	The 2019 International Conference on Control, Automation and Information Sciences				
Wednesday, October 23					
8:30 am-10:00 am	WedT01: *Tutorial I: Marine Target Detection and Classification: Challenges and Solutions*	WedT02: *Tutorial II: Stochastic Sensor Control for Multi-Object Systems*			
10:00 am-10:15 am	Break: *Tea/Coffee Break*				
10:15 am-11:45 am	WedT01: *Tutorial I: Marine Target Detection and Classification: Challenges and Solutions*	WedT02: *Tutorial II: Stochastic Sensor Control for Multi-Object Systems*			
2:00 pm-3:30 pm	WedT03: *Tutorial III: Modern Multi-Target Tracking: A Random Finite Set Approach*	WedT04: *Tutorial IV: Robotic Navigation and Mapping - Advances with Random Finite Sets*			
3:30 pm-3:45 pm	Break: *Tea/Coffee Break*				
3:45 pm-5:15 pm	WedT03: *Tutorial III: Modern Multi-Target Tracking: A Random Finite Set Approach*	WedT04: *Tutorial IV: Robotic Navigation and Mapping - Advances with Random Finite Sets*			
Thursday, October 24					
9:00 am-10:00 am	ThuP01: *Plenary Talk I: Joint Detection and Tracking of Dim Targets: a New Promising Method*				
10:00 am-10:15 am	Break: *Tea/Coffee Break*				
10:15 am-10:45 am	ThuPaA01: *Panel Talk 1: Large-Scale Environmental Perception*				
10:45 am-11:08 am	ThuPaA02: *Panel Talk 2: Is Extended Kalman Filter Really Out-of-Date for Nonlinear Filtering?*	ThuPaB01: *Panel Talk 1: Optimal State Estimation for Complex Industrial Systems - From an Engineering Point of View*			
11:08 am-11:15 am		ThuPaB02: *Panel Talk 2: Environmental Awareness, Information Fusion and Robot Applications*			
11:15 am-11:30 am	ThuPaA03: *Panel Talk 3: Heterogeneous Track-to-Track Fusion in 2D and 3D*				
11:30 am-11:45 am		ThuPaB03: *Panel Talk 3: A.I. for Autonomous Underwater Vehicle*			
11:45 am-11:53 am	ThuPaA04: *Panel Talk 4: Resource Allocation Schemes for Multiple Targets Tracking in Colocated MIMO Radar System*				
11:53 am-12:15 pm		ThuPaB04: *Panel Talk 4: Robust Perception and Autonomous Navigation for Aerial Robots in Complex Environments*			
2:00 pm-2:30 pm	ThuPaA05: *Panel Talk 5: Emerging Visual Sensing Technologies: An Industry Collaboration Showcase*				

2:30 pm-3:00 pm	ThuPaA06: *Panel Talk 6: Tracking with Doppler Measurements*				
3:00 pm-3:15 pm	Break: *Tea/Coffee Break*				
3:15 pm-3:45 pm	ThuPaA07: *Panel Talk 7: Adaptive Spatial Clutter Measurement Density Estimation for Multi-target Tracking*				
3:45 pm-4:15 pm	ThuPaA08: *Panel Talk 8: Routes to the Shining of Arithmetical Average Fusion for RFS Fusion*				
4:15 pm-4:45 pm	ThuPaA09: *Panel Talk 9: Distributed Multi-Agent Multi-Object Tracking with Labeled Random Finite Sets*				

Friday, October 25

8:15 am-8:30 am	Ceremony: *Open Ceremony*				
8:30 am-9:30 am	FriP01: *Plenary talk II: Six Blind Men of Indostan: Theory and Applications of Information Fusion*				
9:30 am-10:00 am	Break: *Tea/Coffee Break*				
10:10 am-11:50 am	FriA01: *Special Session: Recent Topics on Theory, Algorithms and Applications for Active Control of Sound*	FriA02: *Special Session: Multi-Sensor Multi-Object Tracking Using Random Finite Sets*	FriA03: *Machine Learning*	FriA04: *Special Session: Machine Learning and Optimization for Large Scale Sensor Network*	
1:30 pm-3:10 pm	FriB01: *Special Session: Urban Environment Sensing with Wireless System*	FriB02: *Special Session: Data-driven Methods for Positioning and Tracking*	FriB03: *Special Session: Adaptive Radar Detection Algorithms and Performance Analysis*	FriB04: *Information Fusion Methods*	

Saturday, October 26

8:30 am-9:30 am	SatP01: *Plenary Talk III: Push and Pull in Digitalization: Technology Drivers for Sensor Data Fusion*				
9:30 am-10:00 am	Break: *Tea/Coffee Break*				
10:10 am-11:50 am	SatA01: *Special Session: Theory and Applications of Constrained Dynamic Systems*	SatA02: *Special Session: Multi-Object Filtering and Tracking*	SatA03: *Special Session: Track-Before-Detect Techniques for Detection and Tracking of Low SNR Targets*	SatA04: *Radar Signal Processing Methods*	SatA05: *Robust Multi-Target Tracking Methods and the Related Applications*
1:30 pm-3:10 pm	SatB01: *Posters for ICCAIS 2019 I*	SatB02: *Special Session: Recent Advances in SLAM*	SatB03: *Adaptive / Robust Control Methods*	SatB04: *Special Session: Resource Aware Scheduling for Cognitive Radar Systems*	SatB05: *Special Session: Recent Advances in Indoor Positioning*
3:10 pm-3:25 pm	Break: *Tea/Coffee Break*				
3:25 pm-5:05 pm	SatC01: *Posters for ICCAIS 2019 II*	SatC02: *Estimation and Control*	SatC03: *Special Session: Radar Weak Target Detection and Imaging*	SatC04: *Signal and Image Processing*	SatC05: *System Control*

Wednesday, October 23

Wednesday, October 23 8:30 - 10:00

WedT01: Tutorial I: Marine Target Detection and Classification: Challenges and Solutions

The first half

Dr. Xiaolong Chen；Dr. Hao Ding

Hotel Room B

Detection of low-observable target in sea clutter is an important issue for both civil and military applications. Targets covered by sea clutter with low observability are main threats to maritime observation systems and detection of these targets gives a severe challenge to radar survivability. Moreover, the detection process is difficult due to the weak radar returns and complex sea environment. Low-observable marine targets include low attitude, slow moving, small size, highly maneuvering, and stealthy targets. Their radar returns have a common characteristic, i.e., low signal-to-clutter ratio in time and frequency domains.

This tutorial is based on the research and experiments of tutors over the past ten years, and has been presented at several international conferences. It coves sea clutter modelling and analysis, sea clutter suppression, basic and advanced marine target detection techniques. Firstly, challenges of marine radar detection will be introduced including the challenges of sea clutter suppression, complex marine targets, and radar signal processing. Then, sea clutter models and how these models can be used to determine the expected detection performance will be demonstrated. Subsequently, we will give an overview of main detection techniques from the point of view of detection mechanism, signal modelling, energy integration, radar resolution, and processing domains. Then, this tutorial will give a deep discussion on the development and advances of marine target detection, i.e., ?long-time coherent integration, sparse time-frequency distribution, refined characteristics extraction and estimation via micro-Doppler, and deep learning for detection and classification. At the end of this tutorial, we will provide some real applications and examples of different radar platforms, i.e., shipborne, airborne, and multi-sensor fusion system.

WedT02: Tutorial II: Stochastic Sensor Control for Multi-Object Systems

The first half

Dr. Amirali Khodadadian Gostar

Hotel Room C

A modern sensor control problem consists of determining the best way to task several sensors when each sensor has many modes and search patterns. In the multi-target tracking applications, the task assigned to a sensor control system is to track the moving targets to achieve a defined objective in an optimal way. The allocation of sensors and their modes defines the action space of the underlying Markov decision problem.

Controlling a sensor or a set of sensors at each moment includes choices as of where to point and/or what mode to use. In this tutorial, some methods in the sensor control problem and their applications on the multi-target tracking will be explained. More specifically, the sensor control problem in random finite sets framework will be discussed in detail.

Wednesday, October 23 10:00 - 10:15

Break: Tea/Coffee Break

Wednesday, October 23 10:15 - 11:45

WedT01: Tutorial I: Marine Target Detection and Classification: Challenges and Solutions

The second half

Dr. Xiaolong Chen；Dr. Hao Ding

Hotel Room B

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Hotel Room C

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Wednesday, October 23 2:00 - 3:30

WedT03: Tutorial III: Modern Multi-Target Tracking: A Random Finite Set Approach

The first half

Prof. Ba-Ngu Vo

Hotel Room B

The random finite set (RFS) framework for multi-sensor multi-target tracking has attached considerable interest in recent years. It provides a unified perspective of multi-target tracking in a very intuitive manner by drawing direct parallels with the simpler problem of single-target tracking. This framework has led to the development of well-known multi-target filters such as the Probability Hypothesis Density (PHD), Cardinalized PHD (CPHD), Multi-Bernoulli filters and a recent advance, the Generalized Labeled Multi-Bernoulli (GLMB) filter, which can handle in excess of a million targets in the presence of high clutter and misdetections. The tutorial will walk the audience from the essence of the RFS to the latest developments such as filtering, smoothing, system identification and control. Matlab code will be provided to all participants. It is envisaged that participants will come away with sufficient know-how to implement and apply these algorithms as well as a set of tools that will help advance their research.

WedT04: Tutorial IV: Robotic Navigation and Mapping - Advances with Random Finite Sets

The first half

Prof. Martin Adams

Hotel Room C

Automatic solutions to robotic navigation and mapping lie at the core of any autonomous vehicle based applications. To achieve this, the software, which controls a mobile robot's actuators, continuously needs up-to-date and accurate estimates of the location of the vehicle and objects in its environment. For robust solutions, algorithms capable of making these estimates in the presence of model and measurement uncertainties, which take many forms, are necessary. Known as Simultaneous Localization And Mapping (SLAM) algorithms, they have traditionally been based on random vectors to represent robot poses (or its trajectory) and map feature positions, and they are based on Bayesian filtering or maximum likelihood batch estimation. Alternatively, the problem can be formulated using Random Finite Sets (RFSs). The use of RFSs yields a general measurement likelihood which allows data association and map management routines to be a native part of the RFS approach, as opposed to implementing these concepts with separate algorithms, as carried out within traditional SLAM formulations. RFS formulations also allow the consideration of detection and clutter statistics in the estimator. Thus, the RFS approach offers a robust alternative under non-ideal detection conditions where the probabilities of landmark detections are low, and where there may be many measurement outliers. The first part of this tutorial will introduce the SLAM problem, demonstrate state of the art SLAM methods and will review the mathematical formulation of RFS SLAM. The RFS based solutions to SLAM, based on the Probability Hypothesis Density (PHD) and the more recent Labelled Multi-Bernoulli (LMB) filter, will be presented and their advantages over non-RFS approaches will be demonstrated. The final part of this tutorial will focus on the implementation details of RFS based robotic navigation and mapping/SLAM algorithms. The open-source RFS-SLAM C++ library will be presented, which includes implementations of several SLAM filters, and their use will be demonstrated in a variety of applications.

Wednesday, October 23 3:30 - 3:45

Break: Tea/Coffee Break

Wednesday, October 23 3:45 - 5:15

WedT03: Tutorial III: Modern Multi-Target Tracking: A Random Finite Set Approach

The second half

Prof. Ba-Ngu Vo

Hotel Room B

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The second half

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Hotel Room C

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Thursday, October 24

Thursday, October 24 9:00 - 10:00

ThuP01: Plenary Talk I: Joint Detection and Tracking of Dim Targets: a New Promising Method

A/Prof. Dr. Wei Yi

UESTC Room A

Detection and tracking of dim targets is always an arduous challenge, and has attracted much attention in recent years from both military and civilian areas. Generally, the implementation of the classical detection and tracking approach relies on a thresholding operation by which only the significant measurements with sufficient strength are retained so as to keep the number of tracks manageable. These approaches can fail if the target signal-to-noise ratio (SNR) is low because of the information loss after the thresholding process or too many false tracks resulted by lowering detection threshold. To combat this problem, the track-before-detect (TBD) techniques directly process the unthresholded raw data or thresholded data with very low inter-mediate thresholds, and have been shown to be able to achieve superior performance for tracking of low SNR targets. Generally, TBD methods can be classified into two categories: the single frame recursive style TBD and the batch style TBD. This report focuses on a novel joint detection and tracking procedure by extending the standard batch style TBD methods, and is referred to as multi-frame detection and tracking (MFDT). Specifically, some recent research progresses and promising testing results on real data recently done by our group will also be introduced.

Thursday, October 24 10:00 - 10:15

Break: Tea/Coffee Break

Thursday, October 24 10:15 - 10:45

ThuPaA01: Panel Talk 1: Large-Scale Environmental Perception

Prof. Ba-Ngu Vo

UESTC Room A

Environmental perception refers to the understanding of the dynamic environment and projection of future status for decision-making. Understanding of environmental elements and events in space/time provides an awareness of what is happening in the vicinity, to understand how information, events, and one's own actions will impact goals and objectives, immediately and in the near future. Large-scale environmental perception requires the capability to use all available information sources to build understanding of large environments involving large no. elements. This capability underpins a wide range of applications such as Wide Area Surveillance, Search & Rescue, Smart Cities, Autonomous Vehicles, etc. This talk discusses some of the theoretical and practical challenges for large-scale environmental perception as well as suggestions for tackling these.

Thursday, October 24 10:45 - 11:15

ThuPaA02: Panel Talk 2: Is Extended Kalman Filter Really Out-of-Date for Nonlinear Filtering?

Prof. Zhansheng Duan

UESTC Room A

For linear systems, the optimal filtering is provided by the celebrated Kalman filter. For nonlinear systems, only suboptimal filters can be obtained in general. The extended Kalman filter (EKF) is such a suboptimal filter. Historically it helped the promotion of the Kalman filter. With the emerging of more advanced nonlinear filters, however, the EKF is receiving less and less attention because it performs the worst most often. In this talk, we will revisit the EKF from a new perspective and present some of our own proposals on nonlinear filtering.

Thursday, October 24 10:45 - 11:08

ThuPaB01: Panel Talk 1: Optimal State Estimation for Complex Industrial Systems - From an Engineering Point of View

Prof. Lei Ma

UESTC Room B

State optimal estimation is an essential technology to control and safety monitoring of complex engineering systems. Challenges raise due to harsh operation conditions such as nonlinearities and time-varying dynamics, non-Gaussian and non-stationary noise characteristics. This talk addresses state estimation of complex industrial systems ranging from battery SOC estimation, fault diagnosis of high-speed train running boggy to robot localization and navigation. We put emphasis on tackling practical problems during engineering the methods to real applications.

Thursday, October 24 11:08 - 11:30

ThuPaB02: Panel Talk 2: Environmental Awareness, Information Fusion and Robot Applications

Associate Prof. Weifeng Liu

UESTC Room B

With the rapid development of big data, cloud computing, 5G network communication technologies, we are experiencing an era of Internet of Things, which profoundly affects the future production and lifestyle. All these require the refined awareness of the environment and information fusion. At the same time, the development of robot technology provides a carrier and platform for realizing the refined perception and fusion. In this context, this panel talk focuses on the discussions and prospects of environmental awareness, information fusion and robotics applications in different scenarios.

Water environment management is the core of urban development and ecological protection. The existing methods face realistic challenges such as extensive management, delay in aging, and difficulty in traceable of pollution. The refined management of water environment provides a means to solve problems effectively. This talk focus on the challenges and opportunities in the refined management.

Thursday, October 24 11:15 - 11:45

ThuPaA03: Panel Talk 3: Heterogeneous Track-to-Track Fusion in 2D and 3D

Dr. Mahendra Mallick

UESTC Room A

Homogeneous track-to-track fusion (T2TF) in a multisensor tracking system has been widely studied. However, research on heterogeneous T2TF is limited at present. A common limitation of the current work on heterogeneous T2TF is that the cross covariance due to common process noise cannot be computed. This is because two local trackers use different dynamic models, and hence the common process noise does not exist. In our recent works, we considered the heterogeneous T2TF problem in 2D and 3D.

In this talk we shall first review the existing research on heterogeneous T2TF. Then we shall present our work in 2D and 3D, which overcomes existing limitations. This talk will focus primarily on the 3D heterogeneous T2TF problem. For the 3D problem, we used a passive infrared search and track (IRST) sensor and an active air moving target indicator (AMTI) radar with the nearly constant velocity motion of the target. The active AMTI tracker uses the Cartesian state vector with 3D position and velocity, and the dynamic model is linear. A passive IRST tracker commonly uses modified spherical coordinates (MSC) for the state vector, where the dynamic model is nonlinear. In this formulation, the common process noise is explicitly modeled in both dynamic models. Therefore, it is possible to take into account the common process noise. We use the cubature Kalman filter (CKF) in both trackers due to its numerical stability and improved state estimation accuracy over existing nonlinear filters. The passive tracker used a range-parameterized MSC-based CKF, and the active tracker uses a Cartesian CKF. We performed T2TF using the information filter (IF), where each local tracker sends its information matrix and the corresponding information state estimate to the fusion center. The IF handles the common process noise in an approximate way. Results from Monte Carlo simulations show that the accuracy of the proposed IF-based T2TF is close to that of the centralized fusion with varying levels of process noise and communication data rate.

Thursday, October 24 11:30 - 11:53

ThuPaB03: Panel Talk 3: A.I. for Autonomous Underwater Vehicle

Associate Prof. Feihu Zhang

UESTC Room B

In recent years, Autonomous Underwater Vehicle (AUV) becomes one of the most efficient tools for ocean exploration and exploitation. However, due to the unpredictability of the underwater environment, underwater robots are required to achieve high ability of intelligent and maneuver ability for different kind of ocean operations. Meanwhile, A.I has also dramatically changed the revolution of Robotics. This talk focus on the combination of AUV and A.I in current marine robotics applications.

Thursday, October 24 11:45 - 12:15

ThuPaA04: Panel Talk 4: Resource Allocation Schemes for Multiple Targets Tracking in Colocated MIMO Radar System

Dr. Junkun Yan

UESTC Room A

The problem of multiple targets tracking has been of great interest for various commercial and military applications. Technically speaking, based on the multibeam concept, multiple targets can be tracked by a single colocated multiple-input multiple-output radar. Here, the expression 'multibeam' refers to a mode of operation where multiple simultaneous transmit beams are synthesized by different probing signals from various colocated transmitters. However, this simultaneous multibeam working mode generally possesses limited working resources, e.g. the number of multibeams and the total transmit power of multiple beams. To ensure that the limited resources can be exploited effectively, resource allocation (RA) schemes are needed to be designed. The current talk will first show the physical explanation of the RA strategy, and then discuss several resource optimization schemes for different application backgrounds.

Thursday, October 24 11:53 - 12:15

ThuPaB04: Panel Talk 4: Robust Perception and Autonomous Navigation for Aerial Robots in Complex Environments

Dr. Fei Gao

UESTC Room B

Aerial robots have drawn greatly intentions due to their mobility, agility, and flexibility. In complex environments, the capability to navigate with full autonomy is essential to deploy aerial robots in field and industrial applications. In this talk, I focus on key techniques in robotics autonomous navigation. I will firstly introduce my past research on robotics perception and sensor fusion, which builds the foundation for autonomous robots. Then online motion planning algorithms and system integration will be introduced. Cutting-edge robotics applications and methodologies will be covered in this talk.

Thursday, October 24 2:00 - 2:30

ThuPaA05: Panel Talk 5: Emerging Visual Sensing Technologies: An Industry Collaboration Showcase

Dr. Reza Hoseinnezhad

UESTC Room A

This talk will provide a brief overview of deep neural networks and go through several examples of industrial applications where these tools (along with traditional machine vision techniques) are employed to solve detection and tracking problems. The presentation is pitched at a general audience level with more emphasis on practicality rather than theory. There is a main message that will be conveyed by the presentation through various examples involving detection and classification of people, safety gears, skin texture, and many other features/object classes in practical applications. For the audience from industry, you will see how these translate into improved efficiency and safety, leading to savings in cost. For academics, you will see examples of how sophisticated techniques can be effectively employed to solve important (and seemingly simple) problems that matter to industries in various sectors.

Thursday, October 24 2:30 - 3:00

ThuPaA06: Panel Talk 6: Tracking with Doppler Measurements

Mr. Gongjian Zhou

UESTC Room A

Incorporation of Doppler measurements, which contain valuable information of both target position and velocity states, is beneficial to tracking filter but also data association as well as false track discrimination. Two tracking filters with Doppler measurements will be presented after a survey on this topic. One is the sequential nonlinear tracking filter without measurement decorrelation, the other is the statically fused converted measurement Kalman filtering method. Then, a multi-target tracking method based on linear multi-target tracking framework will be presented. Simulation results demonstrate the effectiveness of the tracking methods.

Thursday, October 24 3:00 - 3:15

Break: Tea/Coffee Break

Thursday, October 24 3:15 - 3:45

ThuPaA07: Panel Talk 7: Adaptive Spatial Clutter Measurement Density Estimation for Multi-target Tracking

Prof. Taek Lyul Song

UESTC Room A

Measurements obtained from the sensor in the surveillance environment include clutter measurements as well as target measurements. To efficiently track targets in such a surveillance environment, a data association technique is needed to effectively distinguish between the target measurements and the clutter measurements. Most of data association techniques are developed under the assumption that the spatial probability distribution of clutter measurements is assumed to be known and uniformly distributed. However, in real tracking environments, assuming a uniform distribution can result in deterioration of target tracking performance because the prior information about clutter measurements is unknown. To carry out the target tracking in practice, several clutter measurement density estimation methods have been proposed for non-parametric target tracking without assuming the homogeneity of the clutter distribution. Among them, the spatial clutter measurement density estimator (SCMDE) computes the sparsity of clutter measurement which is the reciprocal of clutter measurement density. The SCMDE estimates clutter measurement density by searching the nth nearest measurement from the measurement of interest for which clutter measurement density is obtained by calculating the volume of the hyper-sphere centered at the measurement of interest. The SCMDE considers all adjacent measurements only as clutter, so the estimated clutter measurement density is biased in the situation when multiple targets are located in the vicinity of the measurement of interest, which may result in degraded target tracking performance. In this Panel Talks, the MTT-SCMDE, representing the SCMDE for multi-target tracking which is an extension of the SCMDE for effective applications in multi-target tracking environments, is introduced.

Thursday, October 24 3:45 - 4:15

ThuPaA08: Panel Talk 8: Routes to the Shining of Arithmetical Average Fusion for RFS Fusion

Dr. Tiancheng Li

UESTC Room A

Just in this year (2019), independent research groups from China to Germany, Australia, Italy, South Korea, Sweden, U.S. and Israel have reported some interesting theoretical properties and experimental advantages of the arithmetic average (AA) fusion (or the like using another name) in comparison with the prevailing geometric average (GA) fusion approach called GCI or EMD, in the context of RFS fusion for decentralized target tracking. This unexpected resonance demonstrates explicitly that the AA fusion is not only effective for RFS fusion but superior to its competitor, especially in dealing with frequent missed detection, closely distributed targets and massive sensors, and in faster/online computing. These findings based on critical theoretical studies and careful experimental studies overturn some earlier influential criticizes about the AA fusion. "Talk is cheap, show me the data".

The speaker is fortunately a witness and a pioneering promoter of the RFS-AA fusion approach from the beginning when he by accident found that the 20-years-old Gaussian mixture (GM) merging method, together with the standard average consensus for fusing cardinalities, serves super for multi-sensor GM-PHD fusion. He then developed the earliest AA-fusion based consensus and flooding protocols for multi-sensor RFS fusion, using GM and particles, respectively. In this talk, close connection to the so-called minimum discrimination information (MDI) principle, statistics and consistency of both AA and GA fusion approaches, as well as some very recent insightful experimental studies will be highlighted. Following this is the speaker's personal experience and perspectives to developing the AA-fusion-based Consensus and Flooding algorithms for large-scale complex networks.

Thursday, October 24 4:15 - 4:45

ThuPaA09: Panel Talk 9: Distributed Multi-Agent Multi-Object Tracking with Labeled Random Finite Sets

Ms. Suqi Li

UESTC Room A

Distributed Multi-agent Multi-object Tracking (DMMT) has increasingly attracted research interest from the tracking community as the cooperation of multiple agents (sensors) can clearly help to overcome the limitations of a single-agent system. In the distributed setting, the Generalized Covariance Intersection (GCI), also called the Exponential Mixture density (EMD) is a good choice for the fusion rule, since it can avoid inherently double counting of common information among agents. As for the formulation of local filtering, the labeled random finite set filters have showed great potential in terms of producing object trajectories as well as enhancing tracking performance. Considering these respects, this talk provides a brief overview of our recent research results

on DMMT with labeled random finite sets using GCI fusion rule. Firstly, a comprehensive analysis is provided, showing that the fusion performance of the standard GCI is highly sensitive to label inconsistencies between agents; this phenomenon is referred to as "label inconsistency sensitivity". To counteract this phenomenon, two promising approaches (including the label-uniformizing GCI and the label-matching GCI) are then presented.

Friday, October 25

Friday, October 25 8:15 - 8:30

Ceremony: Open Ceremony

Friday, October 25 8:30 - 9:30

FriP01: Plenary talk II: Six Blind Men of Indostan: Theory and Applications of Information Fusion

Prof. Dr. Pramod K. Varshney

Hotel Room A

Information fusion refers to the acquisition, processing and synergistic combination of information gathered by various knowledge sources and sensors to provide a better understanding of a phenomenon. This fascinating field has evolved over the past three decades. Information fusion concepts are being applied to a wide variety of fields such as military command and control, robotics, image processing, air traffic control, medical diagnostics, pattern recognition, environmental monitoring, IoT and smart cities. This talk will present an overview of the field, present some recent research results and illustrate its utility by means of some examples.

Friday, October 25 9:30 - 10:00

Break: Tea/Coffee Break

Friday, October 25 10:10 - 11:50

FriA01: Special Session: Recent Topics on Theory, Algorithms and Applications for Active Control of Sound

Hotel Room A-1

Chairs: Chuang Shi (University of Electronic Science and Technology of China, China), Yoshinobu Kajikawa (Kansai University, Japan)

A Deinterleaving Method for Mixed Pulse Signals in Complex Electromagnetic Environment

Hao Mu, Jie Gu and Yaodong Zhao (Science and Technology on Electronic Information Control Laboratory, China)

The 2019 International Conference on Control, Automation and Information Sciences

In complex electromagnetic environment, pulse signals from different emitters are highly overlapped in time, spatial and frequency domains. Traditional methods perform poor in deinterleaving mixed signals having similar pulse parameters, arrival directions and frequency sets. In this paper, a deinterleaving method employing the clustering and the machine leaning is proposed to solve this problem. The proposed method first clusters pulse signals based on multiple parameters, and trains a supervised learning model using features representing pulse sequences' variation trend. The model is used to predict whether different clustered signal groups belong to the same emitter. As a result, mixed pulse signals are deinterleaved into different emitter clusters. A verification test is presented to measure the performance of the proposed method.

pp. 1-4

The Outlier Elimination Methodology of Ultra-Short BaseLine Positioning Data

Yun Liu, Cuie Zheng, Dajun Sun and Yun Zhao (Harbin Engineering University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Ultra-short baseline positioning is an important acoustic positioning method for underwater vehicles. The main purpose of this paper is to reduce the positioning error caused by outlier of acoustic measurements .The paper first introduces positioning theory and error source of ultra-short baseline, then analyzes the influence of motion trajectory of underwater vehicles on the variation characteristics of time difference of arrival and range. On the basis of Kalman filter, an outlier elimination methodology based on dynamic innovation threshold has been proposed. Experimental data from submarine "Exploration No. 1" testing in South China Sea in 2017 is used to verify the effectiveness of proposed method. The paper combines multiple channel information of acoustic array to eliminate positioning outlier and analyzes the depth positioning results before and after the elimination of outlier. The results show that outlier eliminating rate can reach up to 88.2%, and the effective positioning data rate increases by 4.9%.

pp. 5-10

Steady-state performance for the sign normalized algorithm based on Hammerstein spline adaptive filtering

Chang Liu, Zhi Zhang and Xiao Tang (Dongguan University of Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, by combining the Hammerstein spline adaptive filtering model with the L1 norm minimization criterion, we present a new sign adaptive normalized least mean square algorithm based on Hammerstein spline adaptive filter (HSAF-SNLMS). Meanwhile, the steady-state perform-ance of the proposed algorithm is extensively investigated by application of the energy conservation relation and Price theorem in the case of non-Gaussian noise. Simulation results under the background of the identification of the Hammerstein spline nonlinear

system are in good agreement with the theoretical calculations.
pp. 11-15

Blockchain based user authentication in NB-IoT system for active noise cancellation

Man Xiong, Kun Zhu and Ran Wang (Nanjing University of Aeronautics and Astronautics, China)

The 2019 International Conference on Control, Automation and Information Sciences

Narrow Band Internet of Things (NB-IoT) is an emerging cellular-based technology with the characteristics of low power consumption, large connection, wide range coverage, and low cost. It's widely used in the fields of intelligent meter reading, vehicle tracking, logistics tracking, etc. due to its advantages. Similarly, it can be used to construct an IoT system for transmitting the information required by an active noise cancellation system. Such an IoT system bring security risks. In general, cryptography is used to protect the security, but the cryptography system is vulnerable to be attacked due to the centralized structure. In this paper, we choose to use blockchain technology to deal with this problem. The main reason is that it is decentralized, which naturally makes it safer. We first establish the model of NB-IoT system, then we build a private chain and design a certified smart contract which is tested in the simulation environment before it's deployed to the private chain, because it can't be changed once it has been deployed. The smart contract will get the identify information from the security gateway and then verify it, returning the result that decides whether the message was accepted. The results show that the message from the terminal will only be accepted when the identity information is completely correct, otherwise it will be dropped

pp. 16-21

Comparison of Virtual Sensing Techniques for Broadband Feedforward Active Noise Control

Yoshinobu Kajikawa (Kansai University, Japan); Chuang Shi (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Active noise control (ANC) is one of noise reduction techniques based on the acoustic wave superposition. When an anti-noise wave with the same amplitude and opposite phase of the noise wave is generated from the secondary source, the sound pressure level of the unwanted acoustic noise can be reduced at the desired location, where an error microphone is placed to monitor the error signal and make the whole system a closed-loop control problem. If the error microphone cannot be placed at the desired location due to the application constraint or physical limitation, virtual sensing (VS) is one of the solutions. In this paper, we compare two virtual sensing techniques for reducing the broadband noise. One of them is called the remote microphone (RM) method, which estimates the transfer function from an error microphone location to a desired location. The RM method has been reported on the effectiveness for the narrowband noise reductions. Another technique is called the auxiliary filter based virtual sensing (AF-VS) method, which preserve the information about the optimal noise control filter achieving the maximum noise reduction at the desired location. The AF-VS method has more superior advantages for broadband noise reduction. In this paper, we compare the noise reduction performance between the two VS methods through some experimental results. The experiment results demonstrate that the AF-VS method can realize higher noise reduction for broadband noise at the desired location than the RM method and has no limitations on the geometrical relationship between the error microphone location and the desired location ·

pp. 22-26

FriA02: Special Session: Multi-Sensor Multi-Object Tracking Using Random Finite Sets

Hotel Room A-2

Chairs: Suqi Li (University of Electronic Science and Technology of China, China), Tiancheng Li (University of Salamanca, Spain)

Interactive Multiple-Target Tracking via Labeled Multi-Bernoulli Filters

Amirali Khodadadian Gostar and Tharindu Rathnayake (RMIT University, Australia); Chunyun Fu (Chongqing University, China); Alireza Bab-Hadiashar (RMIT University, Australia); Giorgio Battistelli and Luigi Chisci (Università di Firenze, Italy); Reza Hoseinnezhad (RMIT University, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

In many cases, the multi-target tracking system is essential for realizing the current state of an environment. The standard multi-target tracking algorithms assume that each target state evolves independently and regardless of other targets' states. However, in a real scenario this assumption does not hold in that the motion of any target is dependent on other targets. This paper proposes a new mathematical solution for multi-target tracking system with interacting targets. In the proposed method the prediction operation of the labeled multi-Bernoulli filter is extended to incorporate all possible interactions between targets. The results show that in scenarios where the assumption of a standard motion model is violated, the proposed method achieves higher accuracy for the state estimation of the targets. Also, it shows better performance for estimating the identity of the targets.

pp. 27-32

Distributed Joint Mapping and Registration with Limited Fields-of-View

Lin Gao (University of Florence, Italy); Giorgio Battistelli and Luigi Chisci (Università di Firenze, Italy); Amirali Khodadadian Gostar and Reza Hoseinnezhad (RMIT University, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

The interest of this paper is to fuse maps, expressed in different local coordinates, of multiple mobile agents with limited fields-of-view, without knowledge of the relative poses among agents. To this end, the map is modeled as a multi-object Poisson process and a recently developed approach, named Cauchy-Schwarz fusion (CSF), is adopted. In order to perform calibration among local coordinates, the information-theoretic interpretation of CSF is exploited to build a suitable map discrepancy to be minimized with respect to the drift and orientation parameters. A multi-hypothesis method is adopted in order to efficiently solve the resulting optimization problem.

pp. 33-38

Multiple marine ships tracking from multistatic Doppler data with unknown clutter rate

Thanh Cong Do (Curtin University, Australia & Thai Nguyen University of Technology, Vietnam)

The 2019 International Conference on Control, Automation and Information Sciences

The data collected by a multistatic Doppler radar system includes information on both true targets and clutter. The estimation of clutter directly influences the effectiveness of the multitarget tracker in practical applications. This paper proposes a method for tracking multiple marine ships using multistatic Doppler radar system in an environment with unknown clutter rate. Specifically, the clutter rate is first estimated and then bootstrapped into the state-of-the-art Vo-Vo filter to track multiple targets on-the-fly. Numerical results demonstrate the validity of the proposed method provide that the clutter parameter vary slower than that of the data.

pp. 39-44

Multi-sensor Multi-target Tracking Using Labelled Random Finite Sets with Homography Data

Jonah Ong (Curtin University, Australia); Du Yong Kim (RMIT University, Australia); Nordholm Sven (Curtin University of Technology, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

This paper proposes a solution for multi-sensor multi-target tracking with homography data using the labelled random finite set with a top-down Bayesian recursion formulation. The proposed method encapsulates multi-target state motion, appearance and disappearance and all aspects of noise, detection and association uncertainty from multiple sensors. This technique naturally incorporates the fusion of multi-sensor measurements to improve the fidelity of multi-target trajectories estimation. A linear Gaussian multi-target model with simulated homography data from multiple sensors is undertaken for verification.

pp. 45-51

Multi-acoustic Array Localization and Tracking Method based on Gibbs-GLMB

Zhengwang Tian (Hangzhou Dianzi University, China); Weifeng Liu (Hangzhou Dianzi Univerisity, China); Feng Xin Ru (Hangzhou Dianzi University, China)

The 2019 International Conference on Control, Automation and Information Sciences

We consider an acoustic array of a specific arrangement for the tracking of targets by time difference of arrival (TDOA) measurement and angle of arrival (AOA) measurement. To solve the target trajectory and state estimation problem under a cluttered environment, this paper proposes a multi-acoustic array localization tracking method based on the Gibbs-generalized label multi-Bernoulli (Gibbs-GLMB) filter. Firstly, the TDOAs are calculated by using the generalized cross-correlation algorithm (GCC), and the AOAs are derived from the received signal directions. Secondly, we assume the independence of the targets, and fuse the measurements which are then used to track the multiple targets via the Gibbs-GLMB filter. Finally, the effectiveness of the method is verified by Monte Carlo simulation experiments.

pp. 52-57

FriA03: Machine Learning

Hotel Room B

Chairs: Gongjian Zhou (Harbin Institute of Technology, China), Yong Jia (Chengdu University of Technology, China), Yongqiang Cheng (National University of Defense Technology, China)

Multi-view features-based HRRP classification via sparsity preserving projection

Bangzhen Xu (Nanjing University of Science and Technology, China); Hong Gu (Nanjing University of Science & Technology, China); Weimin Su and Yiqin Chen (Nanjing University of Science and Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

Feature extraction is an important step in radar high-resolution profile (HRRP) recognition area. Traditional feature extraction methods are constrained to the original signal itself without taking advantage of abundant information exists in multiple views. In this paper the multi-view sparsity preserving projection (MVSPP) method is proposed for feature extraction of HRRP. The core of this method is taking sparsity preserving projection to reduce dimensions of multi-view features and introducing kernel trick to ensure their similarities. Based on the characteristic of SVM classifier we propose a new combined kernel function instead of the traditional linear kernel function. To obtain the optimal solution, MVSPP adopts an iterative procedure. Experiments based on measured HRRP data verify the advantage of the proposed method. In addition, factors affecting the convergence speed of the algorithm are analyzed. Moreover, the performances of two kinds of kernel functions are compared.

pp. 58-63

Ship Detection Based on Faster R-CNN in SAR Imagery by Anchor Box Optimization

Durga Kumar and Xiaoling Zhang (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Object detection in synthetic aperture radar (SAR) imagery is a fundamental and challenging problem in the field of SAR imagery analysis for many fields like, military, intelligence, commercial applications etc. Object detection based on faster regions convolutional neural network (Faster R-CNN) has lesser running time as compare to convolutional neural network (CNN) in the detection process. Nowadays, anchor boxes are widely used in the detection model. This paper aims to provide an anchor box optimization method to improve the ship detection accuracy in SAR imagery. By using Residual Network (ResNet-50) as a backbone in Faster R-CNN and it's compatible anchor sets better mean Average Precision (mAP) achieved. We compared the mAP with the two set of anchor parameters, we found that in the ship detection process mAP achieves more than 4.29% significant improvement.

pp. 64-69

CCNet: Cross-Combination Neural Network for Feature Extraction in Person Re-Identification

Hyunguk Choi and Hoyeon Ahn (Gwangju Institute of Science and Technology, Korea (South)); Moongu Jeon (Gwangju Institute of Science and Technology (GIST), Korea (South))

The 2019 International Conference on Control, Automation and Information Sciences

Person re-identification is an important field for multi-target multi-camera tracking in an urban surveillance system. In this paper, We proposed the cross-combination neural network called CCNet for the feature extraction module in person re-identification. The CCNet is lightweight and high-performance backbone model to extract features instead of widely used models such as ResNet and Inception models. The convolution block of CCNet is to combine with various convolution modules such as the depthwise separable convolution, dilated convolution. This structure helps the model to learn the relationship between each feature generated from various modules. Besides, we propose a reduction block that combine with standard CNN, the average-pooling and the max-pooling module to reduce the loss of information. Experimental evaluation shows that CCNet has similar or better performance than the widely used backbone models. The CCNet achieved 63.27% in Rank 1 accuracy and the mean average precision (mAP) results of the CCNet is similar to that of the latest backbone models in Market1501 dataset without pre-training.

pp. 70-74

Compressing Deep Models using Multi Tensor Train Decomposition

Xin Yang and Weize Sun (Shenzhen University, China); Lei Huang (Beijing Institute of Technology, China); Shaowu Chen (ShenZhen University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Deep learning is a very influential research direction in data science and has been applied to various fields in recent years. However, deep neural network usually comes with high computational complexity and large memory storage requirement, thus is difficult to be deployed in mobile devices. The technique of deep neural network compression can reduce the parameter redundancy in depth models by using the low rank and sparsity characteristics of weight matrices or tensors and therefore suitable for applications in mobile systems. In this paper, we employ the Tensor Train decomposition with sparsity constraint for the compression of both convolutional layers and the fully connected layers. Furthermore, the idea of multi Tensor Train decomposition is proposed to improve the performance of the compression model. Specifically, a set of patterns are defined to reshape the original weight matrices or tensors into different shape of high dimensional tensors for compression using Tensor Train decomposition. New network structure is then built based on the decomposition and the number of parameters is highly decreased. Experiments show that the robustness of the compression model increases with the number of patterns employed in the deep model, and the proposed compression approach can achieve a high compression ratio with small performance loss.

pp. 75-80

Sparsity-Based Naive Bayes Approach for Anomaly Detection in Real Surveillance Videos

Ammar Mansoor Kamoona, Amirali Khodadadian Gostar, Alireza Bab-Hadiashar and Reza Hoseinnezhad (RMIT University, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

Anomaly detection in video surveillance data is a challenging tasks due to the dynamic environment of the surveillance area. Multiple solutions have been proposed to tackle this problem ranging from using handcrafted features to end-to-end deep leaning methods. This paper proposes a model-based approach to anomaly detection for surveillance video data. This solution is based on sparsity estimation of pre-trained deep features. We aim to harvest the sparsity information of C3D deep features and use it as an additional information to differentiate the normal and anomalous event in a video. The proposed approach uses the na\"ive Bayes model within multiple instance learning framework. Experimental results shows that using sparsity information of C3D deep features could improve na\"ive Bayes approach and enhance the accuracy of the decision boundary.

pp. 81-86

FriA04: Special Session: Machine Learning and Optimization for Large Scale Sensor Network

Hotel Room C

Chairs: Zhiguo Wang (The Chinese University of Hong Kong, Shenzhen, China), Xiaojing Shen (Sichuan University, China)

Speaker: Gang Li，Title：Detection of Sparse Signals in Sensor Networks via Locally Most Powerful Tests Speaker: Xiaojun Yang，Title：Adaptive sensor management for target tracking in wireless sensor networks via sparsity-promoting approaches Speaker: Wenqiang Pu，Title：Overcoming DoF Limitation in Robust Beamforming: A Penalized Inequality-Constrained Approach Speaker: Zhiguo Wang，Title：Stabilizing the Accelerated ADMM for General Linearly Constrained Nonconvex Optimization

Friday, October 25 1:30 - 3:10

FriB01: Special Session: Urban Environment Sensing with Wireless System

Hotel Room A-1

Chairs: Guolong Cui (University of Electronic Science and Technology of China (UESTC), China), Tian Jin (National University of Defense Technology, China), Yong Jia (Chengdu University of Technology, China)

Design and Implementation of Digital Modulator In High-Speed Data Transmission System

Lili Zhang and Wen Kuang (Institute of Electronic Engineering, China)

The 2019 International Conference on Control, Automation and Information Sciences

With the requirement of high-speed data transmission system, the optimization method to design a general and wide-band digital modulator is proposed by utilizing the general-purpose quadrature modulation algorithm and high speed digital signal processing technologies. In this paper, based on the unified digital signal processing platform, the functions of channel coding, constellation mapping, interpolation, filtering and digital up converter are realized. By configuring different software modules, the modulated signal with variable symbol rate is realized. Taking QPSK signal as an example, all functions are implemented on hardware platform. Functional simulation and resource consumption reports show that the design logic module functions are correct, meeting the timing requirements and rational use of resources. The results show that the program obtain high coding gain and rich functionalities. which achieve the requirements of system and have certain practicality and versatility in future.

pp. 87-91

NLOS Targets Imaging with UWB Radar

Songlin Li (University of Electronic Science and Technology of China, China); Guolong Cui (University of Electronic Science and Technology of China (UESTC), China); Shisheng Guo (University Of Electronic Science And Technology Of China, China); Huquan Li (University of Electronic Science and Technology of China, China); Lingjiang Kong (University of Electronic Science and Technology of China (UESTC), China); Xiaobo Yang (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper addresses a target imaging method for non-line-of-sight (NLOS) target shielded by surrounding in the L-junction scenario, exploiting ultra wideband (UWB) multiple-input multiple-output (MIMO) radar. We analyze the electromagnetic wave diffraction and reflection propagation in the L-junction scenario and establish the echo model. An NLOS target imaging method based on multipath exploitation of the diffraction and first-order reflection is proposed. Moreover, we also present a multiplication fusion method to suppress the high-order multipath ghosts. Finally, simulation results validate the validity of the multipath-exploitation-based target imaging method.

pp. 92-96

Target Imaging Based on Generative Adversarial Nets in Through-wall Radar Imaging

Huiyuan Zhang (Beijing KaiSaChuanQi Technology co., LTD, China); Ruiyuan Song, Shengyi Chen, Gang Wang, Yong Jia and Chao Yan (Chengdu University of Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

For multi-input multi-output (MIMO) through-wall radar imaging (TWRI), multipath ghosts, side/grating lobe artifacts and wall penetration effect degrade the imaging quality of the obscured targets inside an enclosed building, there in hindering target detection. In this paper, an approach based on generative adversarial nets (GAN) is proposed to achieve multipath ghosts, side/grating lobe artifacts and wall penetration effect suppression with regard to MIMO TWRI. Specifically, the whole task is divided into two steps (Firstly, multipath ghosts and wall penetration effect are suppressed but the side/grating lobes are preserved. Secondly, side/grating lobes are eliminated.) Then a GAN network is applied to solve those two steps. Extensive electromagnetic simulations and comparisons demonstrate that the proposed approach achieves better suppression of multipath ghosts, side/grating lobe artifacts, wall penetration effect and other significant superiorities, including priori wall information not being required and robustness for different array deployments and building layouts.

pp. 97-102

DOD and DOA Estimation for Bistatic Co-Prime MIMO Array Based on Correlation Matrix Augmentation

Chuan Zhou (Run Technologies co., ltd and Zhejiang University, China); Zehua Li, Yong Jia, Gang Wang, Chao Yan and Yu Lv (Chengdu University of Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper mainly deals with the problem of joint DOD and DOA estimation for bistatic co-prime array by forming two augmented correlation matrices. Firstly, according to the difference co-array of co-prime transmitting array, an augmented transmitting correlation matrix is constructed to serve for DOD estimation by one-dimension MUSIC. Afterward, a two step augmentation method based on transmitting and receiving difference co-arrays is proposed to generate an augmented transmitting/receiving (T/R) correlation matrix which is utilized to calculate the paired DOAs by one-dimension MUSIC with the estimated DODs. Numerical simulations demonstrate the effectiveness of the proposed algorithm.

pp. 103-107

A Fast Building Layout Reconstruction Algorithm for Through-Wall Radar

Y Zhang (University of Electronic Science and Technology of China, China); Guolong Cui and Lingjiang Kong (University of Electronic Science and Technology of China (UESTC), China); Shisheng Guo and Huquan Li (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, we consider the reconstruction problem of building layout and interior objects only using the attenuation power. Different from the traditional imaging mode, we introduce a

novel scanning mechanism based on the bistatic radar. According to the attenuation characteristics of electromagnetic waves penetrating the objects, the received signal power is utilized to complete the reconstruction. We propose a fast building layout reconstruction algorithm which combines the filtered back projection (FBP) and sub-regional optimization. The algorithm not only can greatly improve operational efficiency, but also effectively solve the star-shaped tail problem of the projection algorithm. The numerical results have validated the effectiveness of the algorithm.
pp. 108-112

FriB02: Special Session: Data-driven Methods for Positioning and Tracking

Hotel Room A-2

Chairs: Tiancheng Li (University of Salamanca, Spain), Miodrag Bolic (University of Ottawa, Canada), Hongqi Fan (National University of Defense Technology, China)

Joint Target Tracking and Classification with Scattering Center Model for Radar Sensor

Ronghui Zhan, Liping Wang and Jun Zhang (National University of Defense Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, a model-based joint tracking and classification (JTC) method for wideband radar is proposed. The method is based on 3D scattering center model (3D-SCM), which is used to generate the predicted high range resolution profile (HRRP) with the information of target aspect angle. The aspect angle is estimated from the target state with particle filter. Target classification is implemented through the data match and correlation of observed HRRP with predicted HRRPs. For the continuity of tracking procedure, the estimate uncertainty of target state and class probability decreases as the filter's recursion proceeds, and thus to obtain a stable tracking and classification result. The effectiveness of the proposed method is validated by simulation results for maritime ship targets.
pp. 113-117

A Track-oriented Approach to Target Tracking with Random Finite Set Observations

Tiancheng Li (University of Salamanca, Spain); Junkun Yan (Xidian University, China); Xiaoxu Wang (Northwestern Polytechnical University, China); Hongqi Fan (National University of Defense Technology, China); Liang Yan (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

We have earlier presented a data-driven framework for target tracking, which models the target movement by using a trajectory function of time (T-FoT) rather than a Markov model. In this work, we extend the approach to the case of random finite set observations consisting of both missing and false data. More challenging, the missing and false data are generated under unknown ratios, i.e., they can not be accurately modeled. To tackle this problem, we here propose a data-driven method for identifying the real measurement of the target from clutter if the target is detected and for declaring a misdetection otherwise. Simulation is conducted to demonstrate the effectiveness of our approach, in comparison with the Bayesian-optimal approach.
pp. 118-123

Posterior Cramér-Rao Lower Bound of Target Tracking System using Quantized Innovations

Zhi Zhang and Zhaolei Liu (Nanjing Research Institute of Electronics Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper explores the problem of posterior Cramér-Rao lower bound (PCRLB) for the state estimation algorithms with quantized innovations in wireless sensor networks (WSNs). By the unscented Kalman filter (UKF), we derive the theoretical lower bound to evaluate the performances of this kind of estimators. Numerical example is provided in support of theoretical analysis, and the performances of the estimators are benchmarked by the proposed PCRLB.
pp. 124-128

Multi-platform track initiation method in dense clutter environment

Jin ZhongQian (The 20th Research Institute of China Electronics Technology Group Corporation, China); Liu GuanLong (Jilin University, China); Lu Yao (The 20th Research Institute of China Electronics Technology Group Corporation, China); Jiaqi Zhang (Xi'an Research Institute of Navigation Technology, China); Zhao Wang and Yang Di (The 20th Research Institute of China Electronics Technology Group Corporation, China)

The 2019 International Conference on Control, Automation and Information Sciences

The track initiation is the premise of target tracking. How to reduce the initiation of false track as much as possible under the condition of ensuring the normal initiation of the target, especially the effective reduction of false track in the strong clutter environment is an important direction of track initiation research. Aiming at the problem of track initiation in dense clutter environment, this paper proposes a multi-hypothesis, multi-rule, adaptive, multi-platform track initiation algorithm combined with clutter filtering technology. The experimental results show that the algorithm has higher track initiationing efficiency and clutter suppression effect.
pp. 129-133

FriB03: Special Session: Adaptive Radar Detection Algorithms and Performance Analysis

Hotel Room B

Chairs: Jun Liu (University of Science and Technology of China, China), Weijian Liu (Wuhan Electronic Information Institute, China), Yongchan Gao (Xidian University, China)

Robust Distributed Sonar CFAR Detection Based on Modified VI-CFAR Detector

Shuping Lu, Xu Sun, Feng Ding and Ranwei Li (Hangzhou Applied Acoustic Research Institute, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper proposes a robust distributed constant false alarm ratio (CFAR) detection algorithm to deal with the multistatic sonar target detection problem in the heterogeneous underwater environment. The local detector in the distributed sonar network employs the modified variability index (VI) CFAR where we apply the automatic censored mean level detector (ACMLD) and order statistic CFAR（OS-CFAR）to enhance its robustness in the more complex environment. The "MAJORITY" fusion rule is considered in the distributed fusion center. The performance of the proposed detection algorithm is analyzed by computer simulation and measured sonar data. The results show that, compared with the distributed cell averaging (CA) CFAR and VI-CFAR detectors, the new distributed detector achieves a better robustness in complex heterogeneous underwater environment.
pp. 134-139

Data dividing based approach for target detection with limited secondary data

Juexin Zhang (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

For target detection in unknown noise, sufficient secondary data is needed to form a nonsingular estimate of the noise covariance matrix (NCM). However the secondary data size is usually small in practice. Aiming to deal with the cases of limited secondary data, a new detection strategy involving data dividing is proposed for existing detectors in this paper. Firstly

the primary/secondary data vectors are divided by row into several groups, ensuring that the data model of each group meets the requirements of the existing detectors. Then the data of each group can be individually used for target detection. The final detection result is synthesized by those of all groups. In the simulation section, the polarization-space-time generalized likelihood ratio (PST-GLR) detector is selected to demonstrate the effectiveness of the detection strategy in the case of limited secondary data.
pp. 140-144

Robust GLRT Detection Exploiting Persymmetry in Partially Homogeneous Environments

Jun Liu (University of Science and Technology of China, China); Weijian Liu (Wuhan Electronic Information Institute, China); Chengpeng Hao (Institute of Acoustics, Chinese Academy of Sciences, China); Danilo Orlando (Universita' degli Studi Niccolo' Cusano, Italy); Alfonso Farina (Leonardo Company Consultant, Italy)

The 2019 International Conference on Control, Automation and Information Sciences

We exploit persymmetry to study the adaptive detection problem with multiple observations in partially homogeneous environments where noise shares the same covariance matrix up to different power levels between the test and training data. A persymmetric subspace model is designed for taking into account steering vector mismatches. Based on the persymmetric subspace model, we propose a generalized likelihood ratio test in partially homogeneous environments. The proposed detector is proved to exhibit a constant false alarm rate property against both the covariance matrix structure and the scaling factor. Numerical examples show that the proposed detector, compared to its counterparts, is more robust to steering vector mismatches.
pp. 145-150

Subspace signal detection using distributed MIMO radar in structured interference and Gaussian disturbance

Liyan Pan and Yongchan Gao (Xidian University, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, we deal with the problem of detect a target in structured interference and noise for a MIMO radar with spatially dispersed antennas. The target signal lies in a multi-rank subspace with unknown coordinates and the noise covariance variance matrix is unknown. A subspace detector based on generalized likelihood ratio test (GLRT) is proposed. To further mitigate the effect of small sample support, we derive a persymmetric GLRT detector to suppress interference and noise , which employs the persymmetric structure of covariance matrix. Finally, numerical examples are provided to illustrate the performance improvements of the proposed detectors over the traditional detectors, especially for the proposed persymmetric one in the training-limited scenarios.
pp. 151-155

A Feedback based Detection Procedure with Low Communication Rate for Distributed MIMO Radar

Yangming Lai, Tao Zhou, Haowen Xie and Shixing Yang (University of Electronic Science and Technology of China, China); Boxiang Zhang (UESTC, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper considers the detection problem and its realistic implementation for distributed multiple-input multipleoutput (MIMO) radar system in severe environment with limited communication bandwidth such as land battlefield. In view of bandwidth improvement of modern wireless communication compared with the previous ones and the limitation of the bandwidth in battlefield environment, a distributed detection procedure with low communication rate is proposed. The local measurement information is censored and the remaining data are transmitted to fusion center for detection. Considering the bidirectional transmission of wireless communication, a new feedback mechanism is proposed. The fusion center and local decision results are fed back to the next detection, and the threshold is adjusted adaptively to obtain additional detection performance gain. Eventually, numerical simulations are carried out to verify the effectiveness and feasibility of the proposed procedure.
pp. 156-160

FriB04: Information Fusion Methods

Hotel Room C

Chairs: Reza Hoseinnezhad (RMIT University, Australia), Yunfei Guo (Hangzhou Dianzi University, China)

Short-term Load Forecasting of Power System Based on Adaptive Fusion of Mixed Kernel Function

Jiancheng Wang and Yonghua Xu (Quzhou Guangming Power Investment Group Co., Ltd, China); Meilei Lv (Quzhou University, China); Daxing Xu (University of Quzhou, China)

The 2019 International Conference on Control, Automation and Information Sciences

Neural network is an important tool to solve the problem of nonlinear system prediction and control. It has been widely concerned by scholars. However, the existing neural network cannot adaptively allocate the weight of mixed kernel function according to the sample characteristics when it is applied to electric load forecasting. Aiming at this problem, short-term load forecasting algorithm based on adaptive fusion of mixed kernel function is proposed. Firstly, kernel functions are selected from the standard local kernel function and the global kernel function library to form a mixed kernel function. The weight variables and parameters of the kernel function are combined to form a new parameter state vector. Then a nonlinear parameter estimation model is established. Based on this model, the high-order cubature Kalman filter is used to estimate the parameter state, so that the local kernel function and the global kernel function can be adaptively fused. Moreover, the trained neural network is used to predict the load. Finally, the experimental analysis is given based on the actual grid data, and the effectiveness of the adaptive fusion of mixed function algorithm is proved.
pp. 161-165

Improvements to Measures of Nonlinearity Computation for Polynomial Nonlinearity

Mahendra Mallick (Independent Consultant, USA)

The 2019 International Conference on Control, Automation and Information Sciences

In our Fusion 2010 paper, we calculated curvature measures of nonlinearity (CMoN) of a polynomial curve in 2D using differential geometry, Bates and Watts and direct parameter-effects curvatures. The parameter-effects curvatures require the Jacobian and Hessian of the measurement function evaluated at the estimated parameter. Previously we obtained the maximum likelihood (ML) estimate of the parameter x by numerical optimization. In this paper, we present analytic expressions for the ML estimate and associated variance. We show through Monte Carlo simulations that the variance of the estimator and the Cram´er-Rao lower bound (CRLB) are nearly the same for different powers of x. We also find that the bias error is small and the mean square error (MSE) is close to the CRLB and variance of the ML estimate. Our numerical results show that the average normalized estimation error squared (ANEES) lies within the 99% confidence interval most of the time, indicating that the variance is consistent with the estimation error.
pp. 166-171

An Alternate Derivation of Polar/Spherical to Cartesian Measurement Conversion Using Conditional Density

Mahendra Mallick (Independent Consultant, USA); Zhansheng Duan (Xi'an Jiaotong University & College of Electronics and Information Engineering, China); Mark Morelande (RMIT, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

Common methods for calculating the converted Cartesian position measurement and associated covariance from polar or spherical measurements are: standard conversion, debiased conversion, unbiased conversion, and modified unbiased conversion (MUC). In this paper we present an alternate derivation of the converted Cartesian position measurement and associated covariance from polar or spherical measurements. First we obtain the conditional density of the true polar or spherical variables conditioned on the measurement. Then

we derive all moments of the Cartesian position using this conditional density. We show that these two moments of the Cartesian position can be calculated exactly assuming that measurement errors are zero-mean Gaussian and independent. We propose that "conditional mean" and "conditional covariance" would be better terminology than "MUC measurement."
pp. 172-176

Recursive LMMSE Centralized Fusion with Compressed Multi-Radar Measurements

Qingpeng Zhang (Xi'an Jiaotong University, China); Zhansheng Duan (Xi'an Jiaotong University & College of Electronics and Information Engineering, China); Uwe D. Hanebeck (Karlsruhe Institute of Technology & Karlsruhe Institute of Technology (KIT), Germany)

The 2019 International Conference on Control, Automation and Information Sciences

For multi-sensor centralized fusion with linear measurements, simply stacking all measurements up and then applying the Kalman filter at the fusion center can give the optimal estimation performance. This optimal performance is independent of how the measurements from different sensors are stacked up. However, for centralized fusion with multiple radar measurements under the recursive LMMSE filtering framework, the performance really matters as to how to stack the measurements from different radars. In [1], we have shown that centralized fusion with stacked recombined multi-radar measurements outperforms the one with stacked original measurements under the recursive LMMSE filtering framework. In this paper, we further develop a new multi-radar centralized fusion approach by compressing all measurements first and then applying the recursive LMMSE filter with single radar measurements at the fusion center. Numerical examples show that the new centralized fusion with compressed measurements has better estimation accuracy and smaller noncredibility than the ones with stacked measurements.
pp. 177-182

3D ResNet with Ranking Loss Function for Abnormal Activity Detection in Videos

Shikha Dubey and Abhijeet Yashawant Boragule (Gwangju Institute of Science and Technology, Korea (South)); Moongu Jeon (Gwangju Institute of Science and Technology (GIST), Korea (South))

The 2019 International Conference on Control, Automation and Information Sciences

Abnormal activity detection is one of the most challenging tasks in the field of computer vision. This study is motivated by the recent state-of-art work of abnormal activity detection, which utilizes both abnormal and normal videos in learning abnormalities with the help of multiple instance learning by providing the data with video-level information. In the absence of temporal-annotations, such a model is prone to give a false alarm while detecting the abnormalities. For this reason, in this paper, we focus on the task of minimizing the false alarm rate while performing an abnormal activity detection task. The mitigation of these false alarms and recent advancement of 3D deep neural network in video action recognition task collectively give us motivation to exploit the 3D ResNet in our proposed method, which helps to extract spatial-temporal features from the videos. Afterwards, using these features and deep multiple instance learning along with the proposed ranking loss, our model learns to predict the abnormality score at the video segment level. Therefore, our proposed method 3D deep Multiple Instance Learning with ResNet (MILR) along with the new proposed ranking loss function achieves the best performance on the UCF-Crime benchmark dataset, as compared to other state-of-art methods. The effectiveness of our proposed method is demonstrated on the UCF-Crime dataset.
pp. 183-188

Saturday, October 26

Saturday, October 26 8:30 - 9:30

SatP01: Plenary Talk III: Push and Pull in Digitalization: Technology Drivers for Sensor Data Fusion

Prof. Dr. Wolfgang Koch

Hotel Room A

Comprehensive networking, ubiquitous sensor technology, robots, drones, artificial intelligence, machine learning, ... and many more of these buzzwords! Digitalization has long since dominated almost all areas of modern life. Defence & Security is no less affected by the "digital revolution" in all its branches. On the contrary - many fundamental technologies have their roots in this area.

For a wide range of applications, we consider trends and practical examples to shed some light on the impact of comprehensive digitalization on sensor data fusion, i.e. on surveillance, resources management and supporting smart decisions. Fusion technology is basic for acing successfully and responsibly in the increasingly complex technosphere that is surrounding us.

Cognitivity of communication and sensor systems, automation of platforms up to levels of autonomy, manned-unmanned teaming, and handling of big or sparse data are technologies enabled by sensor data fusion and intelligent resources management and will be discussed by considering examples. Some more visionary ideas of fusion algorithms that are exploiting quantum physics inspired mathematics will conclude the talk.

Saturday, October 26 9:30 - 10:00

Break: Tea/Coffee Break

Saturday, October 26 10:10 - 11:50

SatA01: Special Session: Theory and Applications of Constrained Dynamic Systems

Hotel Room A-1

Chairs: Linfeng Xu (Northwestern Polytechnical University, China), Zhansheng Duan (Xi'an Jiaotong University & College of Electronics and Information Engineering, China), Gongjian Zhou (Harbin Institute of Technology, China), Feng Yang (Northwestern Polytechnical University, China)

Stabilizing Control for Cyber-Physical Systems against Energy-Constrained Deception Attacks

Jing He, Liang Yan, Linfeng Xu and Shi Yan (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Stabilizing control of cyber-physical systems (CPSs) is an important yet challenging problem since system modelling may face the coexistence of multiple uncertainties including unknown disturbances, unknown bounded delays, stochastic malicious attack and stochastic mode switching in complex environment, which cause system performance to deteriorate or even be unstable. However, the above uncertainties are rarely considered simultaneously in existing study. To this end, a novel system model is proposed to reflect not only the nonlinear characteristics, external disturbances and time-varying delays, but also the randomly occurring deception attacks, which is energy-constrained and lead to the system mode switching. We aim at designing a controller such that the system achieve the prescribed H_∞ disturbance rejection level. By constructing an appropriate Lyapunov-Krasovskii functional (LKF) and using the stochastic analysis techniques, the addressed controller design problem is transformed to an convex optimization problem, which can be solved by a linear matrix inequality (LMI) approach. Illustrative examples are given to show the effectiveness of the designed controller.

pp. 189-194

Improved Predictor-Corrector Guidance with Hybrid Lateral Logic for No-fly Zone Avoidance

Haibing Lin and Yanli Du (Nanjing University of Aeronautics and Astronautics, China); Erwin Mooij (Delft University of Technology, The Netherlands); Wu Liu (Nanjing University of Aeronautics and Astronautics, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, an improved predictor-corrector algorithm with hybrid lateral logic is proposed to enhance the maneuverability during re-entry, which lets the reusable launch vehicle (RLV) possess the ability of avoiding a no-fly zone. First, the longitudinal guidance is converted to the quasi-equilibrium guidance algorithm once current states satisfy the joint point condition. During each guidance period in the gliding phase, a quadratic parametric model is devised to adjust the magnitude of the bank angle instead of utilizing the linear one. Then, an artificial potential field based lateral guidance law is designed for no-fly zone avoidance by transforming the problem into finding the reference heading angle. But the bank angle reverses while the RLV is approaching the target, which may aggravate the instability problem and increase the energy consumption. Aiming at above problem, the lateral guidance is combined with conventional heading angle deadband corridor, which works when the RLV leaves the influence area of the no-fly zone. Finally, numerical simulations show that the proposed lateral guidance logic not only is effective for no-fly zone, but also performs well in reducing the times of reversals. The Monte Carlo simulation results further demonstrate the robustness of the above guidance algorithm considering the random initial dispersions and errors.

pp. 195-200

Extended Disturbance Observer Based Execution Adjustment Estimation Method of Dynamic Demand Response

Yaqing Zhao (Southeast University, China); Xin Shan (NARI Group Corporation, China); Wenjun Bi, Ying Wang, Kun Yuan and Kaifeng Zhang (Southeast University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Since Dynamic demand response (DDR) has the characteristics of large quantity and uncertainty, it is difficult to get accurate response power in real time. At the same time, it is very important to know the execution adjustment of DDR accurately and quickly for updating DDR control strategy and frequency regulation of power system. In this paper, we design an extended disturbance observer (EDO) to estimate the execution adjustment of DDR. Firstly, in order to facilitate the design of estimation scheme, a simplified load frequency control (LFC) model is obtained by using model fitting method. Then, by combining the load variation with tie-line power exchange as an extended disturbance, a reduced-order LFC model of power system is derived. Finally, based on the reduced-order LFC model, EDO can be designed by pole-assignment method. The execution adjustment of DDR can be obtained by subtracting the measured value of tie-line power from the estimated value of the observer. From the simulation results of a multi-area LFC control system, the effectiveness of the proposed scheme is demonstrated.

pp. 201-205

Simulation Analysis for Ultra-wideband Positioning Algorithms

Feng Yang, Xinyi Tang and Litao Zheng (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Ultra-wideband (UWB) positioning technology has received wide attention due to its advantages in indoor positioning. Considering practical application, the improved time of arrival (TOA), time difference of arrival (TDOA) and time difference of arrival-angle of arrival (TDOA-AOA) hybrid algorithms based on least squares method are discussed and compared in the paper. The comparative analysis in this paper includes two aspects: different numbers of base stations and different area lengths. The positioning accuracy and computational complexity are compared under these two conditions. Through the simulation experiments on static and dynamic target positioning, the performances of the three algorithms are verified and analyzed, which can strongly support the practical application usage.

pp. 206-211

Set-Membership Filtering with Quadratic Inequality Constraints

Xiaowei Li, Xuedong Yuan, Fanqin Meng, Yiwei Liao, Haiqi Liu, Xuqi Zhang and Xiaojing Shen (Sichuan University, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper investigates the problem of setmembership filtering for nonlinear dynamic systems with general nonconvex inhomogeneous quadratic inequality constraints. We propose an ellipsoidal state bounding estimation in the setting of unknown but bounded noise. To guarantee the on-line usage, at each time step, the nonlinear function is linearized by Taylor expansion, where the bounding ellipsoid of the remainder is updated on-line based on the current state bounding ellipsoid. Moreover, based on the remainder bounds and the constraints, both the state prediction and measurement update of the filtering can be transformed to a semidefinite programming problem which can be solved efficiently. A typical numerical example demonstrates the effectiveness of this filtering.

pp. 212-217

SatA02: Special Session: Multi-Object Filtering and Tracking

Hotel Room A-2

Chairs: Weifeng Liu (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou, Zhejiang Province, China), Baishen Wei (Guangzhou University, China), Benlian Xu (Changshu Institute of Technology, China)

Nearest-neighbour Joint Probabilistic Data Association Filter Based on Random Finite Set

Shuang Liang (Xidian University, China); Yun Zhu (Shaanxi Normal University, China); Hao Li and Maoguo Gong (Xidian University, China)

The 2019 International Conference on Control, Automation and Information Sciences

To deal with the track coalescence problem and improve the tracking performance of the standard joint probabilistic data association (JPDA) filter, an improved nearest-neighbour JPDA filter based on random finite set (RFS) is proposed when target identity is irrelevant. First, the standard JPDA filter is utilized to compute the target posterior density. Then, the posterior density is optimized by reordering the target index in each global association hypothesis using a novel nearest-neighbour method. Finally, the marginalized posterior densities of all targets are obtained as independent Gaussian densities. Compared to conventional data association methods, the proposed approach needs less computing time and achieves satisfactory tracking accuracy.

pp. 218-223

Joint Time-Space Resource Allocation and Waveform Selection for the Collocated MIMO Radar in Multiple Targets Tracking

Xi Li (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Compared with conventional phased array radar, the collocated multiple input multiple output (MIMO) radar can effectively control the transmitting beam width by means of sub-array division. Therefore, different targets may be illuminated simultaneously with one beam in the collocated MIMO radar, providing greater freedom degree in resource management. The joint time-space resource allocation and waveform selection optimization model for the collocated MIMO radar is proposed in this paper, where the objective function that takes both the system resource and tracking precision into consideration is minimized under the guarantee of effective targets detection. Through solving the proposed optimization model, the corresponding joint optimization algorithm is obtained. The optimal sampling period, sub-array number, illuminated targets set, transmitting energy and transmitting waveform parameters combination is chosen adaptively, where the former four realize the time-space resource allocation and the last one realizes the waveform selection. Simulation results demonstrate that the proposed algorithm can reduce objective function compared with fixed corresponding parameter algorithms by jointly controlling the working parameters of the collocated MIMO radar effectively.
pp. 224-229

Better Night Vehicle Detection With Visible-light and Infrared Cameras: A Fusion Framework Based on YOLOv3

Feng Yang, Haiwei Hu and Wentong Li (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Night vehicle detection is a basic task to achieve all-weather uninterrupted object detection. It is not only beneficial to automatic identification technology in the field of national defense and military, but also to promote the development of intelligent transportation system. The main difficulty of night detection is how to achieve robust and accurate detection function under weak illumination. In addition, the complex ground environment is also an essential problem in vehicle detection from aerospace to ground. To solve these problems better, this paper proposes a fusion framework using visible and infrared information based on YOLOv3, combining with the current high-performance detection module to improve the performance for specific poor lighting conditions and complex ground features. Through training and testing the visible and infrared dataset which collected by autonomous UAV, the rationality and practicability of the proposed framework are proved.
pp. 230-235

Improved Box Particle CPHD Algorithm for Group Target Tracking

Xuan Cheng (Xidian University, China); Hongbing Ji (School of Electronic Engineering, Xidian University, China); Yongquan Zhang (Xidian University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Aiming at the problems of large computation and poor estimation performance of the existing box particle CPHD algorithm for group target tracking in strong clutter environment, an improved box particle CPHD algorithm for group target tracking is proposed. This algorithm utilizes the characteristic of likelihood function in box particle filter to generate an adaptive rectangular tracking threshold, which eliminates a large number of clutter measurements and reduces greatly the computational burden. In addition, the estimation performance is improved by modifying the way of box particles supplementation and k-means clustering algorithm in the state extraction. The simulation experiments show that the proposed algorithm has a higher real-time performance and better estimation performance in strong clutter environment.
pp. 236-242

A Novel Identity Authentication Method by Modeling Photoplethysmograph Waveform

Shuo Cheng (Changshu Institute of Technology, China); Yongxin Chou (Changshu Insititute of Technology, China); Jicheng Liu and Ya Gu (Changshu Institute of Technology, China); Xufeng Huang (The East China Science and Technology Research Institute of Changshu Co., Ltd, China)

The 2019 International Conference on Control, Automation and Information Sciences

In order to improve the reliability of identity authentication, this study explores a novel PPG-based method. First, a morphology modeling method is proposed to quantitatively describe the PPG waveform with 12 features. The probabilistic neural network (PNN) and random forest (RF) are used to recognize which subject the PPG waveforms belong to. Then, the measured PPG signals are engaged as the experimental data to validate the proposed method. The experimental results show that the performance of RF is better than that of PNN, the average kappa coefficient is over 93%. Therefore, the proposed method has great potential in identity authentication by wearable devices.
pp. 243-247

SatA03: Special Session: Track-Before-Detect Techniques for Detection and Tracking of Low SNR Targets

Hotel Room B

Chairs: Zengfu Wang (Northwestern Polytechnical University, China), Daikun Zheng (Air Force Early Warning Academy, China), Wei Yi (University of Electronic Science and Technology of China, China)

Double-directional Bernoulli Track-Before-Detect filter with particle flow

Chao Liu (Beihang University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Track-before-detect (TBD) aims to detect and track a weak target by integrating measurements over time and position. The key prerequisite to the integration is the accurate representation of the target measurement. However, the TBD methods implemented by the particle filter rely too much on the proposal density, and thus the representation of the measurement is not accurate enough. Therefore, this letter proposes a novel TBD method, which incorporates the newly developed particle flow filter into the Bernoulli TBD filter to improve the measurement representation. Moreover, the poor initial state estimation is also refined by a double-directional filtering solution. The effectiveness of this method is demonstrated on the simulation results of a fluctuating weak target tracking in K-distributed clutter.
pp. 248-253

A Velocity Filtering Method for Track-Before-Detect with Multiple Sensors

Tao Han, Liangliang Wang and Gongjian Zhou (Harbin Institute of Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

Detecting and tracking weak target with multiple sensors performs superiorly to that with single sensor. In this paper, a multi-sensor velocity filter based track-before-detect (MS-VF-TBD) method in mixed coordinates is proposed for weak target detection. First, the predicted position in the global Cartesian coordinate of each cell of each sensor is achieved in terms of the assumed velocity and the position in Cartesian coordinate which is converted by the cell in sensor coordinate. Then the measurement of the cell is added onto the cell closest to the predicted position converting back to the global sensor coordinate to realize the process of target energy integration within multiple sensors. The energy accumulation procedure of multiple sensors is derived in detail. Simulation results demonstrate the superiority of the proposed method compared with other MS-TBD methods in terms of detection probability and estimation accuracy.
pp. 254-258

A Track-Before-Detect Method for Rotating Radars with Revisit Interval Uncertainty

Peiyuan Li (Harbin Institute of Technology, China); Liangliang Wang and Gongjian Zhou (Harbin Institute of Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

In traditional track-before-detect (TBD) algorithms, intervals between frames are considered to be uniform. The uncertainty of revisit intervals is not taken into account. However, revisit intervals of the target varies with its states in rotating radars. This may lead to degradation in energy integration due to the use of inaccurate revisit intervals in conventional methods. In

this paper, a velocity-filtering-based TBD method with revisit interval uncertainty (RIU-VF-TBD) is proposed to address the above problem. The revisit interval is solved precisely using the space-time joint solution. Using the angle relation between target movement and the motion of antenna, the revisit interval is solved iteratively until accuracy requirement is reached. Each measurement cell in polar coordinates is converted to Cartesian coordinates and predicted according to an assumed velocity and the precisely solved revisit interval. Then, every predicted Cartesian position is converted back to polar coordinates for energy accumulation. Procedures of the revisit interval calculation and energy integration are derived in detail. Simulation results demonstrate the superiority of the proposed algorithm compared with conventional VF-TBD methods.
pp. 259-264

A Real-Time Filtering Approach for Plot-Sequences Outputted by Multi-Frame Track-Before-Detection

Kezhu Liu, Wujun Li and Lingjiang Kong (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper addresses the real-time filtering problem respect to the multi-frame track-before-detection (MF-TBD). Instead of making detections on each single frame, MF-TBD jointly processes multiple raw data frames at each time, which can remain and utilize more target information. Thus, different from the conventional detection procedure which provides single point plot to a tracker, output of MF-TBD is plot-sequence. However, for batch processing MF-TBD, there are repetitive parts (named plot-sets) under a number of consecutive batches in time series while the correlation among each plot in the plot-set is complex and unpractical to computation. In this paper, by avoiding the computation of correlation, a novel filtering approach is developed for filtering and fusion to the plot-sequences outputted by batch processing MF-TBD. Last, simulation results show that the proposed algorithm can correctly estimate target trajectories and significantly enhance the tracking accuracy compared with the MF-TBD without our filtering algorithm.
pp. 265-269

Maneuvering Target Joint Detection and Tracking Using Multi-Frame Integration

Daikun Zheng (Air Force Early Warning Academy, China); Hong Xu (Navy University of Engineering, China); Chang Zhou (Air Force Early Warning Academy, China)

The 2019 International Conference on Control, Automation and Information Sciences

The authors present an efficient joint detection and tracking algorithm for maneuvering target. To exploit the space-time correlation of the target among successive frames, we derive an expectation multi-frame test statistic containing a quantifiable term of target motion character by probabilistic dynamic programming. A joint filtering and smoothing estimation based on the interacting multiple model (IMM) is developed to design and calculate the state transition probability of target motion. The proposed algorithm promises a satisfying detection performance in that the designed state transition probability can steer the test statistic to be integrated along the real target trajectory more likely. Besides, better tracking performance can be obtained since the outputs of the proposed algorithm are filtered or even smoothed trajectories of the detected targets. Simulation results illustrate the performance of the proposed algorithm.
pp. 270-275

SatA04: Radar Signal Processing Methods

Hotel Room C

Chairs: Mahendra Mallick (Independent Consultant, USA), Qiang Huang (Nanjing Research Institute of Electronics Technology, China)

Generalized Space-Time Adaptive Monopulse Angle Estimation Approach

Rong Zhou (AVIC Leihua Electronic Technology Research Institute, China)

The 2019 International Conference on Control, Automation and Information Sciences

For airborne radar, Space-time adaptive processing (STAP) is the key technique to suppress both clutter and interference and detect moving target in strong ground clutter. Monopulse technique after STAP is used to estimate target angle. However, with this adaptive processing, the typical monopulse technique is no more effective because the main beams are distorted, that may lead to angle errors. This paper is concerned with the main beam distortion that results from clutter suppression by STAP. Generalized monopulse is extended to a space-time adaptive architecture to improve the accuracy of angle estimation. Simulation results show that performance of the proposed method is superior to that of the typical method.
pp. 276-280

A Knowledge-Aided Wald Detector for Target Detection in Sea Clutter

Yisong Zhang, Wenguang Wang, Nan Wang and Jihuang Yang (Beihang University, China)

The 2019 International Conference on Control, Automation and Information Sciences

A new knowledge-aided Wald detector is proposed in this paper to deal with the target detection under the inhomogeneous sea clutter. Aim to the scenario of dynamic sea clutter, the proposed detector updates the covariance matrix of background by comprehensive use of the prior information matrix and the covariance matrix. At the same time, the morphological processing is introduced to obtain the final detection result. Both the simulation and measured data show that the proposed detector can achieve better detection performance than KA-Wald detector. The experimental results show that the proposed knowledge-aided Wald detector is effective to target detection under the inhomogeneous sea clutter.
pp. 281-284

Joint Estimation of DOA and Frequency with Sub-Nyquist Sampling in a Sparse Array Radar System

Zhan Zhang (University of Electronic Science and Technology of China, China); Ping Wei (University of Electronic Science and Technology of China, Chengdu, China); Ningkang Chen, Lijuan Deng and Huaguo Zhang (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Direction-of-arrival (DOA) estimation has been an important research topic in the field of radar signal processing for a long time. Recently, joint estimation of DOA and frequency has been extensively studied. This paper considers joint DOA and frequency estimation of multiple narrow-band signals received by array radars at sub-Nyquist rates. A new sub-Nyquist array architecture (a sparse array radar whose the reference unit connects to a sparse multi-coset structure and the other units connect to 2 channel multi-coset structure) and corresponding efficient technique (a joint estimation algorithm with an augmenting method) are proposed. The estimation algorithm can match frequencies up with corresponding DOAs, and the augmenting method can increase the capability of the number of identifiable signals from $M-1$ to $Q-1$ (Q is extended estimating degrees of freedom). We further analyze the minimum total sampling rate of achieving joint estimation. Simulations results verify the effectiveness and performance of this technique in this sparse array structure.
pp. 285-290

A Measurement-Mixed Localization Algorithm in Distributed MIMO Radar System

Haowen Xie, Tao Zhou, Yangming Lai and Lingjiang Kong (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, the problem of location with limited communication bandwidth is considered for non-coherent multiple-input multiple-output (MIMO) radar with widely separated antennas. Firstly, we build a MIMO radar system model with limited communication bandwidth and signal processing mechanism of the system. Then we propose a measurement-mixed localization algorithm, which consider the problem of localization joint with parameter and signal measurements in homogeneous noise environment. Our proposed algorithm can explore the potential of the positioning in the communication-limited MIMO radar system and take full advantage of the measurements from the radars to improve localization accuracy. Simulation results show that the measurement-mixed localization algorithm can correctly localize the target with high accuracy under the condition of high signal-to-noise ratio (SNR).
pp. 291-295

Sea/Land Clutter Recognition for Over-The-Horizon Radar via Deep CNN

Zengfu Wang, Can Li, Zhishan Zhang and Hua Lan (Northwestern Polytechnical University, China); Kun Lu (Nanjing Research Institute of

Electronics Technology China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Over-the-horizon radar (OTHR) is of significance in persistent surveillance. To localize targets, coordinate registration (CR) has to be carried out to transform the coordinates of the targets from the slant coordinate system to the ground coordinate system. An alternative way to improve the accuracy of CR is the utilization of sea-land transitions and islands. The key novelty of this paper is a solution of recognizing sea/land clutter based on the range-Doppler spectrum of OTHR. We propose a deep convolutional neural network~(DCNN) with multiple hidden layers to learn features of different levels directly from the input R-D spectrum of sea/land. With the help of massive training data, the results of the experiment show that the proposed DCNN performs better than the support vector machine method and the least-mean-square method.

pp. 296-300

SatA05: Robust Multi-Target Tracking Methods and the Related Applications

Hotel Room D

Chairs: Ba-Ngu Vo (Curtin University, Australia), Taek Lyul Song (Hanyang University, Korea (South))

An explicit track continuity algorithm based on the GM-PHD filter with adaptive birth intensity

Yiyue Gao, Defu Jiang, Yan Han and Song Wang (Hohai University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Due to its low computational cost, the Gaussian mixture (GM) implementation of the probability hypothesis density (PHD) filter is a good candidate for multi-target tracking (MTT), especially in real-time processing applications. In this study, we propose an explicit track continuity algorithm based on the GM-PHD filter with unknown target birth intensity for online MTT. In this approach, the identity labels of Gaussian components are divided into three classes, and the labels of confirmed components are unchanged through the overall filtering process, this can provide explicit MTT. Based on the measurement not associated with the predicted components, the adaptive target birth intensity is obtained. The simulation results demonstrate that the proposed approach can achieve explicit MTT under the unknown target birth intensity scenes.

pp. 301-306

Multi-Target Tracking based on the EK-GLMB Filter in 3D Using Active Radar with Velocity Measurement

Boxiang Zhang (UESTC, China); Yangming Lai, Qi Yang and Lingjiang Kong (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

The measurement collected by 3D (3-dimensional) active radar is usually a non-linear polar coordinate measurement and capture true targets and false clutter information. Furthermore, the true targets are usually unknown and time-varying and the correlation between targets and measurements is uncertain. Hence, multi-target tracking in 3D is extremely challenging. In this paper, we firstly establish 3D polar coordinate measurement model. Specifically, for the radar which can measure line-of-sight (LOS) rate and target Doppler information, we build 3D velocity-measurement model by modifying the former. Then, combined with the non-linear measurement model, a tracking algorithm based on the extended Kalman (EK) generalized labeled multi-Bernoulli (GLMB) filter is proposed for multi-target tracking in 3D. Finally, numerical results demonstrate the validity of the proposed method in 3D using active radar in the presence of detection uncertainty, false observations, and noise.

pp. 307-312

Likelihood Adjustment based on Informativeness of Observation for Extended Object Tracking

Koichiro Suzuki (Denso IT Laboratory, INC., Japan); Norikazu Ikoma (Nippon Institute of Technology, Japan); Chiharu Yamano (Denso IT Laboratory, INC., Japan); Mitsutoshi Morinaga (DENSO Corp., Japan)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper we consider the problem of extended object tracking when a few measurements are available. For automotive safety, it is important to estimate the state of vehicle, i.e. position, velocity and its extent, using multiple measurements from unique object. Many observation models of extended object for vehicle tracking problem have been proposed, but they paid less attention about a number of measurements that can degrades the likelihood of target. We propose a novel likelihood adjustment method based on informativeness of observation, which correspond to the number of observed points and their formation, in a context of extended object tracking. Numerical simulations with a simplified but essential model figure out performance of the proposed method by comparing with conventional methods.

pp. 313-318

RTS Smoother for GLMB filter

Tran Thien Dat Nguyen (Curtin University, Bentley, Australia); Jongmin Yu (Curtin University, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, we implement a low-cost but effective smoothing strategy to smooth estimated tracks returned by the GLMB filter. While the forward filtering step is carried out via the GLMB filtering procedure, the backward smoothing step is recursively implemented from the final time step to the first time step via a smoothing algorithm. In particular, the smoothing algorithm is based on the Rauch-Tung-Striebel (RTS) of fixed-interval smoother. We demonstrate our smoothing strategy on a linear Gaussian model and the experimental results show improved tracking performance.

pp. 319-324

Sensor Control for Multi-Target Tracking in the Presence of Doppler Blind Zone

Xin Xie, Hemin Sun, Weihua Wu, Yichao Cai, Surong Jiang and Changfei Wu (Air Force Early Warning Academy, China)

The 2019 International Conference on Control, Automation and Information Sciences

For multi-target tracking of unmanned airborne radar, tracking performance is seriously deteriorated by the presence of the Doppler blind zone (DBZ). Aiming at this problem, a sensor control method based on Cauchy-Schwarz divergence (CSD) to suppress the influence of DBZ is proposed in this paper. Firstly, the jump Markov model is introduced into the novel Gaussian mixture probability hypothesis density (PHD) filter. Secondly, the Cauchy Schwarz divergence expression between the predicted intensity and the posterior intensity of the filter is derived. Finally, based on Cauchy-Schwarz divergence, by controlling the trajectory of the unmanned aerial vehicle (UAV), the DBZ is avoided as much as possible, thereby improving the quality of measurements and the multi-maneuvering-target tracking performance of the unmanned airborne radar. Simulation results show that the proposed method can effectively suppress the influence of DBZ.

pp. 325-330

Saturday, October 26 1:30 - 3:10

SatB01: Posters for ICCAIS 2019 I

Hotel Room A-1

Chairs: Mahendra Mallick (Independent Consultant, USA), Suqi Li (University of Electronic Science and Technology of China, China)

Multiple source DOA tracking based on Multi-Bernoulli Particle Filter under acoustic vector sensor array

Sunyong Wu, Xudong Dong, Jun Zhao and Qiutiao Xue (Guilin University Of Electronic Technology, China); Cai Ruhua (School of Mathematics and Compute Science, Guilin University of Electronic Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

According to the problem of multiple source direction of arrival (DOA) tracking of acoustic vector sensor (AVS) array, a two-dimensional DOA tracking algorithm based on Multi-target Multi-Bernoulli (MeMBer) filtering is proposed. A Multi-Bernoulli random finite set (RFS) framework is employed to characterize the randomness of the number of active targets, as well as measurement process, so as to establish the observation equation. Since the closed-form solution of the multi-target posterior probability density is difficult to implement, the particle filter algorithm is used to obtain an approximate solution. The MUSIC spectrum function has been regarded as the likelihood function of particle filtering and exponentially weighted to enhance the weight of particles at high likelihood area. The merits of this proposal are that the MeMBer filtering is able to operate more directly on AVS array signals, effectively solving the problem of multiple time-varying target recognition. Simulation experiments show that this algorithm can accurately track the source state and estimate the number of sources.

pp. 331-336

Modification of Q-learning to Adapt to the Randomness of Environment

Xiulian Luo, Youbing Gao, Shao Huang, Yaodong Zhao and Shengmiao Zhang (Science and Technology on Electronic Information Control Laboratory, China)

The 2019 International Conference on Control, Automation and Information Sciences

Q-learning is a typical model-free algorithm in reinforcement learning to achieve a goal by interacting with an uncertain environment. However, conventional Q-learning cannot reach convergence and even learns bad policies when the state transition and the immediate reward of the environment are randomly distributed. This paper gives a modification of the Q-learning algorithm by exploring a Monte Carlo method to settle the above problems. Furthermore, simulation experiments are performed to validate the modified Q-learning algorithm.

pp. 337-340

Neural Q-Learning Based on Residual Gradient for Nonlinear Control Systems

Yanna Si (Henan University of Science and Techonlogy, China); Jiexin Pu (Henan University of Sci. & Tech., China); Shaofei Zang (Henan University of Science and Techonlogy, China)

The 2019 International Conference on Control, Automation and Information Sciences

To solve the control problem of nonlinear system under continuous state space, this paper puts forward a neural Q-learning algorithm based on residual gradient method. Firstly, the multi-layer feedforward neural network is utilized to approximate the Q-value function, overcoming the "dimensional disaster" in the classical reinforcement learning. Then based on the residual gradient method, a mini-batch gradient descent is implemented by the experience replay to update the neural network parameters, which can effectively reduce the iterations number and increase the learning speed. Moreover, the momentum optimization method is introduced to ensure the stability of the training process further and improve the convergence. In order to balance exploration and utilization better, ε-decreasing strategy replaces ε-greedy for action selection. The simulation results of CartPole control task show the correctness and effectiveness of the proposed algorithm.

pp. 341-345

Bearings-Only Target Motion Analysis using Ray Tracing

Raegeun OH and Taek Lyul Song (Hanyang University, Korea (South)); Jee Woong Choi (Hanyang, Korea (South))

The 2019 International Conference on Control, Automation and Information Sciences

Target angular information in a 3-dimensional space consists of an elevation angle and an azimuth angle. The azimuth angle indicates the direction of the target in a horizontal plane while the elevation angle indicates the direction of target signal in a vertical plane established from a passive line array sonar. The acoustic signals gathered by the line array sonar have different elevation angles as they propagate through multiple paths. The target angle measured by the line array sonar is, in fact, a conical angle that indicates the direction of incoming signal to the line array sonar system. Therefore, bottom bounce path produces an inaccurate target location if it is interpreted as the azimuth angle in the horizontal plane as is commonly used in exiting TMA technologies. Therefore, it is necessary to consider the conical angle effect on bearings-only Target Motion Analysis (BO-TMA). In this paper, the conical angle of target that causes angular ambiguity will be simulated. And the BO-TMA method using Particle Swarm Optimization (PSO) is proposed to solve the angular ambiguity problem.

pp. 346-350

Trajectory Tracking Control of a Large Six-DOF Platform Based on Integral-Type Terminal Sliding Mode Control and Bat Algorithm

Zhiyuan Cheng, Weijia Li, Yaozhong Wu and Yuhang He (Huazhong University of Science and Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, an integral-type terminal sliding mode control (ITSMC) based on an improved reaching law and the bat algorithm (BAT-ITSMC) is proposed for the large six degree of freedom (Six-DOF) platform. The bat algorithm is firstly used to optimize the parameters of the ITSMC. The chattering problem of trajectory tracking for the large Six-DOF platform is difficult to avoid. To deal with the limitation, the integral-type terminal sliding mode surface is used. The utilization of bat algorithm ensures the high efficiency of the parameter optimization. The stability is analyzed by Lyapunov method. Finally, the simulation results are presented to validate the effectiveness and stability of the proposed method.

pp. 351-356

Rapid Recognition of Human Behavior Based on Micro-Doppler Feature

Chengzhi Wang, Zhangjing Wang, Yueqin Yu and Xianhan Miao (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, we use principal component analysis (PCA) and Mel frequency cepstrum coefficient (MFCC) to study the classification of human behavior based on micro-Doppler features. The PCA can reduce linear dimensionality and computational complexity. The MFCC can extract micro-Doppler features of different frequencies. The combination of PCA and MFCC can reduce the time which is used to extract the micro-Doppler features of human behavior and the time which is used to calculate the feature extraction. So, the combination method can realize real-time processing. We collect data from 6 differential behaviors of 12 person by using the frequency modulated continuous wave (FMCW) radar. And then, we classify human activities by using support vector machine which is extracted from PCA and the MFCC feature vectors. Experimental results show that our method has a good recognition rate.

pp. 357-361

A Survey on Virtual Bass Enhancement for Active Noise Cancelling Headphones

Kenneth Coker and Chuang Shi (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

This survey paper includes a modernized update on multiple initiatives taken to enhance virtual bass. It provides an overview of how much work has been accomplished in this research area, which is an evolving trend at the moment. The paper introduces a virtual bass toolbox that is easy to use for beginners and elaborates three main kinds of virtual bass enhancement algorithm. The auditory feeling of low frequency is discussed and a vivid analysis of the missing fundamental effect is also provided. A wide range of commercial products of the ANC headphones are compared. This paper also shows the trend of attempting the virtual bass enhancement in active noise cancelling (ANC) headphones. We present some open-ended questions in the latter portion of this paper, and this provides a full concept of the future research to carry out the virtual bass enhancement in ANC headphones.

pp. 362-366

A Labeled multi-Bernoulli Filter for Multisource DOA Tracking

Gaiyou Li (University of Electronic Science and Technology of China, China); Ping Wei (University of Electronic Science and Technology of China, Chengdu, China); Yuansheng Li and Yiqi Chen (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper addresses the problem of multisource direction-of-arrival (DOA) tracking based on the labeled multi-Bernoulli (LMB) filter. In order to avoid information loss, we directly utilize the received signal at an array antenna.The normal superpositional measurement model can be used to describe the relationship between DOAs from multiple sources to the received signal. LMB is not conjugated under the multi-target likelihood function of this distribution, so no analytical solution can be obtained. In order to overcome such difficulty, the likelihood of superpositional measurement model is approximated as a complex Wishart random matrix, and the updated LMB distribution is computed by matching the probability hypothesis density (PHD) of posterior. The auxiliary particle filter is employed to implement the LMB filter, and the performance of proposed algorithm is verified via simulations.

pp. 367-372

Adaptive-Transition-Set Track Before Detect Algorithm Based on Dynamic Programming

Dan LE, Qiang Huang and Zhaolei Liu (Nanjing Research Institute of Electronics Technology, China); Xianyan WU (Nanjing Agricultural University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Original dynamic programming based track-before-detect (DP-TBD) assumes that targets run with nearly uniform motions and known velocities. However, targets in real-world scenes do not always run with nearly uniform motions and their velocities are usually unknown, and all we know is the minimum and maximum speeds of these targets. Original DP-TBD suffers significant performance loss under the circumstances. Aiming at the problem, this paper proposes an adaptive-transition-set DP-TBD (ATS-DP-TBD) algorithm, which refines the transition set of DP-TBD by estimating the states of targets as DP-TBD processes the measurement frames. The transition set initially is rough, which is determined by the minimum and maximum speeds, then becomes more accurate by a filter. Simulation results show that the proposed ATS-DP-TBD outperforms the original DP-TBD, the detection probability increases by 0.17, and the number of the false alarms is reduced over 94%.

pp. 373-377

Path Planning for Mobile Robot Using Improved Adaptive Rapidly-exploring Random Tree

Songcan Zhang and Jiexin Pu (Henan University of Science and Technology, China); Yanna Si (Henan University of Science and Techonlogy, China); Lifan Sun (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Path planning based on RRT has achieved great achievements in a complex and high dimensional environment. RRT algorithms require the user to choose an appropriate stepsize and bias probability before path planning, however, selecting algorithm parameters suitable for various environments is not only difficult but also time consuming. An improved adaptive RRT algorithm is proposed in this paper and has two notable features. Firstly, it can automatically determine the initial range of stepsize and bias probability according to the relative complexity of the robot's working environment, which is ever highly problem dependent and time-consuming process. Secondly, it can automatically adjust these two parameters on the basis of the collision detection result as the iteration continue.Various numerical experiments are demonstrated and validated to illustrate the effectiveness and obvious advantages of the proposed algorithm over the basic RRT algorithm under different environmental conditions.

pp. 378-383

Focusing Bistatic Forward-looking SAR Images use Omega-k algorithm based on Modified Hyperbolic Approximating

Xiaohu Zhang (Nanjing University of Science and Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

Forward-looking imaging has many potential applications, such as self-landing, navigation, etc. This paper shows a modified hyperbolic approximating method for bistatic forward-looking SAR imaging. Compared with the original hyperbolic approximating, the modified method can handle the bistatic forward-looking geometry better and make the equivalent range history more accurate. Based on the modified approximating method, a modified Omega-k imaging algorithm is deduced. Finally, numerical simulations are used to validate the proposed modified hyperbolic approximating and the imaging algorithm.

pp. 384-388

Local directional intensity pattern for facial expression recognition

Weijia Huang and Zhengyan Zhang (Jiangsu University of Science and Technology, China); Huaming Liu (Fuyang Teachers College, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper presents a new face descriptor, local directional intensity pattern (LDIP), for human facial expression recognition. Considering the edge information and pixel intensity changes of face images, local features extracted from not only frequency domain but also spatial domain are encoded in a compact way, which makes features complementary to each other and much more discriminative. Additionally, the histogram refinement further reduces the feature dimensions while enhancing the performance of the texture descriptor. Extensive experiments are conducted to verify the effectiveness of our proposed method. The experimental results demonstrate that the LDIP is a discriminative and efficient facial expression descriptor, which achieves higher recognition rate than other descriptors.

pp. 389-394

Target Localization in CEMS Based on Shunt-Wound Radial Basis Function Network

Hao Wu, Yongqiang Cheng, Xixi Chen and Zheng Yang (National University of Defense Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

In the complex electromagnetic space, the traditional methods can not normally work, because of the absence of the model information about the space. Due to the rapid development of artificial neural network, the data-driven method is available and effective for solving the localization issues in CEMS. However, because the unknown electromagnetic environment can not support us to select the input of training data, the inputs of training data are nonuniform, which would result in the unexpected performance of RBF network. For solving the problem, the convex transformation and the shunt-wound structure are proposed and employed in this article. Furthermore, the experimental results show the proposed RBF network is better.

pp. 395-399

Distributed Multi-Sensor Information Acquisition for Target Localization with Range and Doppler Measurements

Yongqiang Cheng, Xixi Chen, Hao Wu and Zheng Yang (National University of Defense Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper presents an analysis of target localization accuracy, attainable by the use of Fisher information metric, configured with distributed multi-sensor. First, the mathematical relationship between data information content and target parameters is derived according to the radar's measurement model of range and velocity. Then, radar information metric and information acquisition under different bandwidth and different systems are analyzed. Finally, simulation results show the effectiveness of the proposed method. Conclusions in this paper could be useful for the configuration and management of multi-sensor networks.

pp. 400-404

SatB02: Special Session: Recent Advances in SLAM

Hotel Room A-2

Chairs: Martin D Adams (University of Chile & Advanced Mining Technology Centre, Chile), Chunyun Fu (Chongqing University, China), Amirali Khodadadian Gostar (RMIT University, Australia)

Feature extraction of laser point cloud based on clustering algorithm and curvature function

Feng Yang, Haotian Li and Bo Jin (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

With its irreplaceable advantages, lidar is widely used in Simultaneous Localization And Mapping (SLAM) applications. In regards to lidar, the key point is the feature extraction of laser point clouds. However, the existing feature extraction algorithms for laser point clouds, such as the curvature function, line tracking and splitting with merging, exist the disadvantages of complex parameter adjustment and low extraction accuracy. A joint method of extracting breakpoints by density-based spatial clustering of applications with noise (DBSCAN) algorithm and extracting corner and edge by the curvature function is proposed. The experimental results show that the joint feature extraction algorithm is more accurate than line tracking algorithm and the curvature function in extracting breakpoints and corners, and it simplifies the procedure of parameter adjustment.

pp. 405-410

Multi-Robot Cooperative SLAM Based on Distributed Extended Kalman Filter

Feng Yang, Mengting Yan, Bo Jin and Haotian Li (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

For improving the positioning accuracy and mapping efficiency of the robots, a novel multi-robot cooperative simultaneous location and mapping (SLAM) system based on distributed Extended Kalman filter (EKF) is presented. The proposed approach first designs the model of multi-robot system. Second, each robot is estimated by EKF-SLAM algorithm to realize the local positioning. In the process of independent mapping of robots, when a landmark is observed for several times, Covariance Convex (CC) fusion algorithm is used to fuse multiple observations to improve the measurement accuracy. Finally, after the cooperative positioning of multiple robots, the maps constructed by each robot are merged to get a complete map. Simulation results show that compared with the single-robot EKF-SLAM, the proposed multi-robot cooperative SLAM approach can establish a larger map more accurately and quickly.

pp. 411-416

Advanced Mapping Using Planar Features Segmented from 3D Point Clouds

Feiya Li and Chunyun Fu (Chongqing University, China); Amirali Khodadadian Gostar (RMIT University, Australia); Shuien Yu and Minghui Hu (Chongqing University, China); Reza Hoseinnezhad (RMIT University, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

Simultaneous localization and mapping has two parallel tasks: localization and mapping. A new approach is introduced in this paper to tackle the mapping problem. Ubiquitous planar surfaces (e.g. walls of buildings along the roads) existing in urban environments are employed as features for mapping. The initial planar surfaces are segmented from the raw point cloud data, by means of the modified selective statistical estimator. Then, planes originating from non-static objects (e.g. large vehicles) and redundant planes resulting from the same building surfaces are removed. Lastly, closely located plane segments that share the same plane equations are properly combined. By this means, small plane segments are merged and useful map features are formed. The constructed map, represented by planar features, is compared with real scenes in Google Map. The comparison results show that the planar features match the building profiles very well. The constructed feature map proves to be accurate, and the proposed mapping method saves storage space by using simple planar features instead of raw point clouds themselves.

pp. 417-422

An improved feature extractor for the Lidar Odometry and Mapping (LOAM) algorithm

Clayder A Gonzalez (Universidad de Chile, Chile); Martin D Adams (University of Chile & Advanced Mining Technology Centre, Chile)

The 2019 International Conference on Control, Automation and Information Sciences

This work proposes an improved feature extractor for the Lidar Odometry and Mapping (LOAM) algorithm, which is currently the highest ranked algorithm in the Karlsruhe Institute of Technology and Toyota Technological Institute (KITTI) visual odometry ranking. This article proposes and justifies the substitution of LOAM's current feature extraction method with the Curvature Scale Space (CSS) based feature extraction algorithm for the processing of 3D Point Cloud Data (PCD). The justification is based on in improvement of the repeatability of the detection of robust features for LOAM and an improvement in the associated computational cost. The LOAM's feature extractor and CSS feature extractor were tested and compared with simulated and real data including the KITTI visual odometry dataset using the Optimal Sub-Pattern Assignment (OSPA) and Absolute Trajectory Error (ATE) metrics. The results showed that LOAM based on the CSS feature extractor out performed that based on the original LOAM feature extractor with respect to these metrics.

pp. 423-429

Mobile Sensor Path Planning for Multi-region Surveillance with Different Mission Importances

Yaoying Tang and Yao Wang (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper considers the path planning problem for mobile platform equipped with monostatic radar. The aim is to maximize the radar surveillance performance in disjoint areas of interest (AOIs) with different mission importances by adjusting the positions of mobile sensor dynamically, while satisfying the min/max speed constraints and turning angle constraint among each movement. To evaluate the radar surveillance performance of all AOIs, we propose an information collection ratio metric based on detection probability of the radar system for AOIs at each moment. For the challenge of high dimensionality, we present an algorithm based on particle swarm optimization (PSO) to solve this constrained optimization problem (COP). Finally, simulation results verify the feasibility of the algorithm.

pp. 430-434

SatB03: Adaptive / Robust Control Methods

Hotel Room B

Chairs: Lei Ma (Southwest Jiaotong University, China), Weifeng Liu (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou, Zhejiang Province, China)

Adaptive Neural Disturbance Observer Based Nonsingular Fast Terminal Sliding Mode Control for Underwater Robot Manipulators

Zengcheng Zhou (Huazhong University of Science and Technology, China); Guoyuan Tang, Hui Huang and Zijian Yuan (Huazhong University of Science and Techonology, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper presents an adaptive neural disturbance observer based nonsingular fast terminal sliding mode (NFTSM) control method for underwater robot manipulators in the presence of external disturbances. Radial basis function (RBF) neural networks are used in the disturbance observer to approximate the unknown external disturbances， which can improve the robustness of the control system. Moreover, an improved reaching law is applied in the NFTSM strategy to quicken the response of input signals in the different control period. Afterward, it can be demonstrated that all the state signals are ultimately bounded via the Lyapunov stability theory. Finally, numerical simulation results are carried out to verify the effectiveness of the proposed method.

pp. 435-440

Design of Turret Servo System Based on Optimized Model-Compensation Active Disturbance Rejection Controller

Yaoyang LU (Nanjing University Of Science And Technology, China); Pan Long Wu (Nanjing University of Science and Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

In order to improve the anti-disturbance performance of the self-propelled anti-aircraft gun (SPAAG) turret azimuth servo system, an optimized model-compensation active disturbance rejection control (ADRC) for servo system was proposed. By using the recursive least squares method input with the cross-axis current and the actual rotational speed, inertia and impact load of the servo system is identified, which is compensated to the ADRC. The performance evaluation results show that this algorithm can generally decrease the pressure of extended state observer for estimating disturbance and enhance the robustness and control precision of systems.
pp. 441-446

Visual Sensor-Based Dynamic Identification of a 6-RSS Parallel Robot

Pengcheng Li, Ahmad Ghasemi and Wenfang Xie (Concordia University, Canada); Wei Tian (Nanjing University of Aeronautics and Astronautics, China)

The 2019 International Conference on Control, Automation and Information Sciences

The parallel robot has some unique properties such as higher speed, stiffness, and load carrying capacity compared with serial robots. However, the dynamic model of the parallel robot is normally more complex than that of the serial robots, due to the highly coupling relation between the moving components. Hence this property affects the control performance of the parallel robot. To address this issue, this paper focuses on the dynamic identification of the parallel robots for advanced model-based control design purpose. A visual sensor-based dynamic identification method for a 6-DOF revolute-sphere-sphere (6-RSS) parallel robot is proposed. Compared with the conventional identification method for parallel robots, the measurement of the actuator torque data and the exact knowledge of the built-in robot controller are not needed in the proposed method. The time-consuming method for solving forward kinematics of the parallel robot can be avoided. The explicit form of the dynamic model of the 6-RSS parallel robot is built based on the virtual work principle. By adding a visual servoing controller to both simulation and real systems, a closed-loop output-error identification method is developed to estimate the dynamic model. The experiment tests show that the output of the identified model matches that of the real plant with satisfactory accuracy when both systems are subjected to the same input.
pp. 447-452

Single Target Dynamic Tracking and Hunting Based on Multi-Agent systems Control

Feng Xin Ru (Hangzhou Dianzi University, China); Weifeng Liu (Hangzhou Dianzi Univerisity, China); Zhengwang Tian (Hangzhou Dianzi University, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, a joint tracking and hunting algorithm is proposed for single target dynamic tracking and hunting in multi-agent systems. The tracking association algorithm uses SMHT(sequence multi-sensor multiple hypothesis tracker).After obtaining the target state estimation in the clutter environment, the distributed controller is designed by using the consistency theory to realize the dynamic hunting of the single target by the multi-agent system. The controller design is divided into two parts: multi-agent communication topology design and deviation vector design.The simulation results show that the joint tracking and hunting algorithm can make the multi-agent system form formation, maintain the formation and realize the dynamic tracking and hunting of single target. Index Terms-Multi-agent, Formation Control, Consistency, Hunting, SMHT
pp. 453-458

Optimization of Multi-effector Aircraft Control Allocation based on Generalized Inverse

Guo Yiming (Northwestern Polytechnical University & School of Automation, P.R China); Mei Wu (Northwestern Polytechnical University & School of Automation, China); Luo Yu (Shaanxi Polytechnic Institute, China)

The 2019 International Conference on Control, Automation and Information Sciences

In order to realize the coordinated control of multi-effector aircraft, this paper uses the generalized inverse method to design its control allocation scheme. Then the particle swarm optimization (PSO) to choose the generalized inverse matrix with the best allocation efficiency, which is expressed by attainable moment subset (AMS), is proposed. Finally, according to the control efficiency matrix of a multi-thrust vector airship, the optimization design of the generalized inverse allocation matrix is carried out by PSO algorithm. The simulation result shows that an effective schedule can be found with the help of PSO algorithm and optimization goals will be achieved.
pp. 459-463

SatB04: Special Session: Resource Aware Scheduling for Cognitive Radar Systems

Hotel Room C

Chairs: Junkun Yan (Xidian University, China), Chenguang Shi (Nanjing University of Aeronautics and Astronautics, China), Tianxian Zhang (University of Electronic Science and Technology of China, China)

Joint Dwell Time and Bandwidth Optimization for Multiple-Target Tracking in Radar Network

Wei Qiu (Nanjing University of Aeronautics and Astronautics, China)

The 2019 International Conference on Control, Automation and Information Sciences

A joint dwell time and bandwidth optimization algorithm is proposed in this paper for multiple-target tracking in radar network. The Bayesian Cramer-Rao Lower Bound (BCRLB) is utilized to be the accuracy metric for target tracking. The primary objective of this algorithm is to improve the low probability of intercept (LPI) performance of radar network by jointly optimizing the dwell time and transmission bandwidth of each radar, which is constrained by a predefined BCRLB requirement for target tracking. The simulation results show that the proposed algorithm can effectively reduce the total dwell time consumption and achieve a better LPI performance in radar network.
pp. 464-468

Adaptive dwell scheduling based on a novel online pulse interleaving technique for phased array radar

Qianqian Tan (University of Electronic Science and Technology of China, China); Ting Cheng (University of Electronic Science and Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

Aiming at the dwell scheduling of phased array radar, an adaptive method based on a novel on-line pulse interleaving technology is proposed. The time and energy vectors with variable length are introduced to realize the pulse interleaving, whose idea comes from the scheduling analysis method based on the scheduling interval. The novel online pulse interleaving technology is combined with the scheduling method based on the time pointer. Therefore, the resulting scheduling algorithm is a perfect combination of two types of adaptive dwell scheduling methods. Compared with existing dwell scheduling algorithm with pulse interleaving, the proposed algorithm is more general, and can be applied to tasks with multiple pulse repetition intervals. The simulation results demonstrate the effective of the proposed dwell scheduling algorithm
pp. 469-474

Optimal Resource Allocation for Multiple Target Tracking in Phased Array Radar Network

Jinhui Dai, Junkun Yan and Wang Penghui (Xidian University, China); Hongwei Liu (National Laboratory of Radar Signal Processing, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this study, an optimal resource allocation (ORA) strategy is presented for multiple target tracking (MTT) in the phased array radar (PAR) network. The primary goal of the PAR network is to minimize the resource consumption of the system under the condition that the desired MTT accuracies must be met. Based on this, we develop a novel resource allocation model and prove that it is convex and separable. The optimal solution can be obtained easily by solving sub-problems in parallel through CVX toolbox. Simulation results demonstrate that compared with the uniform allocation resources scheme, the ORA strategy requires less resource for predetermined MTT performance.
pp. 475-478

Resource Management of Multiple Phased Array Radars for Multi-Target Tracking

Jiaqin Huang (AVIC Leihua Electronic Technology Institute, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, a resource management method of multiple phased array radars for multi-target tracking is proposed. In order to minimize the track resource usage while still guaranteeing multi-target continued tracking performance, a novel resource allocation model is presented in which the parameters include radar-to-target assignment, revisit time and dwell time can be optimized. And an improved PSO is proposed to solve the optimization problem. The performance of the allocation model and improved PSO is demonstrated by the simulation.

pp. 479-483

Low Probability of Intercept Performance Optimization for an Integrated Multi-static Radar and Communication System

Chenguang Shi and Lintao Ding (Nanjing University of Aeronautics and Astronautics, China); Fei Wang (Nanjing University of Aeronautics and Astronautics, Nanjing, China); Jianjiang Zhou (Nanjing University of Aeronautics and Astronautics, China); Sana Salous (Durham University, United Kingdom (Great Britain))

The 2019 International Conference on Control, Automation and Information Sciences

This paper investigates the low probability of intercept (LPI) performance optimization for an integrated multi-static radar and communication (IMRC) system, which is composed of multiple transmitters operating at different frequencies, a radar receiver (RR) and a communication receiver (CR). The IMRC system is capable of fulfilling the requirements of both radar and communication sub-systems. The basis of the LPI optimization strategy is to minimize the total radiated power by optimizing the power resource allocation at each transmitter for radar waveforms and information signals, which is constrained by a predetermined target detection performance for the RR and a desired information rate for the CR. Subsequently, the resulting optimization problem is solved by an efficient solution procedure based on the approach of linear programming and the Karush-Kuhn-Tuckers (KKT) optimality conditions. Numerical results demonstrate the effectiveness of the proposed algorithm.

pp. 484-488

SatB05: Special Session: Recent Advances in Indoor Positioning

Hotel Room D

Chairs: Xiansheng Guo (University of Electronic Science and Technology of China, China & New Jersey Institute of Technology, USA), Fei Wen (Shanghai Jiaotong University, China)

An Adaptive Localization Approach Based on Deep Adaptation Networks

Lei Wang and Yuan Shao (University of Electronic Science and Technology of China, China); Xiansheng Guo (University of Electronic Science and Technology of China, China & New Jersey Institute of Technology, USA)

The 2019 International Conference on Control, Automation and Information Sciences

The traditional WiFi fingerprint-based indoor positioning methods show poor performance due to the fluctuation of received signal strength (RSS) caused by environmental changes and heterogeneous hardware. Recent studies reveal that domain adaptation is a suitable strategy to overcome the above drawbacks by reducing the discrepancy between two domains. However, most existing methods can only learn some shallow representation features, which just reduces the domain discrepancy to some extent. Comparatively, deep neural networks (DNN) can learn deep transferable features to manifest invariant factors underlying different domains. Thus, we propose a Deep Mean Correlation Alignment (DMCA) domain adaptation network to reduce the domain discrepancy efficiently. DMCA can learn transferable features from domain shift minimization by aligning the mean embeddings of the hidden representation in a reproducing kernel Hilbert space, and aligning the second-order statics of hidden representation of different domains. Experiment results demonstrate that our proposed approach outperforms other existing methods in accuracy and robustness.

pp. 489-493

A Semi-supervised Naive Bayesian Method for Labeling Heterogeneous Fingerprints

Yuan Shao and Lei Wang (University of Electronic Science and Technology of China, China); Xiansheng Guo (University of Electronic Science and Technology of China, China & New Jersey Institute of Technology, USA)

The 2019 International Conference on Control, Automation and Information Sciences

The traditional construction of radio maps for indoor localization suffers from extensive work loads. Labeling the fingerprints of passive crowdsourcing can effectively alleviate the work pressure of radio map construction while maintaining high location estimation accuracy. Although Naive Bayes method shows stable classification ability in presence of less correlated and missing data, which are the characters of RSSI data in WiFi positioning, the frequency histogram based native Bayes methods show poor performance in estimating conditional probability when the interval setting of discretization is not appropriate. So, we use KDE to calculate the conditional probability of naive Bayes instead of frequency histogram. Consider that the fingerprints to be labeled can provide valuable information, we further propose the transductive semi-supervised method where the fingerprints to be labeled assist in the learning process. The RMSE of experimental data is 2.418m, more accuracy than other benchmark algorithms, proving the validity and efficiency of the proposed algorithm for labeling crowdsourced heterogeneous fingerprints.

pp. 494-498

Improved Smartphone-based PDR Localization for Arbitrary Placement

Huajun Shen (University of Electronic Science and Technology of China, China); Xiansheng Guo (University of Electronic Science and Technology of China, China & New Jersey Institute of Technology, USA); Hui-yong Li (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Accurate heading information is one of the most important parameters for pedestrian dead reckoning (PDR) techniques. However, existing smartphone-based PDR methods need pedestrian to keep the smartphone in horizontal posture to detect the pedestrian heading, which is not practical. In this paper, we propose a placement-independent pedestrian heading estimation method based on the gradienter. Horizontal posture is common for the placement of mobile phone , and we keep checking the placement. Once the mobile phone is detected in the horizontal posture, the accurate heading information is obtained. According to the turning detection module, the real-time pedestrian heading is matched by integrating the environment information and access point (AP) deployment information. Experimental results show that the error per 100m can be controlled within 2.7m while the smartphone is in arbitrary placement. This method shows good practical value in fast fingerprint database construction.

pp. 499-504

A Fusion Rule Based on Connectivity in Wireless Sensor Networks

Shufang Xu (Hohai University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Wireless sensor networks (WSNs) have become a very active research area and apply in target detection and fusion in recent years. In this paper, we focus on the connectivity characteristics of WSNs and the influence of network connectivity on target detection performance. Based on distributed detection fusion system and network connectivity, we propose a new fusion rule to improve detection. The influence of nodes number, signal to noise ratio and nodes communication radius on system performance is analyzed and simulated in detail. The experiments and simulations also compare the performance differences between the proposed fusion rule and the traditional counting rule.

pp. 505-509

A real-time video surveillance and state detection approach for elevator cabs

Zhen Sun, Benlian Xu and Di Wu (Changshu Institute of Technology, China); Mingli Lu (Changshu Institute of Technology Changshu, China); Jinliang Cong (Changshu Institute of Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

Manually monitoring abnormal events occurring in elevator cab is time-consuming and hard to react instantly. In this paper, we develop an intelligent video surveillance and state identification system for elevator cabs, in which the information such as the state of cab door, the behavior of human body, as well as the number of people in an elevator cab can be estimated and judged for security evaluation. In our proposed framework, the state detection of the elevator door is first implemented by an improved ViBe algorithm; afterwards, a trained deep learning model, i.e., an SSD_MobileNet model, is utilized to accurately estimate the number of people in the elevator cab; finally, a state identification approach in the case of two abnormal behavior occurring in cabs is developed through the ViBe and optical flow based algorithms, respectively. To evaluate the effectiveness of our proposed system, several real surveillance videos from elevator cab are tested, and the results show that the accuracy of door detection is reached by 95.6%, and the accuracy of counting people in cab by 94.1%, and the accuracy of abnormal events detected in cab by 92.2% and 91.7%.

pp. 510-515

Saturday, October 26 3:10 - 3:25

Break: Tea/Coffee Break

Saturday, October 26 3:25 - 5:05

SatC01: Posters for ICCAIS 2019 II

Hotel Room A-1

Chairs: Zengfu Wang (Northwestern Polytechnical University, China), Wei Yi (University of Electronic Science and Technology of China, China)

A compensation integration algorithm based on adjacent cross correlation function

Tingting Xin, Guohong Wang, Liang Zhang and Xiangrong Ding (Naval Aviation University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Aiming at the problem of serious range migration and doppler migration in high-velocity and strong-maneuverability moving target echo, this paper proposes an ACCF-based(adjacent cross correlation function) compensation integration algorithm. The method first corrects the range migration and doppler bending by ACCF transform, then corrects the linear doppler migration by constructing a quadratic phase compensation function , and finally realizes energy accumulation by slow time dimension Fourier transform. Compared with the ACCF-LVD algorithm, the propsed algorithm only involves one nonlinear operation, and it does not require the radar to provide redundant information, and it is not limited to the parameter estimation range. In addition, the iterative ACCF algorithm has to perform two nonlinear operations,so loss of the signal-to-noise ratio is twice as large as the proposed algorithm, and the detection performance is also much worse. The simulation results show that the proposed method greatly improves the detection performance and it can detect the target with low signal-to-noise ratio as well as multi-target.

pp. 516-521

Robust H∞ Trajectory Following of Autonomous Vehicles with Delay and Packet Dropout

Changfang Chen, Minglei Shu, Ruixia Liu and Nuo Wei (Shandong Computer Science Center, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper proposes a robust H∞ trajectory following controller for autonomous vehicles with delays and packet dropout. The network-induced delay and dropout will degrade the control effect and system performance. A robust H∞ controller is presented to achieve the desired trajectory following and lateral control. The closed-loop H∞ performance can be guaranteed if certain linear matrix inequality (LMI) conditions are satisfied, under which the closed-loop system is asymptotically stable with an H∞ disturbance attention level. The uncertainty effects of the tire cornering stiffness and external disturbances are considered in the control design. Simulations are carried out to verify the effectiveness of the proposed control approach.

pp. 522-527

Smart building environment monitoring based on Gaussian Process

Qiang Zhang and Rui Duan (University of Electronic Science and Technology of China, China); Jinkai Wang (UESTC, China); Ying Cui (University of Electronic Science and Technolgy of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

With the widespread use of the Internet of Things (IoT), it is possible to continuously and accurately monitor different phenomena in the environment. For example, indoor environment detection of smart buildings, pollution source monitoring of smart cities, etc. This paper focuses on indoor environmental monitoring, using intelligent devices to collect indoor environmental data, analyzing the spatial correlation of data, using Gaussian Process (GP) to achieve spatial field reconstruction, and data prediction at any position in space. Most importantly, this method has practical significance in energy conservation and emission reduction and safety monitoring methods. The proposed approach was implemented in Intel Berkeley Lab, where the obtained results are highly promising.

pp. 528-533

A Method of Initial Orbit Determination for Space Group Targets

ZhengTao Zhang (The 14th Research Institute Of China Electronic Technology Group Corporation, China); Qiang Huang and Zhi Zhang (Nanjing Research Institute of Electronics Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

Generally the initial orbit determination algorithm handles a single space target and little attention has been paid to that for group targets. Since the association problem in an extended dense space group is usually difficult, we propose an initial orbit determination method to directly estimate the mean orbital elements of the group targets. Firstly, an improved density clustering algorithm is used to accurately segment the dense group targets from the space background. Then the mean orbital elements of the space group targets are estimated by fitting the trajectory of the group with a perturbed ellipse. The J2 perturbation is considered in the geometric orbit determination. The ill-condition problem of the short-arc geometric determination is solved by improving the merit function

pp. 534-539

Research on Commutation Torque Ripple Suppression of Open-winding Brushless DC Motor

Huang Qi (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

The open-winding brushless dc motor has no neutral point, and the phase windings are electrically isolated, which can realize independent control of each phase. Firstly, the mathematical

model of open-winding brushless dc motor is introduced, the influence of each phase caused by the mutual inductance and the impact of the diode freewheeling for non-commutation phase with the same bus power supply are analyzed. Secondly, the current commutation process of open-winding brushless dc motor during the commutation period is analyzed. It is concluded that if the turn-off and the conduction phase current with the same change rate, under the ideal Back electromotive (Back EMF) force condition, the non-commutation phase current is constant, then the electromagnetic torque remains the same. Thirdly, the working principle and process of overlapping commutation with phase current closed-loop control are given, the voltage applied on turn-off phase and the delay shutdown time formulas in overlapping commutation are derived. Finaliy, the control method is carried on the Matlab simulation and experiment, both simulation and experimental results indicate that the control method can realize the commutation torque ripple suppression of open-winding brushless dc motor.
pp. 540-545

Influence of Correction for Atmospheric Refraction In passive TDOA location on system TDOA error

Changjiang Liu and Wang Chao Feng (SSS14, China); Dan LE (Nanjing Research Institute of Electronics Technology, China)

The 2019 International Conference on Control, Automation and Information Sciences

When measuring the aerial target, the influence of atmospheric refraction will lead to its measurement error. Algorithm correction for atmospheric refraction of passive TDOA location system is described. The influence of atmospheric refraction correction on system error is analyzed theoretically. The effectiveness of atmospheric refraction correction of passive TDOA location system is verified by the actual data.
pp. 540-543

Efficient Implementation of Recursive Multi-Frame Track-Before-Detect Algorithm Based on FPGA

Ph Zhang, Wujun Li and Xiaobo Yang (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

It is widely recognized that the multi-frame Track-Before-Detect (MF-TBD) approaches show more advantages than the traditional Detect-Before-Track (DBT) approaches in the scene of weak targets detection and tracking. However, few studies focus on the engineering implementation of MF-TBD approaches in radar detection. Different from the traditional DBT approaches which only consider measurement points after single frame threshold detection, the implementation of MF-TBD approaches requires more transmission bandwidth and storage space. In this paper, we first analyzed the computational complexity of R-MF-TBD algorithm. Then the parallel processing architecture (PPA) was proposed to adapt the R-MF-TBD algorithm. Finally, we implemented the architecture for processing radar data on FPGA, and the correct tracks are output while the processing time is significantly lower than the software simulation.
pp. 544-549

Multi-frame Track-before-detect Algorithm for Passive Sonar System

Qiyun Peng, Wujun Li and Lingjiang Kong (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

It has been widely verified superiority of multi-frame track-before-detect (MF-TBD) for weak-target detection and tracking. In this paper we apply MF-TBD approach to solve weak unknown and time-varying number of targets detection and tracking problem for passive sonar system with excellent concealment. MF-TBD signal processing method is exclusive developed for the passive sonar system. Compared with conventional tracking structures, MF-TBD establishes the joint estimation strategy of target kinematic states based on maximum a posteriori probability (MAP) criteria. By directly processing multi-frame unthresholded raw bearing time record (BTR) data, MF-TBD achieves energy accumulation for weak targets and improves detection performance. Finally, simulation results are performed to verify its efficiency for passive sonar system.
pp. 550-555

Research on Maneuvering Target Tracking Algorithm Based on Multiple Model and Its Application in Radar Networking

Jiaqi Zhang and Xiushe Zhang (Xi'an Research Institute of Navigation Technology, China); Jiaqi Song (Xidian Unversity, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper studies the problem of maneuvering target tracking, and focuses on the maneuvering target tracking algorithm under the framework of autonomous multiple model, cooperative multiple model and variable multiple model structure, and deduces the processing steps of the typical tracking algorithm under the above three types of multi-model structure framework. Combined with the practical application requirements of radar networking system, a feasible method for spatial registration and time registration is proposed. The effectiveness of multi-model tracking algorithm is verified by constructing radar network simulation environment. The application of multi-model tracking algorithm in radar network system is sorted out and summarized. The conclusions given in this paper have guiding significance for the engineering implementation of radar networking system.
pp. 556-561

An Automatic Driving Algorithm for Outdoor Wheeled Unmanned Vehicle

Ping Wu, Zhihong Dou, Mengnan Cui, Hao Liu, Zhichao Niu and Gangjun Liu (Beijing Aerospace Automatic Control Institute, China)

The 2019 International Conference on Control, Automation and Information Sciences

In order to satisfy the requirement of automatic driving of outdoor unmanned vehicle, an automatic driving algorithm composed of integrated navigation and guidance control is proposed. The integrated navigation algorithm, which is fused with IMU, GNSS receiver and odometer, is designed based on SCKF with second-order fixed nonlinear expansion as the measurement model. The guidance control algorithm divides the expected route into segments and calculates the lateral and angular deviation between unmanned vehicle and the segmented route according to the longitude, latitude, heading angle and the key points sequence of the electronic map. The algorithm eliminates the deviation by incremental PID controller to realize the route tracking segment by segment. The simulation experiment results show that the accuracy of the integrated navigation algorithm based on SCKF is better than that based on SKF. The outdoor experiment verifies the effectiveness of the proposed automatic driving algorithm.
pp. 562-567

Research on Fast Target Detection And Classification Algorithm for Passive Millimeter Wave Imaging

Zhiguang Cheng, Jintao Xiong, Yingjie Liu and Yin Zhang (University of Electronic Science and Technology of China, China); Jianyu Yang (School of Electronic Engineering, China)

The 2019 International Conference on Control, Automation and Information Sciences

Safety monitoring system based on passive millimeter wave (PMMW) is getting much more popular among security check field due to its advantages as no radiation, no contact, which has been wildly applied in public area as airports, railway stations, etc, to detect dangerous substances hidden under clothing.In this paper, an algorithm of Classifying Target After Segmenting (CTAS) is proposed to solve real-time detecting problem. In segmentation section, the accuracy of target segmentation is improved by applying the modified traditional maximum entropy segmentation algorithm. In classification section, a new neural network which's structure is similar to LeNet-5 is built by using Inception Module. Depthwise Separable convolution is applied to enhance the model's calculation performance. The test result shows that the overall classification accuracy of the test set image is 98.9%, and the calculation speed fits the real-time requirement properly.
pp. 568-573

A Novel Method for Concealed Target Detection and Classification Based on Passive Millimeter Wave Imaging

Jintao Xiong, Hang Shui, Yingjie Liu, Zhaochang Cao and Yin Zhang (University of Electronic Science and Technology of China, China); Jianyu Yang (School of Electronic Engineering, China)

The 2019 International Conference on Control, Automation and Information Sciences

Passive millimeter wave(PMMW) imaging, which possesses advantageous features as no radiation, non-contact to human body, concealed targets detecting, plays an important role when applied to public security check. The traditional PMMW image classification methods rely on features extracted by experts manually. However, it is more difficult to extract exact features manually, given the low resolution and less information of the PMMW images. Deep learning (DL) based on convolutional neural network (CNN) has the characteristics of automatic feature extraction. In this paper, a target classification method based on CNN is proposed to classify the PMMW images. Better effects are realized by the proposed CNN model which combines

the structure of LeNet model and the structure construction idea of VGGNet, with the advantages of uncomplicated structure and few parameters. The problem of low recognition accuracy of PMMW image in fewer samples cases is also solved. The measured data shows that the overall classification accuracy of the proposed algorithm is 98.17% on the testing set images. For a single category of guns, knives and other small objects, the accuracy is 100%, 95.8% and 98.7%, respectively. The measured data also indicates that compared with traditional algorithms of Machine Learning and other DL method, under the same image samples condition, the effects of proposed algorithm is obviously improved.
pp. 574-579

A Scheduling Method of Generalized Tasks for Multifunctional Radar Network

Xueting Li, Longxiao Xu and Tianxian Zhang (University of Electronic Science and Technology of China, China); Lingjiang Kong (University of Electronic Science and Technology of China (UESTC), China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, a scheduling method of generalized tasks for multifunctional radar network is proposed. Considering the actual relationship between task execution performance and the length of task dwell time as well as the high correlation of tasks periods, in this paper, the membership functions between execution performance and dwell time of tasks are considered to be nonlinear and the periods of tasks are arbitrary. Firstly, a radar task model with random period for multifunctional radar is built, and the exponential membership functions are set to ensure the generality of tasks. Then, the slots and common periods of radars in network are determined. Next, the periods of tasks are adjusted and tasks are assigned to corresponding radars respectively. Furthermore, tasks are scheduled in corresponding radars in network by greedy algorithm and heuristic algorithm. Finally, the numerical simulations are presented to evaluate the validity of the method.
pp. 580-585

Investigations on High Reliability Permanent Magnet Motor Controller for Electric Vehicle

Huang Qi (Northwestern Polytechnical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Electric vehicles are gradually becoming a means of transportation for people, and their technical reliability and safety are very high. The motor controller is a device that converts the battery DC power supply to the three-phase AC power source, and drives the output power of the permanent magnet synchronous motor. This paper designs a permanent magnet motor controller based on Renesas microcontroller. The analysis is carried out from the aspects of component selection, hardware protection structure principle, PCB layout, control algorithm, structural strength and thermal analysis. Finally, the prototype controller is produced and the experimental platform is built. The efficiency characteristic test, power generation test and temperature rise test were performed on the permanent magnet synchronous motor controller. The experimental results verify the rationality of the design.
pp. 586-591

SatC02: Estimation and Control

Hotel Room A-2

Chairs: Zhansheng Duan (Xi'an Jiaotong University & College of Electronics and Information Engineering, China), Linfeng Xu (Northwestern Polytechnical University, China)

Sensing Structure for Blind Spot Detection System in Vehicles

Shayan Shirahmad gale bagi (University of Tehran, Iran); Hossein Gharaee (ITRC, Iran); Behzad Moshiri (University of Tehran & University of Waterloo, Iran); Mohammad Khoshnevisan (Northeastern University, USA)

The 2019 International Conference on Control, Automation and Information Sciences

Sensor selection is an essential aspect of blind spot detection (BSD) systems. Indeed, we must choose the sensors appropriately to accomplish high accuracy and performance in any driving condition. Each sensor has exclusive properties which are suitable for a few specific circumstances. Therefore, a comprehensive study is warranted to determine the optimum number of sensors and the type of sensors for BSD. Although sensors have some deficiencies which can deteriorate the whole system's performance, a combination of multiple types of sensors together with data fusion methods in most cases can substantially compensate for sensors imperfection. In this paper, we have concentrated on multi-sensor fusion in BSD system and its advantages which cannot be achieved in a single-sensor BSD system. A sensing structure for the BSD system is proposed considering the indispensable factors in BSD coupled with sensors constraints, features, and specifications.
pp. 586-591

Acoustic Scene Classification Technique for Active Noise Control

Shengwang Jiang, Chuang Shi and Hui-yong Li (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper works on the idea of integrating the acoustic scene classification technique in active noise control (ANC), whereby the major difficulty lies in the limited dataset available from an ANC system in use. A large-scale acoustic scene dataset recorded by a different acoustic device has to be considered. This leads to the research problem of acoustic scene classification by mismatched devices. Hence, an ensemble of the convolutional neural networks (CNNs) is demonstrated with a novel data augmentation method. Monaural samples are processed by head-related transfer functions (HRTFs) of 24 azimuths to add in the artificial spatial information. Every two symmetrical azimuths are then paired together to provide a tempo-spectral feature consisting of 4 channels. 12 CNNs are trained with respective features. Finally, different ensemble strategies are carried out and their classification accuracies are compared. The random forest used as the ensemble meta-learner achieves the best accuracy of 65.1% over 10 acoustic scenes.
pp. 592-596

Human parameter estimation Based on sparse reconstruction

Yueqin Yu, Zhangjing Wang, Xianhan Miao and Chengzhi Wang (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Target estimation has a crucial role in the field of radar signal processing. In this paper, we combine time-frequency analysis and sparse signal processing methods to investigate the human target parameter estimation. Firstly, we construct an over-complete dictionary in the sparse time-frequency domain; and then, we reconstruct the time-frequency image of the target signal; lastly, based on the time-frequency graph of the reconstructed signal, we obtain important parameters of the human target such as the motion speed and gait period. By comparing the parameters obtained from our method with other time-frequency analysis method, the results show that our method has more accurate and robust. We also find that noise has little effect on the reconstructed time-frequency image. We apply the reconstructed time-frequency image in actual road environment. The radar echo data show that reconstructed time-frequency image has promising performance.
pp. 597-602

Likelihood-based Sensor Fusion in Radar/Infrared System Using Distributed Particle Filter

Qi Yang (University of Electronic Science and Technology of China, China); Ming Li (University Of Electronic Science And Technology Of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, the distributed data fusion problem in radar/infrared system which is composed of radar and infrared, is considered. Generally, the different dimensions of local measurements and the strong nonlinearity of infrared measurement equation are two major issues in radar/infrared system. For these issues, a parameterized likelihood-based distributed particle filter (P-L-DPF) algorithm is used, where the local likelihood function (rather than posterior or measurement) is regraded as the filtering results since the likelihood function can preserve the most original measurements information. Meantime, we approximate the likelihood function using polynomial expansion, and transmit polynomial coefficients to the fusion center, which

efficiently reduces the transmission requirements. In the simulation, an example that a radar/infrared system tracks a moving target is given, the results show that the tracking performance of the P-L-DPF algorithm outperforms the posterior-based DPF (P-DPF) algorithm and is very close to the measurement-based centralized particle filter (M-CPF) algorithm.
pp. 603-608

SatC03: Special Session: Radar Weak Target Detection and Imaging

Hotel Room B

Chairs: Xiaolong Li (University of Electronic Science and Technology of China, China), Jibin Zheng (Xidian University, China)

Sea Clutter Suppression using EMD-SVD-FRFT Filtering

Wenguang Wang, Cheng Chen and Yilin Wang (Beihang University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Sea clutter suppression is one of the major measures to improve target detection from sea clutter. Singular value decomposition-fractional Fourier transform (SVD-FRFT) filtering is conducted to suppress sea clutter without impairing the target even when the target and first-order sea clutter are mixed in the Doppler spectrum. However, for the range cells with only sea clutter, the SVD-FRFT filtering cannot thoroughly suppress the sea clutter owe to energy concentration of sea clutter to some extent in FRFT domain, which gives rise to false alarm in target detection. To address this problem, the combination of empirical mode decomposition (EMD) and SVD-FRFT is proposed to separate target from sea clutter and pre-suppress the sea clutter. The experiment based on real measured sea echo shows that the novel method can obtain superior performance.
pp. 609-613

Long time coherent integration for a maneuvering target with multiple motion states

Xin Fang (University of Electronic Science and Technology of China); Zongjie Cao and Rui Min (University of Electronic Scinece and Engineering of China, China); Yiming Pi (University of Electronic Sciences and Technology, China); Jubo Hao (University of Electronic Science and Technology of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

During a long time coherent interval, the maneuvering target may have multiple motion states, which would result in motion parameters change (MPC). In order to correct the MPC effect, a coherent integration method based on time-frequency (TF) characteristics is presented in this paper. Specifically, the piecewise function in terms of motion parameters of a maneuvering target is first utilized to construct the motion model. Then, the change time of acceleration and the corresponding motion parameters in each state can be estimated via calculating the straight-line equation of each motion state and their intersections in TF plane. Based on the estimated motion parameters, the MPC effect can be removed. At the same time, the range cell migration (RCM) and Doppler spectrum spread (DSS) effects induced by the target motion can also be corrected. Finally, the coherent integration is achieved via inverse Fourier transform (IFT) and FT with respect to range frequency and slow time, respectively. Simulation results demonstrate the effectiveness of the presented coherent integration method.
pp. 614-618

Marine Target Detection Based on Improved Faster R-CNN for Navigation Radar PPI Images

Mou Xiaoqian (Naval Aviation University, China); Xiaolong Chen (Naval Aviation University); Jian Guan (Naval Aeronautical University, China); Baoxin Chen (Naval Aviation University, China); Yunlong Dong (Naval Aeronautical and Astronautical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Marine target detection is always an important issue in the field of target detection, and scholars at home and abroad have achieved fruitful research success, but there are still some problems while using traditional detection method such as Large interference of sea clutter on target detection and limited detection performance. Recently, deep learning has been rapidly developed and widely applied in the field of target detection, However, there is currently no related research on the application of deep learning to navigation radar.In this paper, we propose a marine target detection method based on improved Faster R-CNN for navigation radar PPI (Plane Position Indicator) images. We built our own maritime target dataset by collecting radar measured data under different conditions, and improved the Faster R-CNN target detection method in four aspects. The maritime target detection model was obtained through training and optimization. The experimental results proved that our marine target detection method based on Faster R-CNN shows better detection performance in accuracy and reliability compared with the traditional Faster R-CNN method.
pp. 619-623

IPCPF for Noisy Multicomponent CPSs Analysis

Jibin Zheng (Xidian University, China)

The 2019 International Conference on Control, Automation and Information Sciences

This paper presents the integrated parameterized cubic phase function (IPCPF) for noisy multicomponent cubic phase signals (CPSs) analysis. The IPCPF is based on the parameterized cubic phase function (PCPF) and uses the modulus operator to guarantee a low computational cost [O(N2log2N)]. Theoretical analyses and numerical simulations demonstrate that, compared to the maximum likelihood (ML) method, the IPCPF can obtain a higher anti-noise performance with a lower computational cost.
pp. 624-627

A Sorties Recognition Algorithm of Formation Targets for Wide-band Radar

Wantian Wang (No. 288 Huangpu Street & Air Force Early Warning Academy, China); Ziyue Tang, Jiantao Xiang, Yichang Chen, Yuanpeng Zhang and Hui Xiao (Air Force Early Warning Academy, China)

The 2019 International Conference on Control, Automation and Information Sciences

Aiming at the disadvantage that conventional low resolution radar can't distinguish formation targets in range and azimuth, a sorties recognition algorithm of formation targets is proposed in wide-band radar, which is based on image processing technology and signal detection theory. The Smaller of Constant False Alarm Rate (SO-CFAR) and sliding window detection are used to cluster the targets of different sorties, and eliminate the interference of clutter and noise on sorties recognition. In addition, the connected region labeling technique is carried out to realize the automatic recognition of sorties in formation targets. The experimental results of some measured data illustrate the effectiveness of the proposed method.
pp. 628-631

SatC04: Signal and Image Processing

Hotel Room C

Chairs: Zengfu Wang (Northwestern Polytechnical University, China), Shisheng Guo (University of Electronic Science and Technology of China, China)

Spatio-Temporal Correlation based Anomaly Detection and Identification Method for IoT Sensors

Ying Cui (University of Electronic Science and Technolgy of China, China); Jun Bao (University of Electronic Science and Technology of China, China); Jinkai Wang (UESTC, China); Qiang Zhang and Xingke Jiang (University of Electronic Science and Technolgy of China, China)

The 2019 International Conference on Control, Automation and Information Sciences

Status monitor and anomaly detection of sensor nodes is critical for reliability of internet of things (IoT) system. Due to the complex causes of sensor anomalies, traditional methods that

estimate only sensor state or environment state when detect anomalies cannot satisfy practical requirements. And existing methods often neglect spatial and temporal dependencies among IoT sensor observations. This paper defines faulty nodes and event nodes and proposes a novel anomaly detection and identification method implemented in two stages: 1) Anomaly detection stage by a customized composite distance metric and sensor clustering. 2) Anomaly source identification stage by fuzzy logic system based on spatio-temporal correlation. Experiments demonstrated that the proposed method can effectively detect anomaly sensors and capture spatio-temporal correlation to identify the anomaly source.
pp. 632-637

Research on Energy Saving Control of Elevator

Xiaomei Jiang (Changshu Institute of Technology, China); Michael Namokel (Nordhessen University of Applied Sciences, DIPLOMA Hochschule, Germany)

The 2019 International Conference on Control, Automation and Information Sciences

In this paper, using the dynamic dead time control technology, through the theoretic and practical analysis and research on the power supply, output load and component tolerances on the performance of the inverter, the power supply of the inverter and the load current were detected and the values were used to modulate the delay time of the inverter delay circuit, so that the dead time could be in the optimal state to improve the efficiency and dynamic performance of inverter, and also power grid quality. Practical application results indicate it can reduce power consumption and high surge voltage and current brought by inverter due to unreasonable dead time and thus improve the reliability of the power components. Its performance has been verified in practical application of frequency conversion elevator.
pp. 638-642

Radar Cross Section analysis of common objects for indoor environment sensing by simulation

Pengfei Wang and Yangyang Ma (the Fourth Military Medical University, China); Jianqi Wang (The Fourth Military Medical University, China); Fulai Liang (the Fourth Military Medical University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Given the significance of home environment sensing, a simulation scheme for single static radar cross section measurement, employing the Finite Difference Time Domain (FDTD) method with the frequency range from 0.4 to 3 GHz is proposed, and the scheme is used to carry out the radar cross section of the human body and common objects indoor. The targets to be measured are 3D molding by Computer Aided Design (CAD) firstly and then using a Gaussian plane wave to illuminate the target in far-field conditions. The simulation results clearly show a strong variation in scattering with azimuth, material, and frequency. The ultimate goal is to achieve radar cross section estimation and differentiation of objects in order to design an ultra-wideband (UWB) radar systems for indoor environment sensing and through-wall imaging.
pp. 643-647

Auto Segmentation of Nasopharyngeal Cancer on CT image

Shihao Li, Jianghong Xiao, Ling He, Xingchen Peng and Xuedong Yuan (Sichuan University, China)

The 2019 International Conference on Control, Automation and Information Sciences

Nasopharyngeal carcinoma is a rare type of head and neck cancer. The accuracy improvement of target delineation can help NPC patients to enhance radiotherapy outcome. Target delineation is a labor intensive working, and the results depends on the experience of the physicians. Deep learning methods may increase efficiency of target delineation. In this paper, we used U-Net model to segment tumor targets in CT images with NPC. The samples were randomly split into the training set (302 patients), validation set (100 patients) and test set (100 patients). The U-Net model was trained by CT images labelled by experts. The experimental results showed U-Net was able to segment tumors with an overall dice similarity coefficient of 65.86% for lymph nodes and 74.00% for primary tumor, with respective Hausdorff distances of 32.10 mm and 12.85 mm. Moreover, time cost could be save approximately 30min, compared to 3 h using an entirely manual procedure. To a limited extent, deep learning model can improve accuracy, consistency and efficiency of target segmentation in T stage, but additional physician input may be required for lymph nodes.
pp. 648-652

The research of energy control strategy of four-wheel drive Vehicle with Series-Parallel hybrid power system

Wei Wang and Fufan Qu (China Automotive Technology and Research Center Co., Ltd, China); Chong Guo (Jilin University, China)

The 2019 International Conference on Control, Automation and Information Sciences

The article researches on the energy control strategy of Energy control strategy of four-wheel drive Vehicle with Series-Parallel hybrid power system based on pattern classification. A kind of four-wheel drive hybrid system whose structure is front axle driven by series-parallel hybrid system and rear axle driven by a single motor is designed, and its components are introduced. In addition, mode switching boundary and mode switching dynamic control are designed. According to the system efficiency, the operating points of the powertrain in each mode are optimized. Finally, the economy of the system is verified in a variety of working conditions by vehicle test, and the energy-saving mechanism are verified through the analysis of working condition characteristics, working mode proportion and operating point distribution.
pp. 648-653

SatC05: System Control

Hotel Room D

Chairs: Guolong Cui (University of Electronic Science and Technology of China (UESTC), China), Tianxian Zhang (University of Electronic Science and Technology of China, China)

Control-Hardware-In-the-Loop Simulation Studies using the Remote Terminal Unit 540 from ABB

Tri Tran, C. (Curtin University & Murdoch University, Australia); Joseph Gordon (ABB Australia, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

Battery Energy Storage System (BESS) has come of age for widespread implementation to firm up the integration of renewable energy sources to smart grids. The substation automation system (SAS) has been the platform for deployment of automation functions for transmission and distribution systems since early days. The current architectures of SASs including those recommended by IEC-61850 do not support the integration of BESS for voltage and frequency supports as a default function. Further, the solutions for BESS integration from the industry have not been standardized owing to the fast pace developments in this field. ABB Australia has been the pioneer equipment supplier of BESS and system integrator for various pilot projects worldwide. In this study, the Remote Terminal Unit (RTU) 540 from ABB and the Power Factory simulation software from DIgSILENT (DPF) are used in a Control-Hardware-In-the-Loop (C-HIL) testing for BESS integration. The C-HIL system in this study will be the platform for ABB to verify the future BESS integration solutions. As a part of this study, the three-term linear controllers of Proportional-Integral-Derivative (PID) with dead-bands and first-order filters are designed for voltage and frequency support functions for the IEEE nine-bus benchmark power system. Simulation results demonstrated the success of the umbilical interfaces between the RTU 540 and DPF platform to be used in the verification of future BESS integration projects of ABB.
pp. 654-659

Replacement Controller for IoT-Enabled Dependable Control Systems

Tri Tran, C. (Curtin University & Murdoch University, Australia)

The 2019 International Conference on Control, Automation and Information Sciences

The single layer architecture for operational technology systems with a 'private machine-cloud' together with self-reliant controllers has been presented in previous work. The dependability of the new control system can be quantified thanks to the fault-tolerant structure of multiple processors and the IoT connectivity within the private machine-cloud. As an essential part of this work, a Replacement Controller is developed for the associated self-reliant controller running the model predictive control (MPC) algorithm (called self-reliant MPC). Comprehensive

simulation results for three multi-variable systems comprising a paper machine, a helicopter, and a railway wheel set with bogie technically illustrate the effectiveness of the presented Replacement Controller. The Replacement Controller has significantly improved the control performance of the self-reliant MPC when the switching-over between the duty and standby MPCs takes a relatively long time to complete. The single layer architecture is necessarily modified with embedded Multivariable Stations for installing the Replacement Controllers to ensure that the control performance of the self-reliant MPC is maintained in the presence of sustained communication interruptions between the duty and standby processors.
pp. 660-665

LEACH-MTC：An Network Energy Optimization Algorithm Constraint as Moving Target State Prediction

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When some nodes cooperatively track moving targets in wireless sensor network, some things including network working node selection and network energy consumption are influenced. Thus, this paper proposes an improved algorithm LEACH-MTC (LEACH with Moving Target Constraint) based on low energy adaptive clustering hierarchy protocol (LEACH). Firstly, the target state of nonlinear moving model are predicted utilizing the extended Kalman filter (EKF). Secondly, combining with the prediction information of moving target and the performance of collaborative monitoring, this paper constructs an ellipse coverage covered area of some working nodes, and the direction of change of this area is consistent with the direction of the target movement, subsequently, this paper designs the node sleep strategy constraints as moving target state prediction. Finally, the cluster head selection strategies are proposed based on energy balance utilizing the prediction information of the moving target. Some simulation results show that the LEACH-MTC algorithm can not only ensure the real time consistency between the changing direction of area and the direction of target movement, but also increase the number of network nodes' survival and reduce the network energy consumption.
pp. 666-672

Signal Fusion for Multi-target on Distributed MIMO Radar System

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Distributed MIMO radar system configured with the DTFR (defocused transmit-focused receive) mode can detect and track multiple targets. Due to the non-consistency of the received beams' direction, the system working in TWS (track while scan) mode is faced with the problem of targets' signal matching between different stations, it's difficult to accumulate multi-station's signal effectively. This paper proposes a novel multi-station signal association and fusion technique for multi-target based on sequential Bayesian algorithm that can associate multi-station's signal from different scanning-beams, and further more implement multi-station signal fusion to achieve spatial diversity gain. Performance results with real data obtained from an experimental radar system demonstrate the practical effectiveness of the proposed method.
pp. 666-669

A Fusion and Target Detection method based on SAR and Optical images

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How to effectively and accurately detect target information in the formed images has long been an area that we attach great importance to. For example, we not only need the imaging results not to be affected by the weather and other environments, but also hope that the edge information of the imaging results is very clear and the image resolution is very high. Therefore, a single sensor cannot achieve this effect at the same time. In this case, the fusion rule (nonsubsampled contourlet transform) proposed in this paper solves the problem of insufficient imaging information of a single sensor and removes redundant information. The target is pre-screened to make the target area more accurate. Through spatial morphological filtering, false alarm rate is reduced to improve the success rate of target matching.
pp. 670-675