing, parallel and distributed computer systems, sensor fusion, fractal engineering), decision analysis and systems, economics, electrical engineering (e.g., control, signal analysis, power systems), environmental studies, informatics, medicine, molecular biology, musicology, neurology, robotics, social science, software engineering, spatial visualization, Web engineering, and Web mining.