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	The 2018 International Conference on Control, Automation and Information Sciences			
Friday, October 26				
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10:45 am-11:45 am				
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Friday, October 26

Friday, October 26 9:00 - 10:00

FriP0: Plentary Talk 1

Advanced Biomedical Applications Using Real-time EEG Brain Dynamics
Hung Nguyen

Room 205

Chair: Mahendra Mallick (Independent Consultant, USA)

In this presentation, advanced biomedical applications using real-time EEG brain dynamics are described. The first application involves a thought-controlled wheelchair using mental task brain computer interface. The system used a Hilbert-Huang transform for feature extractor and fuzzy particle swarm optimization with cross mutated artificial network for the classifier. Experiments were conducted on five able bodied subjects and five patients with tetraplegia using EEG signals from six channels, and different time-windows of data were examined to find highest accuracy. The second application involves assessing brain wave activity for monitoring fatigue when performing tasks such as driving. We investigated brain wave activity associated with fatigue in 48 non-professional healthy drivers as they participated in a simulated driving task until they fatigued. The results suggest that as a person fatigues, the brain loses capacity and slows its activity, and that attempts to maintain vigilance levels lead to increased beta activity. The third application concerns the development of a mechanism to effectively detect freezing of gait (FOG) before it occurs in patients with Parkinson's disease (PD), allowing time for a sufferer to avert a freezing episode. The EEG power measures and network properties from 16 patients with PD and FOG were extracted and analyzed. It was found that both power spectral density and wavelet energy could potentially act as biomarkers during FOG. Essentially, real-time monitoring of EEG brain dynamics unlocks a fascinating and exciting future for biomedical applications.

Friday, October 26 10:00 - 10:15

FriP2: Sensors Journal Recommendation

Linlin Liu

Room 205

Chair: Weifeng Liu (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou, Zhejiang Province, P.R. China)

The Seventh International Conference On Control Automation & Information Sciences (ICCAIS 2018) Hangzhou, China.Cooperated with Sensors to publish the extended version of the conference papers in Special Issue "Multiple Object Tracking: Making Sense of the Sensors". This recommendation gives an introduction for the journal.

Friday, October 26 10:15 - 10:45

FriA04: Poster (I)

Room 205

Chair: Aibing Qiu (Nantong University, P.R. China)

Comparison between Heart Rate Variability and Pulse Rate Variability for Bradycardia and Tachycardia Subjects

Yongxin Chou and Ya Gu (Changshu Institute of Technology, P.R. China); Xufeng Huang (The East China Science and Technology Research Institute of Changshu Co., Ltd, P.R. China); Jiajun Lin (East China University of Science and Technology, P.R. China); Jicheng Liu (Changshu Institute of Technology, P.R. China)

Pulse rate variability (PRV) derived from photoplethysmograph (PPG) signal has increasingly applied potentiality in wearable devices for telecare and personal healthcare. In this study, the relevance between PRV and HRV of bradycardia and tachycardia subjects are compared. First, we extract R to R wave interval sequences (RRIs) and P to P wave interval sequences (PPIs) from ECG and PPG signals, respectively. Then, the 5 features in time domain, 7 features in frequency domain and 9 features in nonlinear domain are extracted from PPIs and RRIs. Finally, two-sample t-test is employed to analyze the relevance of each same features. The results show that there are obvious relevance for these features except for basic scale entropy (BSE). Therefore, PRV can be used to analyze HRV for bradycardia subjects except for the pacemaker wearers, which have less variation patterns and higher HR and PR. For the tachycardia subjects, the PRV has more variation patterns than HRV. If we just consider the accuracy between HR and PR, there are not obviously different for bradycardia and tachycardia subjects.

pp. 1-6

Fibbing Based Topology Augmentation in Hybrid SDN

Yuxue Hu (Beijing University of Posts and Telecommunications, P.R. China)

Traffic Engineering (TE) is an important mechanism for Internet service providers (ISPs) seeking to optimize network performance and traffic delivery. The routing optimization plays a key role in TE, finding efficient routes to achieve the desired network performance. Although SDN is attractive for its efficiency in TE, before the overall implementation, backward compatibility is very important for the network evolvement. To support the compatibility for hybrid SDN, in the prior literature, Fibbing—a method of achieving flexibility and robustness by centralized control based on distributed routing has been proposed. In Fibbing architecture, routers are enabled to calculate their own forwarding tables based on the new topology, by introducing fake nodes and links into the original topology. In this paper, after the topology augmentation process, a Merger-Backward (MB) merging algorithm is proposed to reduce the size of the augmented topology and the network overhead. Results show that the proposed MB algorithm can merge more fake nodes and take shorter time to compute the augmented topology than Merger-Forward (MF) to some extent especially when the topology is large.

pp. 7-11

algorithm not only has a low computational complexity, but also has very good estimation accuracy.
pp. 49-54

A Ranking Distance Based Diversity Measure for Multiple Classifier Systems

Yi Yang and Deqiang Han (Xi'an Jiaotong University, P.R. China); Jean Dezert (Onera, France)

Multiple classifier fusion belongs to the decision-level information fusion, which has been widely used in many pattern classification and recognition applications, especially when the single classifier is not competent. However, multiple classifier fusion can not assure the improvement of the classification accuracy. The diversity among those classifiers in the multiple classifier system (MCS) is crucial for improving the fused classification accuracy. Various diversity measures for MCS have been proposed, which are mainly based on the average sample-wise classification consistency between different member classifiers. In this paper, we propose to define the diversity between member classifiers from a different standpoint. If different member classifiers in a MCS are good at classifying different classes, i.e., there exist expert-classifiers for each concerned class, the improvement of the accuracy of classifier fusion can be expected. Each classifier has a ranking of classes in term of the classification accuracies, based on which, a new diversity measure is implemented using the ranking distance. A larger average ranking distance represents a higher diversity. The new proposed diversity measure is used together with each single classifier's performance to design and optimize the MCS. Experiments, simulations, and related analyses are provided to illustrate and validate our new proposed diversity measure.
pp. 55-60

Weighted Evidence Combination with Ranking Distance

Yi Yang, Yongqing Zhou and Deqiang Han (Xi'an Jiaotong University, P.R. China); Wei Ai (CETC, P.R. China)

The theory of belief functions, also called Dempster-Shafer evidence theory, is a powerful tool for uncertainty modeling and reasoning. However, one might encounter counter-intuitive results when using Dempster's rule in evidence combination. To handle this problem, an alternative weighted combination method is proposed in this paper, where the weights are generated according the ranking distance between those evidences to combine. Experimental results show that our proposed approach can obtain rational combination results when compared with prevailing methods.
pp. 61-66

A Resolvable Performance Analysis for the Group Targets

Guilin Zhang (The 28th Research Institute, P.R. China); Yudong Chi and Shujun Zhu (Hangzhou Dianzi University, P.R. China)

The traditional group targets assume that the targets are close and thus unresolvable. In tracking process, the feature of unresolvable is fixed. This is unreasonable when the distance between targets and sensor is short. That is, the unresolvable property is various with the distance and sensor observation accuracy. In this paper, we focus on the resolvable property for the group targets. The decision algorithm. The simulation results show that the proposed method can effectively reflect the change of the group target resolution caused by the change of the distance between the target and the radar.
pp. 67-71

Friday, October 26 10:30 - 11:45

FriA01: Target Tracking I

Room 207

Chair: Ba-Ngu Vo (Curtin University, Australia)

Multi-path Data Association for Over-the-Horizon Radar Using Linear Multitarget Integrated Probabilistic Data Association

Yuan Huang, Sa Yong Chong and Taek Lyul Song (Hanyang University, Korea); Joo Hyun Lee (Hanwha Systems, Korea)

In over-the-horizon radar (OTHR) applications, one target can generate multiple detections due to the multiple signal propagation paths through the ionosphere. Traditional joint multiple detection data association algorithms suffer from the high computational load when they are applied to OTHR. Different from the traditional joint multiple detection data association structures, a novel scheme is developed based on the modulated clutter measurement density. When a measurement cell, which contains one or more measurements, is associated to a track, the proposed scheme considers not only the possibility that this measurement cell is generated by clutter but also the possibility that this measurement cell is generated from other targets. Using the modulated clutter measurement density, a single target data association structure can be applied to multitarget data association. The simulation results show that the proposed algorithm is much more computationally efficient compared to the traditional joint multiple detection joint data association structures.
pp. 72-77

Multi-target Tracking with the Progressive Gaussian Probability Hypothesis Density filter

Junjie Wang, Lingling Zhao and Xiaohong Su (Harbin Institute of Technology, P.R. China); Shi Chunmei (Northeast Forestry University, P.R. China)

Particle flow filter implementations of random finite set filters have been proposed to tackle the issue of jointly estimating the number of targets and states. However, errors resulting from linearization are unavoidable. This paper presents a progressive Gaussian implementation of the probability hypothesis density filter, called the PG-PHD filter. The PG-PHD filter employed the progressive Gaussian filter to predict and update instead of the particle flow filter. The proposed algorithm addresses the drawback of Gaussian particle flow filter by using the progressive Gaussian method to migrate particles to the dense regions of the posterior while no need to linear the measurement function. The simulation results show that the performance of proposed PG-PHD improved significantly compared with the particle flow PHD filter.
pp. 78-83

Multi-frame Multi-sensor Multi-target task allocation Method based on Improved Wolf Colony Algorithm

Feng Yang and Pengxiang Wang (Northwestern Polytechnical University, P.R. China)

With the increasing number of targets, limited sensor resources cannot meet the requirements of reasonable management. Therefore, effectively perform sensor task allocation in the case of multi-target multi-sensor has been widely concerned by scholars. The traditional allocation method only considers single frame allocation, and ignores the relationship between the results of consecutive several frame. Thinking about the sequentiality for continuous time frames, a multi-frame multi-sensor multi-target task allocation method based on improved Wolf Colony Algorithm (WCA) is proposed. In the paper, the allocation results of the previous frames are taken into account at current frame. The threat degree of the next frame of the target which has not been assigned sensor monitoring for several consecutive frames is updated based on the pervious allocation results in multi frames. The multi-sensor multi-target task allocation problem is modeled as a constrained optimization problem, which is solved by the Improved WCA. Simulation results show that the result of allocation of sensor resources is more reasonable, with increase slightly of the allocation time cost, compared with Improved WCA without the method.
pp. 84-89

Spatial Clutter Measurement Density Estimation with the Clutter Probability for Improving Multi-target Tracking Performance in Cluttered Environments

Seung Hyo Park and Yifan Xie (Hanyang University, Korea); Han Du Hee (Hanwha Research and Development Center, Korea); Taek Lyul Song (Hanyang University, Korea)

The spatial clutter measurement density estimator (SCMDE) for estimating the clutter measurement density as a non-parametric variable has been proposed. As the SCMDE estimates the sparsity by considering that the adjacent measurements are generated from clutter, the sparsity may be biased if the target measurement is located close to the measurement of interest.

Moreover, target tracking performance may be degraded in the situation where multiple targets intersect. In this paper, we propose a clutter measurement density estimation method that can more accurately estimate the clutter measurement density by calculating the clutter probabilities of the adjacent measurements. The proposed method is applied to multiple target tracking to verify the performance improvement by a series of Monte Carlo simulation.
pp. 90-95

A RANSAC-Based Track Initialization Algorithm for Multi-Sensor Tracking System

Feng Yang (Northwestern Polytechnical University, P.R. China); Weikang Tang (Northwestern Polytechncial University, P.R. China)

For multi-sensor tracking system, track initialization is a difficult problem due to crossed data association of different steps and different sources. In this paper, a RANSAC-based track initialization algorithm for multi-sensor system is proposed. Considering the fact that target motion is contiguous in time-space domain, measurements of a target are homologous about target motion model within a short period. Therefore, the proposed algorithm uses the homology to associate all measurements regardless of steps and sources. RANSAC technique is utilized to learn target motion model recursively, which associates measurements in a sliding window consisting of sequential measurements from all sensors. The association mechanism via the homology is better to avoid the effect of missed measurements in some time steps or some sensors and maintain robustness in environment with noise and clutter than traditional track initialization algorithms, which is confirmed by simulation results in this paper.
pp. 96-101

FriA02: Control Systems I

Room No.8

Chair: Chuanbo Wen (Shanghai Dianji University, P.R. China)

Observer based tracking control for the isothermal CSTR

Sana Bzioui (Cadi Ayyad University & LAEPT, Morocco); Rafik Channa (Cadi Ayyad University, Morocco)

In this paper, an observer based state feedback control using Parallel Distributed Compensation (PDC) structure has been used to ensure the stability and trajectory tracking for the isothermal CSTR. Continuous Stirred Tank Reactors (CSTRs) are the most important element in the chemical industry. They are characterized by their complexity and nonlinearity. In this study, the Takagi-Sugeno (T-S) approach is proposed to simplify the nonlinear model of CSTR. However, in real-world control problems, the states may not be measurable, so, an observer is designed in order to estimate the immeasurable states and a tracking control is constructed based on the estimated states. An integral action is used to track a reference trajectory. The simulation results show a high precision tracking control.
pp. 102-106

Consensus-based Secondary Frequency Control for Islanded Microgrid with Communication Delays

Pengcheng Cai (Shanghai Dian Ji University, P.R. China); Chuanbo Wen (Shanghai Dianji University, P.R. China); Changju Song (Shanghai Dian Ji University, P.R. China)

In this paper, a distributed control strategy based on consensus algorithm is proposed to deal with the secondary frequency control problem for islanded AC microgrid. The proposed strategy allows the active power set-points of each distributed generator (DGs) unit to be updated in the presence of time-varying bounded communication delays in the distributed communication network, thereby restoring the average frequency of the system to a reference value. In order to further reduce the communication burden, here, an event-driven control method is adopted, that is, the proposed strategy is started only when the system frequency deviation is excessive. Compared with the traditional control method, the proposed strategy only needs the information of the DG itself and its neighbors to achieve the control target, eliminating the need for the microgrid central controller (MGCC) and improving the reliability and flexibility of the system. Simulation results validate the effectiveness of our proposed control strategy.
pp. 107-112

A Real-Time Simulator For Processor-In-the-Loop Simulation of Small Satellites

Dongwon Jung, Heok June You and Kenwoo Kim (Korea Aerospace University, Korea)

This paper presents a real-time simulator environment for hardware-in-the-loop simulation for small satellites. Based on mathematical orbit model and attitude dynamics model, the simulator virtually simulates the orbit conditions of the small satellites with high fidelity of sensors and actuator models.
pp. 113-117

Multi-dimensional Observation Characteristic Function Filtering Based On Fixed Point Equation

Weijie Chen (Hangzhou Dianzi University, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China); Yi Ren (Peking University, P.R. China)

A filter based on characteristic functions is developed in this paper, to fit to a class of non-Gaussian dynamical systems, which state models are linear, measurement models are non-linear and multi-dimensional. TThis paper analyzes the limitations of the characteristic function filtering method designed for multi-dimensional observation models and compares the characteristic function filtering with other Gaussian filters and particle filter. Mainly for the gain matrix, the existing method is that using gradient descent method to calculate the filter gain matrix, but the truncation error caused by this method is large when the nonlinearity is strong. Based on the existing problems, the filter based on fixed point equation is designed in this paper which using fixed point algorithm to replace the gradient descent method.
pp. 118-123

H^{∞} control for a kind of networked control systems with network induced time-delay and data packet dropout

Yanfeng Wang (Huzhou University, P.R. China)

This paper is concerned with the problem of controller design for a kind of networked control systems with network induced time-delay and random data packet dropout. Assuming that the network-induced time-delay is no more than one sampling period of the control system. The data packet drop process obeys the Bernoulli process and the closed-loop system mathematical model is abstained by the means of state aug-mention method. Moreover, the condition of the existence for the control law which makes closed-loop control system exponentially mean-square stable is derived through Lyapunov stability theory. Transformation of matrix inequality is carried out by means of linear matrix inequality (LMI) method. The method of controller design is also given. The controller which makes the closed-loop system stable can be easily obtained by the Matlab LMI toolbox, and through analysis, we can see that the results of the paper are more general than the existing literature. The effectiveness of the method is illustrated by a numerical example.
pp. 124-127

FriA03: Image Processing and Machine Learning I

Room No.9

Chair: Martin D Adams (University of Chile & Advanced Mining Technology Centre, Chile)

Short-Term Power Load Forecasting based on Improved Online ELM-K

Yifan Cheng, Lijun Jin and Ke Hou (Tongji University, P.R. China)

With the research of power system gradually concentrated in the smart grid, the communication network and the sensor technology, the data of the demand side is growing exponentially and complicating. Traditional power load prediction models can no longer satisfy the timeliness and accuracy. This paper presents a short-term load forecast approach based on the improved online kernel extreme learning machine (Online ELM-K). The Cholesky decomposition is adopted to simplify the calculation method of the kernel extreme learning machine (ELM-K) output weights by replacing the matrix inverse with arithmetic. On this basis, the ELM-K model is able to online updating with the new samples. Meanwhile, the generalization ability and learning efficiency of the model are enhanced. The research results based on actual load datasets reveal that the proposed method improves the short-term load prediction accuracy and outperforms the existing methods.
pp. 128-132

A Rapid Webcam-based Eye Tracking Method for Human Computer Interaction

Chenyang Zheng and Tsuyoshi Usagawa (Kumamoto University, Japan)

This study proposes a rapid eye tracking method, to respond to a situation that require a high processing speed but less accuracy. Unlike other studies, this study uses a webcam with a low resolution of 640 × 480, which decreased the cost of devices considerably. We also developed the corresponding algorithm to suit the low-quality image. We use an efficient algorithm to detect the pupils which is based on color intensity change to decrease the calculation load. The processing speed exceeds the requirement of eye tracking for saccade eyeball movement. The result of experiment shows that the proposed method is a fast and low-cost method for eye tracking.
pp. 133-136

Military Scenario Named Entity Recognition Method Based on Deep Neural Network

Xue feng Wang (National University of Defense Technology Institute of Information and Communication, P.R. China)

For the military scenario named entity, the article proposes a supervised named entity recognition method based on deep neural network, which aims to identify and extract the troops, geographical location, weapons and equipment, organization, facilities, battlefield environment, time, etc. in the military scenario. The method avoids the complexity of artificially constructed features and the inaccuracy of military text segmentation. Bi-directional Long Short-Term Memory neural network based on character vector and the conditional random field model are used to automatically extract text features, and then identify the military scenario named entities. Experiments show that the method is higher in recognition accuracy than the traditional method and close to the level of named entity recognition in the general field.
pp. 137-140

Image Copy-Move Forgery Detection based on SIFT-BRISK

Tianyang Du and Lihua Tian (Xi'an Jiaotong University, P.R. China); Chen Li (Dept. of Electronic & Information Engineering, P.R. China)

Copy-move forgery is the most common type of image forgery. SIFT is widely used in copy-move forgery detection due to its excellent scale invariance and rotation invariance. However, the detection efficiency of the traditional SIFT-based method has not performed very well because its high-dimensional feature descriptors leads to a long time of feature extracting and matching. In this paper we propose an efficient method for copy-move forgery detection. First, for the forged image, we determine the SIFT keypoints with scale and position information. Then, we use BRISK algorithm to generate a binary feature descriptor for each keypoint. Finally, we can use Hamming distance to quickly match similar keypoints. The experimental results show that the proposed method obtains a significant improvement in the speed of forgery detection under the premise of better robustness.
pp. 141-145

Resting-state Regional Homogeneity Analysis on Real-time fMRI Emotion Self-regulation Training

Qiang Yang, Yulong Qin, Linyuan Wang and Bin Yan (National Digital Switching System Engineering & Technological Research Centre, P.R. China); Li Tong (National Digital Switching System Engineering & Technological Research Center, P.R. China); Liang Sun and Zhonglin Li (National Digital Switching System Engineering & Technological Research Centre, P.R. China)

Real-time functional magnetic resonance imaging neurofeedback (rtfMRI-NF) is a type of biofeedback in which real-time fMRI signals are used to self-regulate brain function. At present, most of researches pay attention to the effect of rtfMRI-NF on task-state fMRI. However, resting-state analysis brings another angle to explore the neural mechanism of emotion regulation, and can be an important way to reflect brain function. Regional homogeneity (ReHo) analysis is a method to study the consistency of the spontaneous neuronal activity between the given voxel and its adjacent voxel in the resting-state. It can reveal the functional and anatomical closely linked neural circuits. In this paper, we designed a rtfMRI-NF experiment for human emotion self-regulation and used ReHo to analyze the influence of rtfMRI-NF training on the brain function. In the experiment, subjects were divided into two groups, the experiment and the control group. For the experiment group, participants were provided with ongoing information on their emotional states by using real-time multivariate voxel pattern analysis. In the control group, it was the same as that of the experiment group, except for that the feedback information was not related to emotion. We performed the ReHo analysis on the rest data collected from the two groups after the self-regulation tasks, and experiment results showed that there were significant differences between the ReHo maps of the two groups in the temporal lobe, prefrontal cortex, parahippocampal gyrus and fusiform gyrus. These brain regions were closely related to emotional processing, and the results are consistent with previous studies. Furthermore, ReHo can reflect the characteristic changes of spontaneous neural activity in brain, it makes another way to help discover the mechanism of neurofeedback, and it can be used as a research direction to assist in the prediction and diagnosis of mental illness.
pp. 146-150

Friday, October 26 1:30 - 2:45

FriB01: Target tracking II

Room 207

Chair: Feng Yang (Northwestern Polytechnical University, P.R. China)

Multistatic Doppler-based marine ships tracking

Thanh Do (Curtin University, Australia); Hoa Nguyen (The University of Adelaide, Australia)

Multistatic Doppler radar measurements for multiple targets are typically corrupted by noise, missed detections and false alarms. In addition, when targets are close together, it becomes more difficult for the tracker to resolve tracks due to the highly nonlinear and low observability nature of the observation. This paper proposes a solution to the problem of tracking multiple marine ships from multistatic Doppler measurements. We use close form labeled multitarget Bayes filter, which can accommodate unknown and time-varying number of targets, clutter misdetection and association uncertainty, as well as nonlinear target dynamic and measurements via the unscented transform. The efficiency of the proposed algorithm is illustrated via numerical simulation examples.
pp. 151-156

SMC-PHD Target State Extraction based on CFSFDP Clustering Algorithm

Feng Yang (Northwestern Polytechnical University, P.R. China); Miaozang Zhang (Northwestern Polytechncial University, P.R. China); Pengyan Zhang (Hangzhou Hikvision Digital Technology Co.,Ltd.)

The Sequential Monte Carlo PHD (SMC-PHD) filter which can solve the target tracking problems in nonlinear and non-Gaussian systems is an effective PHD implementation. The target state at each moment is characterized by a large number of weighted particles in this filtering algorithm. Therefore, extracting the target state effectively is the key to implementing SMC-PHD filtering. In the SMC-PHD filtering algorithm, the traditional K-means state extraction method commonly used is seriously affected by the initial clustering center which is prone to state estimation errors. To solve the above problems, a multi-target state extraction method based on Clustering Fast Search and Find of Density Peaks (CFSFDP) clustering algorithm

is proposed. Based on numbers of weighted particles output by the SMC-PHD filter, the clustering centers and categories are clustered using the spatial distribution information of the particles, namely local density, distance, and weight information of the particles. Then, multiple target estimation states are extracted from each cluster. The simulation results show that the algorithm proposed in this paper significantly improves the accuracy of the algorithm compared with the classical K-means clustering method and the method Ristic's proposed.
pp. 157-162

Cell Lineage Tracking Based on Labeled Random Finite Set Filtering

Baishen Wei (Guangzhou University, P.R. China); Lin Zhou (The Fifth Affiliated Hospital of Guangzhou Medical University, P.R. China)

One fundamental interest of developmental biology is to resolve lineage relationships between cells. This paper proposes a cell lineage tracking algorithm based on labeled Random Finite Set (RFS) filtering. \delta-Generalized Labeled Multi-Bernoulli (\delta-GLMB) filter is used for cell state estimation. New cells are captured by a measurement-based birth model. In order to capture spawned cells and lineage, a new \delta-GLMB filter which incorporates spawning in addition to new births is proposed. Information regarding spawned cell's lineage is provided with an algorithm which can weigh the distance between new cells and old cells. The new filter can achieve joint estimation of new cell's state and information of its lineage. The efficacy of the proposed method is demonstrated by simulations.
pp. 163-168

An IMM-VB Algorithm for Hypersonic Vehicle Tracking with Heavy Tailed Measurement Noise

Peng Yun, Pan Long Wu and Shan He (Nanjing University of Science and Technology, P.R. China)

In order to solve the problem of degraded tracking accuracy of hypersonic vehicle caused by outliers disturbance in real systems, an interactive multi-model variational Bayesian (IMM-VB) algorithm is proposed. Firstly, the algorithm obtains state prediction values and weights by IMM. Then the Student's t distribution with heavy tail characteristics is used to replace the Gaussian distribution to describe the measurement model. Finally, the measured covariance and the target state are estimated by VB. Simulation results show that the algorithm has higher tracking accuracy than the IMM algorithm under outliers observation conditions.
pp. 169-174

δ-Generalised Labelled Multi-Bernoulli Simultaneous Localisation and Mapping

Diluka Moratuwage (Universidad de Chile, Chile); Martin D Adams (University of Chile & Advanced Mining Technology Centre, Chile); Felipe Inostroza (Universidad de Chile, Chile)

Motivated by the need for simultaneous localisation and mapping (SLAM) algorithms which circumvent the requirement of external data association routines and map management heuristics, and account for realistic sensor detection uncertainty, recent literature has adopted Random Finite Set (RFS) based approaches. Solutions based on the Probability Hypothesis Density (PHD) filter and more recently the Labelled Multi-Bernoulli (LMB) filter have been demonstrated. The LMB filter was introduced as an efficient approximation of the computationally expensive δ-Generalised LMB (δ-GLMB) filter. The LMB filter converts its representation of an LMB distribution to δ-GLMB form and back during the measurement update step. The conversion from a potentially large number of hypotheses in δ-GLMB into a LMB results in a loss of information and in general yields inferior results compared to the δ-GLMB filter. To address this issue, we present a SLAM solution using an efficient variant of the δ-GLMB filter (δ-GLMB-SLAM) based on Gibbs sampling, which is computationally comparable to LMB-SLAM, yet much more accurate and robust against sensor noise, measurement clutter and feature detection uncertainty. The performance of the proposed δ-GLMB-SLAM algorithm is compared with a variant of LMB-SLAM using a series of simulations.
pp. 175-182

FriB02: Control Systems II

Room No.8

Chair: Xingfa Shen (Hangzhou Dianzi University, P.R. China)

Accelerated Multi-Sensor Control for Selective Multi-Object Tracking

Sabita Panicker, Amirali Khodadadian Gostar, Alireza Bab-Hadiashar and Reza Hoseinnezhad (RMIT University, Australia)

This paper focuses on selective multi-object tracking applications where objects with particular labels are of interest, and multiple sensors need to be controlled to achieve the optimum tracking performance for those objects. We formulate a novel solutions for a centralized multi-sensor multi-object system with labeled multi-Bernoulli filters in each sensor node. Our solution includes optimizing a closed-form objective function that can be directly calculated after prediction step in the central node of the sensor network. Importantly, our proposed cost function does not need to be computed after pseudo-update operations, hence a large amount of computation is saved. Simulation results indicate how the proposed methods can lead to significant improvements in terms of tracking accuracy of objects of interest, compared to using the generic (non-selective) sensor control methods. Numerical experiments involving a challenging multi-sensor target tracking application demonstrate that while our proposed method significantly outperforms the common (non-selective) sensor control methods, it performs similar to the state of art method for selective sensor control (selective-PEECS) in terms of the mean-square-error of tracking of the targets of interest. Despite similar performance in terms of tracking error, our method is significantly faster than the state of art (eight times faster in our experiments).
pp. 183-188

An Approach to Multi-sensor Decision Fusion Based on the Improved Jousselme Evidence distance

Lifan Sun (University of Electronic Science and Technology of China, P.R. China); Yayuan Zhang, Zhumu Fu and Guoqiang Zheng (Henan University of Science and Technology, P.R. China); Zi-Shu He (University of Electronics Science and Technology of China, P.R. China); Jiexin Pu (Henan University of Sci. & Tech., P.R. China)

Multi-sensor systems are able to obtain various measurement data, but their accuracy and reliability are difficult to be guaranteed, thus the decision-makings using these data are likely contrary to the facts. In view of this, an approach to multi-sensor decision fusion based on improved Jousselme evidence distance is proposed in the framework of D-S evidence theory. By rationally dividing the similarity Jaccard coefficient matrix, the evidences are about conflicted sensor node described accurately and their weights are reallocated by correction. This facilitates the final decision fusiion. Numerical experimental results demonstrate that the highest recognition rate of the proposed decision fusion approach based on the improved Jousselme distance can be up to 92.52%, which is higher than that of Muphy's approach (nearly 17.28%). Meanwhile, the fusion performance of the uncertainty is reduced by 2 order of magnitude in our approach. To sum up, the proposed decision fusion approach not only recognizes the evidence about conflicted sensor node rapidly, but also has less risk of decision-makings. Thus our approach seems promising and may be applied in wider applications.
pp. 189-193

Operational Network Topology Reconfiguration based on Focus of Guarantee

Hou Jianfeng (National University of Defense Tech, P.R. China)

Network topology reconfiguration is critical for transmission efficiency as well as operational efficiency in operational process. Currently, most researchers pay much attention to the reconfiguration problem caused by adding or deleting nodes or links. In this paper, we propose a novel approach of operational network topology reconfiguration based on Focus of Guarantee (FoG) model, aiming to meet the need of precise operational network organizing. We firstly introduce the FoG concept model and analyze the relationship between FoG and network topology reconfiguration. Afterwards, the optimal problem of network topology reconfiguration is discussed on the basis of traffic characteristic constraints extracted from FoG model. Experiment results show that such FoG based method effectively improves the transmission efficiency of reconstructed operational network.
pp. 194-199

A Sliding Mode Control Method for Manipulator Based on GA Optimize Neural Network

Jing Liu (Henan University of Science and Technology, P.R. China); Jiexin Pu (Henan University of Sci. & Tech., P.R. China); Zhang Chi (Henan University of Science and Technology, P.R. China)

In this paper, a neural network sliding mode control method based on genetic algorithm (GA) is proposed, considering the control accuracy reduction problem of the manipulators caused by the external interference and modeling error. The system is divided into the nominal part and the uncertain part, using state feedback control and improved neural network sliding mode control respectively. Neural network used to approximate the upper bound of uncertainty and serves as an input for the dynamic compensation of the sliding mode controller. At the same time, genetic algorithm is used to optimize the structural parameters of the neural network to ensure effective mapping. The global stability of the system is proved by Lyapunov function. The simulation results show that the proposed method can effectively track the desired trajectory with small error and has good robustness to the external uncertainty.

pp. 200-204

Stochastic geometry based hierarchical power allocation for the uplink ultra-dense networks

Mengting Liu, Ning An, Yinglei Teng and Mei Song (Beijing University of Posts and Telecommunications, P.R. China)

Ultra-Dense Networks (UDNs) is widely considered as a key technology of fifth generation (5G) networks, where access points (APs) are densely deployed to meet the high capacity requirements in various environments. However, the large scale of UDNs inevitably increases the computational complexity and signaling overhead for resource allocation processes. In this paper, employing discrete power levels, we propose a stochastic geometry based hierarchical power allocation scheme to maximize the user sum rate in uplink UDNs. Using stochastic geometry theory, we first group all users in terms of their transmit powers, and then derive two key metrics including statistical informationbased signal to interference and noise ratio (SSINR) and the lower bound of statistical information-based user rate (SR). Furthermore, an alternative genetic algorithm (AGA) is utilized to obtain the power allocation scheme. Simulation results show that the proposed power allocation algorithm is not only able to improve the user sum rate, but also can significantly reduce the signaling overhead and computation complexity.

pp. 205-209

FriB03: Image Processing and Machine Learning II

Room No.9

Chair: Reza Hoseinnezhad (RMIT University, Australia)

The Analysis Between Traditional Convolution Neural Network and CapsuleNet

Feng Yang and Wentong Li (Northwestern Polytechnical University, P.R. China); Weikang Tang (Northwestern Polytechncial University, P.R. China)

Convolution neural networks(CNNs) have made a series of breakthroughs in the fields of autonomous driving, robotics, medical treatment and so on. The powerful feature learning and classification ability of CNNs has attracted wide attention of scholars. With the improvement of the networks structure and the increasing of the networks depth, the performance of tasks such as image classification, detection, recognition, and segmentation has been improved greatly. Recently, CapsuleNet, which is different from CNNs, has been proposed. In CapsuleNet, vectors replace traditional scalar points to better characterize the relationships between feature information and acquire more attributes of things. In this paper, the basic structure and algorithm operating principle of classical CNN models were described firstly, and then the basic neural network, network structure, parameters update and distribution process for the CapsuleNet model were analyzed and summarized. Finally, several sets of training experiments were conducted to compare and analyze the image classification and feature expression capabilities of CapsuleNet and CNN models.

pp. 210-215

Dynamic Hand Gesture Recognition Based On Depth Information

Xinran Bai (Xi'an Jiaotong University, P.R. China); Chen Li (Dept. of Electronic & Information Engineering, P.R. China); Lihua Tian (Xi'an Jiaotong University, P.R. China)

Dynamic hand gesture is consisted by hand movement trajectory and the changes of hand shape. However, some existing methods only focus on the trajectory, and those methods can not accurately recognize the gesture that has the similar trajectory but different hand shape changes. For this problem, a dynamic hand gesture recognition method that combines the trajectory with the hand shape is proposed in this paper. First, we use depth images to determine the hand region and extract the location of palm center, avoiding the effect of lighting condition and complex environment. The absolute position and relative position of the palm center is adopted to represent the trajectory. Next, we present a method which combines convex hull with k-curvature to detect the fingertips contour, which can be a better representation of the hand shape change in dynamic gestures. Then we solve the image blurring problem by voting strategy. Besides, the Temporal Pyramid algorithm is applied to process the extracted features, since it can express temporal features more delicately and unify different feature dimensions. Finally, SVM algorithm is utilized to classify the dynamic hand gesture. The experimental results show that our method has higher recognition rate with less time consuming than the compared methods.

pp. 216-221

A SSD-based Crowded Pedestrian Detection Method

Wenjing Zhang and Lihua Tian (Xi'an Jiaotong University, P.R. China); Chen Li (Dept. of Electronic & Information Engineering, P.R. China); Haojia Li (Xi'an Jiaotong University, P.R. China)

Pedestrian detection, as a fundamental detection task on computer vision, are receiving growing attention in both industry and academia. Considering the problem of pedestrian detection in complex scenes, especially small and crowded objects, we propose a SSD-based crowed pedestrian detection method. In this paper, our method increases density of the default boxes by setting an offset, which can solve the problem of crowed pedestrian detection. SSD which is designed for general object detection is not suitable for pedestrian detection because of a large aspect ratio of pedestrians. Therefore, we adopt unnormal 5*1 convolutional kernels instead of the standard 3*3 ones in order to adapt pedestrian detection. Finally, we present experimental results on public benchmark datasets including Caltech dataset and INRIA dataset, that indicate our method have a better performance for pedestrian detection.

pp. 222-226

Stacked Sparse Auto Encoder Network based Multimode Process Monitoring

Feiya Lv (Zhejiang University, P.R. China); Xiaonan Fan (Inner Mongolia University for Nationlities, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China); Zejing Bao (Zhejiang University, P.R. China)

It is difficult for conventional multivariate statistical process control (MSPC) methods to choose the optimal control limits in multimode online monitoring. This may not only ignore some potential relationships within raw mode data, but also cover the impact of incipient fault. Thus a stacked sparse auto encoder (SSAE) based multimode monitoring method is proposed in this paper to pursuit deeper architecture information and essential characteristics of raw measurements. It is put forward by incorporating real-time mode identification with fault discrimination online within a global model. For incipient faults that cannot be detected by conventional statistical methods, the proposed framework shows a remarkable high efficiency. Experiments on Tennessee Eastman Process (TEP) have shown its efficiency for not only multimode identification, but also fault detection.

pp. 227-232

Chinese Pop Music Emotion Classification Based on FA-SVM

Yuexin Hu, Jingjing Zhang, Wei Jiang and Rongshu Sun (Communication University of China, P.R. China)

Through subjective evaluation experiments, this paper constructs an emotional model suitable for Chinese popular music, and divides Chinese popular music into five categories: sentimental, soothing, joyous, exciting and heroic. By extracting short-time zero-crossing rate, short-time energy, spectrum centroid, MFCC, LPCC and other features, the SVM is used for

building the classifier. Then the FA algorithm is used for optimizing the radial basis function parameters, and finally the accuracy of 86.65% is obtained. Compared with manual tuning, the accuracy of SVM classification is increased by 2.37%. The experiment can verify that the emotional model is feasible. The FA-SVM modeling method is fast and accurate. It is suitable for emotional recognition of Chinese popular music.
pp. 233-237

Friday, October 26 3:00 - 4:15

FriC01: Target tracking III

Room 207

Chair: Wei Yi (University of Electronic Science and Technology of China, P.R. China)

Centralized Multiple-View Information Fusion for Multi-Object Tracking Using Labeled Multi-Bernoulli Filters

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

In many applications, the states of an unknown number of objects need to be estimated using measurements that are acquired from multiple sensors with different fields of view. When object labels are part of their states, the problem is called the multi-sensor multi-object tracking problem. This paper presents a new solution for statistical fusion of multi-sensor information in such problems where the sensors form a centralized network. Assuming that a labeled multi-Bernoulli (LMB) filter is running at each sensor node, we suggest a new approach to fuse the multiple LMB posteriors in a centralized manner. The fused posterior is designed to incorporate all the information provided by multiple sensor nodes for each object label. Numerical experiments involving challenging multi-sensor multi-object tracking scenarios show that the proposed method outperforms the state of the art.
pp. 238-243

Multi-agent formation control and target tracking

Jiarui Xing (Hangzhou Dianzi University, P.R. China); Weifeng Liu (Hangzhou Dianzi Univerisity, P.R. China); Kong Mingxin (Hangzhou Dianzi University, P.R. China)

With the rapid development of sensor information technology, robot control technology and target tracking technology, the target tracking of single target and single agent cannot meet the needs of some occasion. In the past decades, multi-agent control and tracking algorithms have attracted more and more attention. Among them, the control problem of multi-agent has become the research focus of scholars. As an important aspect of multi-agent control problem, formation control has also made considerable progress. It has played an important role in the fields of industry, civil affairs and military affairs [1]. Multi-agent formation has obvious advantages compared with the task of single agent. For example, multi-agent formation can accomplish more and more complex tasks. The efficiency of the task is greatly improved. Even if the single agent in the system fails, it will not affect the completion of the whole task. In order to improve the efficiency of multi-agent system, it is very necessary to study the task of multi-agent coordination. At present, the widely used intelligent formation tracking system includes the target detection and tracking system of unmanned aerial vehicle formation, the ground vehicle object tracking and detection system and the detection and tracking system of the sea surface ship area target.
pp. 244-248

Resolvable Group State Estimation with Maneuver Movement Based on Labeled RFS

Yudong Chi (Hangzhou Dianzi University, P.R. China)

In this paper, the tracking problem of resolvable group target is studied under the framework of labeled random finite set. Due to the dependence of all members in group targets, the original GLMB filter can not effectively track the group targets with fixed structure. In this paper, we combine the graph theory and the labeled random finite set. Then we correct the collaboration noise and give the predict step and update step for a resolvable group target. Further, the UKF filter is introduced and compared with the original GLMB filter. Finally, two simulations are given to compare and verify the proposed algorithm.
pp. 249-254

A Novel Ant-Based Multiple Cells Tracking Approach with Cardinalized Estimation

Mingli Lu (Changshu Institute of Technology Changshu, P.R. China)

Cell migration is an important process in normal tissue, organ or entire organism development and disease. This paper proposes an ant algorithm based on cardinality estimation for clustered cells state and number estimator simultaneously.Cardinality prediction and updating model based on the existence probability of pheromone field are derived for effectively estimating the number of cells. In order to separate clusters cells, an ant work model based on the pheromone gradient information is developed to guide ants movement towards center of interested cells. Experiment results show that our algorithm could automatically track clustered cells in various scenarios, and, it is more accurate than other popular tracking methods
pp. 255-259

A Constrained Passive Motion Sensor Control and Multi-Target Pure Azimuth Tracking Algorithm

Yi Wu (Qing An Group Limited of AVIC, P.R. China); Hao Wang (The 20th Research Institute line of CETC, P.R. China); Guilin Zhang (The 28th Research Institute, P.R. China)

This paper deals with the problem of pure azimuth tracking of mobile sensors by optimizing a metric named probability of missing detection, power and cost (PMD-PaC). By establishing the model of a restricted motion sensor, we first establish a pure azimuth observation model. The mobile sensor control is seen as an optimization problem in moving direction and speed. Finally, the proposed algorithm is verified through a simulation experiment.
pp. 260-263

FriC02: Robotics, Navigation and Guidance

Room No.8

Chair: Quanbo Ge (Hangzhou Dianzi University, P.R. China)

ATLAS Robot A Teaching Tool for Autonomous Agricultural Mobile Robotics

Anthony James Bautista (University of Santo Tomas, Philippines)

Robotics is heralded as an integral part of precision farming, the application of technology to aid the solution of the burdening food shortage. However, robotics is quite intimidating to some students and a challenging subject to handle for professors, particularly as the vehicles used in agriculture can be rather large and powerful. The objective of this research is to develop an interactive teaching tool that can be used to learn the fundamentals of robotics and autonomous navigation as a springboard to the larger agricultural robots. This paper discusses the results of using a robot, named ATLAS due to its use of GPS navigation. Various behaviors that the robot can accomplish were included, such as following a wall surface, and navigating to a target waypoint or set of waypoints. Some real projects developed by students who used the ATLAS robot in their study are also presented. Furthermore, this paper can be used by different educational institutions as an alternative teaching approach in handling robotics subject.

pp. 264-269

Sparse Pointcloud Map Fusion of Multi-robot System

Shiqin Sun (Changshu Institute of Technology, P.R. China); Benlian Xu (Changshu Institute of Technology, P.R. China)

Map building for multi-robot is very important to accomplish autonomous navigation in an unknown large-scale environment and other complex intelligent tasks. The core issue that need to be addressed of multi-robot mapping is how to integrate the data of the different robots into a single global map.In this paper, a matching search strategy based on the co-viewing relationship between key frames is proposed to reduce matching time. We match key frames selected from the maps according to a certain condition instead of matching them individually. Thus, a considerable amount of match time can be reduced. After a set of matched map points is obtained, the motion estimation between matched points is solved by nonlinear optimization and error compensation is used to obtain more accurate camera posture. Finally, the repeated map points after fusion are erased, and establish the connection between the key frames and the map points in the two maps. The algorithm is tested in an indoor environment and the results show that the map after fusion is better than that of a single robot. The experiment shows the validness of the proposed method and reduces the time and error of map building.

pp. 270-274

A guidance method adapted to the full strapdown laser homing system

Di Han and Yangyang Zhao (No. 203 Research Institute of China Ordnance Industries, P.R. China); Gen Wang and Kun Xiao (No. 203 Research Institute of China Ordnance Industries, P.R. China)

In this paper, a new method of modeling a full strap-down laser seeker is proposed for the seeker's characteristics of large field-of-view, small linear area and slight fluctuation in the line-of-sight angle. Moreover, a new switching logic guidance method with pre-estimating function is suggested. Adding pre-estimation and switching correction items to the original, this method is able to switch the line-of-sight angle from the nonlinear to the linear zone quickly and steadily; on the other hand, it also limits the seeker frequent switching between the linear and nonlinear zone caused by the missile's oscillation.

pp. 275-278

Multi AUVs Cooperative Navigation Based on Cross Entropy

Xiuye Tao, Lichuan Zhang, Feihu Zhang and Yijie Yuan (Northwestern Polytechnical University, P.R. China)

Cooperative navigation can support the wide range navigation and positioning service for Autonomous underwater vehicles (AUVs), improving the positioning accuracy of the AUVs at the same time. In this paper, the Cross Entropy (CE) algorithm is applied to cooperative navigation system, in order to solve the problem of the path planning of the master AUV, and making the observation error of the system to be minimum, which would enhance the positioning accuracy of the AUVs. A slave AUV with low accuracy navigation system and a master AUV with high accuracy navigation system are used in the process of algorithm verification. First the navigation model is built in the framework of Markov decision process (MDP). Then, the CE algorithm is used to train the master AUV to select better path in the MDP navigation model. Finally, the optimal paths, which make the cumulative observation error to be minimum during the whole navigation process, are analyzed to verify the reliability of the CE navigation algorithm. The simulation results show that the CE navigation algorithm can select an optimal path of the master AUV to minimize the observation error.

pp. 279-284

A New Robust Student's t based SINS/GPS Integrated Navigation Method

Guangle Jia, Yonggang Zhang, Yulong Huang and Mingming Bai (Harbin Engineering University, P.R. China)

In practical strap-down inertial navigation system (SINS) and global positioning system (GPS) based integrated navigation, heavy-tailed non-Gaussian process noise may be induced by the severe maneuver, and heavy-tailed non-Gaussian measurement noise may be induced by the multi-path propagation of GPS signal. The performance of traditional Kalman filter based SINS/GPS integrated navigation method may degrade for such heavy-tailed non-Gaussian noises. To solve this problem, a new robust Student's t based SINS/GPS integrated navigation method is proposed, in which a new robust Student's t-based Kalman filter is employed to integrate SINS and GPS. Simulation results illustrate that the proposed integration method has higher navigation accuracy and better robustness to resist the heavy-tailed non-Gaussian noises as compared with traditional SINS/GPS integrated navigation method.

pp. 285-290

FriC03: Image Processing and Machine Learning III

Room No.9

Chair: Long Liu (Xi'an University of Technology, P.R. China)

On-line Tracking of Cells and their Lineage from Time Lapse Video Data

Tran Thien Dat Nguyen (Curtin University, Bentley, Australia); Du Yong Kim (RMIT University, Australia)

In this paper, we propose an algorithm for tracking cells that also provides lineage information. Our approach incorporates cell spawning into the random finite set dynamic model of the cell population, which allows the Bayes multi-object filter to capture information on the cells ancestries. A generalized Labeled Multi-Bernoulli (GLMB) filter (with cell spawning model) is applied to track the cells using detections extracted from time lapse video data. Numerical results on a set of stems cells demonstrate the capability of the proposed solution to track the time-varying number of cells as well as their ancestries.

pp. 291-296

RFIDCam: a RFID-Aided Visual Tracking System

Yan Guo and Xingfa Shen (Hangzhou Dianzi University, P.R. China)

With the rapid economic development and the substantial improvement of living standards, intelligent video surveillance technology has attracted widespread attention due to its huge natural advantages and has gradually become a research hotspot across the world. RFID is a non-contact automatic identification technology that automatically identifies target objects and obtains relevant data. Besides it requires no human intervention, the identification work can be used in various complicated and harsh environments. By placing RFID tags on valuable objects and installing RFID reader devices near the surveillance cameras, it can monitor whether valuables pass through the monitoring area and integrate RFID technology into the intelligent video surveillance system to help the system accomplish the target recognition and detection track. Therefore, based on the in-depth study of the current intelligent video surveillance technology, this paper proposes an RFID-based intelligent video surveillance system-RFIDCam, and builds a small experimental platform to verify the feasibility and the effectiveness of RFIDCam.

pp. 297-302

Incipient Fault Diagnosis with DNN Based Transfer Learning

Danmin Chen (State Key Laboratory of Mathematical Engineering and Advanced Computing, P.R. China)

Diagnosis of incipient fault is the key to ensuring the normal running of the system and preventing disasters. Traditional machine learning algorithms require a large number of samples to train. However, samples of incipient fault are difficult to obtain. To solve this problem, this paper proposes an incipient fault diagnosis model with DNN based transfer learning. Transfer learning aims to recognize and apply knowledge and skills learned in previous tasks to novel tasks. Firstly, it extracts features from significant fault with a large number of samples and trains deep neural network. Secondly, these parameters are transferred from the fault model to incipient fault model. Finally, the new model is trained with a small amount of data. The paper demonstrates the efficiency of the proposed model using the Case Western Reserve University bearing data set.

pp. 303-308

Radar Emitter Identification Based on Deep Convolutional Neural Network

Kong Mingxin (Hangzhou Dianzi University, P.R. China); Jing Zhang and Weifeng Liu (Hangzhou Dianzi Univerisity, P.R. China); Guilin Zhang (The 28th Research Institute, P.R. China)

Aiming at the identification and classification of radar radiation sources, this paper proposes a classification method based on the Convolutional Neural Network(CNN) for radar signal classification. Firstly, this paper sets the appropriate learning rate, batch size, iteration number, momentum and weight decay coefficient. Secondly, the time domain real part waveform signal is modeled and the network structure is selected for analysis. Finally, according to the spectrogram of the time domain waveform by Short Time Fourier Transform(STFT), design two different convolutional neural network models. The results show that the network learns more distinguishing feature representations and has better generalization capabilities after STFT. The Deep Learning of CNN has a greater advantage in extracting the feature representations in the spectrogram of the radar signal.

pp. 309-314

A New Panoramic Visual Tracking Method

Long Liu (Xi'an University of Technology, P.R. China)

Since being studied by people, panoramic vision has developed greatly in the field of computer vision. The tracking of moving objects is one of the most classic subjects, which has a wide application prospect. Due to the influence of panorama image distortion, it brings a large error to the target feature extraction, and it is easy to lose the target. The existing method of panoramic vision tracking still has some limitations. For this reason, This paper proposes a panoramic visual tracking algorithm based on adaptive extraction of the fused features. Based on the particle filtering-based tracking framework,the proposed algorithm incorporates adaptive extraction of target regions, fusion of color and shape features and calculation of particle weights into the tracking process, thus significantly improving target tracking accuracy. Experimental results show that the proposed algorithm can solve the problem of change in object's appearance, which caused by the translation, rotation, external illumination and occlusion of the target object, effectively improve the robustness of panoramic vision tracking.

pp. 315-319

Friday, October 26 4:30 - 5:45

FriD01: Nonlinear System and filtering I

Room 207

Chair: Yongxin Gao (Xi'an Jiaotong University, P.R. China)

Optimal Predictive Steering Control for Aircraft Ground Path Following

Zexin Huang, Matt Best and James Knowles (Loughborough University, United Kingdom (Great Britain))

Whilst autopilot systems have been commonly used by aircraft in flight, the control of aircraft when on the ground has received limited attention in the literature. This paper presents a real-time optimal controller based on linear quadratic (LQ) method with a road preview model incorporated with the aircraft model. The aircraft ground dynamics are captured by a 6-DOF nonlinear model which is linearized at a range of equilibrium points. The proposed LQ controller is compared with a reference, simple driver model in runway exit manoeuvres by following the centerline at different speeds. Taking advantage of the road preview mechanism and optimal feedback gain, the presented controller outperforms the driver model with much lower track error.

pp. 320-325

Experimental Study of ADRC based Heading Control of Underwater Flight Vehicles

Tianhai Zheng, Zhengping Feng, Shuo Zhao and Wanjun Pan (Shanghai Jiao Tong University, P.R. China)

The total disturbance estimated by the extended state observer (ESO) in active disturbance rejection controller (ADRC) is affected greatly by measurement noise when the control step is small in heading control of underwater flight vehicles. To prevent the rudder from high frequency chattering caused by measurement noise, a tracking-differentiator (TD) is integrated to the ESO to suppress the impact of sensor noise. Both the results of simulations and tank tests show the effectiveness of improved ADRC based heading control.

pp. 326-330

Research on Heave Compensation Control of Floating Crane Based on Permanent Magnet Synchronous Motor

Xiaogang Huang (Shanghai Maritime University & Quzhou University, P.R. China); Jiancheng Wang and Yonghua Xu (Quzhou Guangming Power Investment Group Co., Ltd, P.R. China); Yizhen Zhu and Tianhao Tang (Shanghai Maritime University, P.R. China); Meilei Lv (Quzhou University, P.R. China)

Offshore installations during harsh sea conditions results in rigorous requirements in terms of safety and efficiency for the floating crane. The forces resulting from the vertical motion of the vessel have an extensive effect on the overall crane structure and its lifetime. Moreover, vessel motion is proposed. Heave compensation is widely applied to decouple lifting loads from the ship motions due to wave excitation. The purpose of this paper is to compensate the vertical motion of the floating crane, analyzed the relationship between the floating crane and rope - hanging objects, establish the whole heave compensation system. Then use permanent magnet synchronous motor complete compensation for the hanging objects heave displacement in the system to achieve the movement. Finally, the static, rising and falling conditions of the actuator are analyzed, simulation results verify the effectiveness of the compensation system.

pp. 331-336

Minor Fault Detection for Permanent Magnet Synchronous Motor Based on Fractional Order Model and Relative Rate of Change

Wei Yu (Foshan University, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China)

Permanent magnet synchronous motor is a kind of typical nonlinear complex system. With its excellent performance such as high torque density, high efficiency and high reliability, it becomes the mainstream motor in the fields of active aircraft, electric vehicles and industrial servo drives. However, the existing fault diagnosis based on integer order model does not consider the fractional-order characteristics contained in the electromagnetic coupling and friction in the motor system, then it is difficult to effectively diagnose minor faults of the current with the residual error signal. In this paper, based on the traditional method, the state space representation based on fractional order model and the fault detection method of Kalman filter algorithm are introduced, and the "secondary detection" is adopted to calculate the relative change rate of typical fault feature quantity , and the experiment is verified.

pp. 337-342

Heading-Parametrized Multiple Model Method for Bearing-only Filtering

Mahendra Mallick (Independent Consultant, USA); Yanjun Yan (Western Carolina University, USA); Sanjeev Arulampalam (Defence Science and Technology Group, Australia)

Bearing-only filtering in two dimensions using a single sensor is a challenging nonlinear filtering problem. In filter initialization, it is commonly assumed that the target is moving towards the sensor and then a large interval for target heading is used to calculate the variance of initial heading. In reality, the heading of the target can be quite different from this assumed heading. We propose a heading-parametrized (HP) multiple model filtering method to handle an arbitrary heading of the target. We use the unscented Kalman filter with Cartesian coordinates (CUKF) and extended Kalman filter with modified polar coordinates (MPCEKF) in the HP multiple model framework. We demonstrate the validity of our approach using Monte Carlo simulations and compare the state estimation accuracy of the HP-CUKF and HP-MPCEKF with the posterior Cram´er-Rao lower bound (PCRLB).

pp. 343-348

FriD02: Nonlinear System and filtering II

Room No.8

Chair: Mahendra Mallick (Independent Consultant, USA)

Posterior Cramér-Rao Lower Bound for Angle-only Filtering in 3D

Mahendra Mallick (Independent Consultant, USA); Sanjeev Arulampalam (Defence Science and Technology Group, Australia); Yanjun Yan (Western Carolina University, USA)

In our previous work, we compared the performance of a number of nonlinear filters for the angle-only filtering (AOF) problem in 3D using bearing and elevation measurements from a single maneuvering sensor. These filters used Cartesian coordinates and modified spherical coordinates for the state vector and were based on discrete-time dynamic and measurement models. The target followed a nearly constant velocity motion. In this paper, we compute the posterior Cram´er-Rao lower bound (PCRLB) for the problem so that the performance of the nonlinear filters can be judged relative to the best possible performance. Results from Monte Carlo simulations show that as the measurement accuracy decreases, the difference between root mean square position and velocity errors and corresponding PCRLBs increases.

pp. 349-354

Vehicle Integrated Chassis Control via Multi-Input Multi-Output Sliding Mode Control

Chunyun Fu (Chongqing University, P.R. China); Reza Hoseinnezhad (RMIT University, Australia); Kuining Li, Minghui Hu, Feihua Huang and Feiya Li (Chongqing University, P.R. China)

Integrated chassis control (ICC) systems are designed to coordinate the control actions of individual chassis control systems, in order to achieve superior overall control performance. Many existing ICC systems employ an implicit mechanism to allocate/distribute the global target control action between the subsystems, which may lead to contradictory or suboptimal individual control actions. To deal with this shortcoming, this paper proposes an ICC solution based on multi-input multi-output sliding mode control. The coupled dynamics between the vehicle states to be controlled are explicitly incorporated in the proposed control design, and the control actions of active rear steer (ARS) and direct yaw-moment control (DYC) are jointly determined by the controller rather than allocated or distributed from a global target control action. Simulink-CarSim co-simulation results show that the ARS and DYC subsystems are well coordinated by the proposed controller to achieve favorable vehicle responses, including side slip angle, yaw rate and vehicle path, under a challenging driving condition.

pp. 355-360

Error-tracking Iterative Learning Control for Gun Control Servo System of Tank

Qiuzhen Yan (Zhejiang University of Water Resources and Electric Power, P.R. China)

A novel error-track iterative learning control scheme is proposed to solve velocity tracking problem for gun control servo system of tank. The system modeling for for gun control servo system of tank and the construction method of desired error trajectory are carried out firstly. Then, Lyapunov synthesis approach is used to design controller, with error-tracking control method used to handle the initial problem of iterative learning control. Adaptive learning control is applied to handle nonlinear uncertainties and external disturbances, together with robust control. As the iteration number increases, the system error of of tank servo system can precisely track the desired error trajectory over the full time interval, which render the state of tank servo system to precisely track its reference signal in the predetermined time interval, and all signal are guaranteed to be bounded. Numerical simulations demonstrate the effectiveness of the proposed error-tracking learning control scheme.

pp. 361-366

Design Linear Feedback and LQR Controller for Lateral Flight Dynamics of F-16 Aircraft

Adnan Ashraf (Northwestern Polytechnical University, P.R. China)

This paper presents the control of lateral flight dynamics of F-16 aircraft using simple control techniques. The control of Lateral flight dynamics is an important characteristic for Automatic Flight Control System (AFCS) design. We used Linear Feedback and Linear Quadratic Regulator (LQR) techniques to control the lateral flight dynamics of aircraft. A linearized aircraft model is used because the control techniques that we used can be applied on linear system. Pole placement technique is used to place the poles at a desire location that stabilized the response of controller and find the value of feedback gain matrix K for Linear Feedback Controller. In LQR technique to find the value of feedback gain matrix K, first we choose an appropriate values of Q and R matrices, where Q and R are weighing matrix. According to the initialization of state space vector, the transient response of lateral dynamics (Slide Slip Angle, Roll rate, Yaw rate and Roll angle) are investigated and the performance of both controllers are compared.

pp. 367-371

L1 Adaptive Control for Tandem-Rotor Helicopter with Anti-Disturbance Capability

Gaoyuan Liu (Northwestern Polytechnical University, P.R. China); Mei Wu (Northwestern Polytechnical University & School of Automation, P.R. China); Adnan Ashraf (Northwestern Polytechnical University, P.R. China)

The tandem-rotor helicopters have high use value both in military and civilian fields. However, few studies have been conducted in order to develop controllers for tandem-rotor helicopters. Because the coupling between control channels is complicated and application context are usually with complex disturbance, so the robustness and adaptive ability of its control system is crucial. The brilliant performance of L1 adaptive control theory has been verified in the design of control system of fixed wing. In this paper, we build the mathematical model of tandem-rotor helicopter with stability augmentation system based on LQR method and design the control structure based on L1 adaptive control theory. We add artificial disturbance to the model to simulate the situation of parameter uncertainty and external interference, to verify the controller's tolerance of disturbance. The simulation results show that the L1 adaptive theory can be applied to design the control system of tandem-rotor helicopters and it will improve the deficiency of traditional adaptive controller and has good robustness and transient characteristics.

pp. 372-377

FriD03: Image Processing and Machine Learning IV

Room No.9

Chair: Du Yong Kim (RMIT University, Australia)

Parasitic Network: Learning-based Network Downsizing of Very Deep Neural Networks for Computer Vision

Jongmin Yu (Curtin University, Australia); Du Yong Kim (RMIT University, Australia); Moongu Jeon (Gwangju Institute of Science and Technology (GIST), Korea)

In recent research on deep nueral network (DNN), network downsizing is one of practical issues for computational and memory efficiency. Specifically, downsizing or compression of networks minimizing the performance degradation becomes a critical problem for deployment of DNNs on resource-limited environments such mobile or embedded platforms. In this paper, we propose a compressed network called the parasitic network (PN) inspired by the relationship between a parasite and host in nature. The concept of the parasitic network is straightforward. The host network provides their mapping results in each layer to the PN as a feed. The PN that much shallower than the host network is trained based on given information from the host network. We demonstrate efficiency of our approach to the network downsizing in image classification and object detection problems which have conquered by the deeper and bigger networks. The experimental results show that PN can provide sample performance to their host network even though their architectural scale is much smaller.

pp. 378-383

Using Long Diameter Verification to Evaluate Antiwear Property of lubricity

Mei Xiao, Zhong-hao Wang and Guo-yu Zhao (Chang'an University, P.R. China)

Diameter size of steel ball wear scar is the main basis for judging lubricating oil antiwear properties in the four-ball friction machine test. A new assessment method for antiwear property of lubricity was presented in the paper. First, the wear scar can be detected by convolution operation of gradient filter operator. The scattered noise and morgan chip are removed by moving window denoising. Second, those noise and morgan chippings near wear area are eliminated in measuring direction through using accumulation de-noising. And a new adaptive threshold method is used to measure the long diameter of wear scar in different direction. Finally, lots of sample data of long diameter are checked by normal distribution. The image sample can be used to evaluate antiwear property if long diameter data obeys normal distribution. Otherwise image sample should be obtained by redoing four-ball friction test. Qualitative experiments showed that the extraction of wear scar area was complete and the edges were clear. Data verification is effective for sample selection.The method is simple and has wide applicability.

pp. 384-388

Neural Network Parameter Updating Method Adopts Step By Step Layer By Layer

Siyu Ji and Kaikai Zhai (Hangzhou Dianzi University, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China)

Aiming at the difficulties in modeling variable nonlinear systems with noise interference, a network model with optimal generalization ability is established to realize the identification of the system. The traditional network parameter training method, like gradient descent method and least squares are centralized, and it is difficult to adaptively update the model parameters according to changes in the system. Firstly, in order to adaptively update the network parameters and quickly reflect the changes in the input and output of the system, the network weights are used as time-varying parameters, and some parameters in the network are updated by Kalman filtering algorithm. Then, in order to further improve the generalization ability of the network, EKF is used to update all the parameters in the network. Finally, the effectiveness of the algorithm is verified by an example of the standard data set UCI-ccpp.

pp. 389-394

An Online-Updating Deep CNN Method based on Kalman Filter for Illumination-Drifting Road Damage Classification

Yan Li (Hangzhou Dianzi University, P.R. China); Mingyue Yang (Hangzhou Dianzi Univerisity, P.R. China); Siyu Ji (Hangzhou Dianzi University, P.R. China); Jing Zhang (Hangzhou Dianzi Univerisity, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China)

Damage of road surface, e.g., Cracks, is the critical problems in road maintenance. Previous automotive road damage detection methods mainly focus on hand-crafted features and shallow classifier models. Recently, deep learning methods have also been proposed. The deep neural networks consist of dozens of parameters, which is usually optimized by the Mini-batch Stochastic Gradient Descent Algorithm (MB-SGD). However, MB-SGD is awkward for online update when new training samples from a drifting system condition, e.g., illumination, are received. In this paper, we first present an experimental study on how the illumination change affects the generalization of a pre-trained deep convolutional neural networks. Then, we propose a novel Kalman Filter based method for online updating the network parameters. Experimental results convince that the illumination change can affect the performance of a pre-trained CNN using training samples from a fixed illumination condition. By using the proposed method, the CNN can online adapt its parameters in the classifier layer to the received training samples sequentially, which leads to a better classification performance. The proposed method alleviates the need of huge amount of training samples covering all system conditions, which are hard to collect and costly.

pp. 395-400

KECA for identifying the habitats of Chinese mitten crab (Eriocheir Sinensis) based on aroma analysis

Lu Ding, Ziwen Guo and Peiyi Zhu (Changshu Institute of Technology, P.R. China)

Chinese mitten crabs (Eriocheir Sinensis) are rich in resources, wide varieties, and extensive origins. Crabs in Yangcheng Lake are most famous. However, some businessmen are driven by profits to subvert the market. In this paper, the aroma of 12 crabs of three producer areas was described by using electronic nose, and the difference in crabs' flavor profile between different producing areas was explored. 8 sensors, response data of the electronic nose were analyzed by using kernel entropy component analysis (KECA), principal component analysis (PCA), and linear discriminant analysis (LDA). Results showed that KECA had a better accuracy than PCA and LDA in locality identification. The distinguish effect of electronic nose on the crabs from different areas was overlapped, such as weeping Tai Lake and Gucheng Lake, but Yangcheng Lake crab could be distinguished dramatically from other localities in KECA. Therefore, electronic nose can be used as an important method to identify the crab habitat based on the different flavor profile of crabs.

pp. 401-404

Saturday, October 27

Saturday, October 27 9:00 - 10:00

SatP0: Plenary Talk 2

Stochastic Estimation in Nonlinear and High-dimensional Systems

Prof. Uwe D. Hanebeck

Room 205

Chair: Zhansheng Duan (Xi'an Jiaotong University & College of Electronics and Information Engineering, P.R. China)

I will focus on stochastic estimation in nonlinear and high-dimensional systems with the following important sub-problems: (1) data fusion for combining several pieces of information, (2) estimating the hidden state of a system given a measurement model and observations, and (3) filtering, i.e., recursive state estimation for dynamic systems. A wealth of stochastic estimation methods are available, ranging from the Kalman filter or the Unscented Kalman filter to Gaussian mixture filters and particle filters. However, coping with nonlinear and high-dimensional systems remains a challenge. I promise to surprise you with a radically different class of efficient estimation methods for optimally approximating the true posterior probability density functions. The key idea is to generate a continuous flow from the prior density to the true posterior and morph the desired approximate density accordingly. Different variants of these progressive estimation methods exist that can be customized for specific problems. I will demonstrate their usefulness by several examples.

Saturday, October 27 10:30 - 11:45

SatA01: Nonlinear system and filtering III

Room 207

Chair: Peiyi Zhu (Changshu Institute of Technology, P.R. China)

Aircraft 3D Trajectory Estimation with a Single Nonlinear Filter Using Two 2D Radars

Mahendra Mallick (Independent Consultant, USA); Yanjun Yan (Western Carolina University, USA); Sanjeev Arulampalam (Defence Science and Technology Group, Australia)

We consider 3D trajectory estimation of an aircraft using two air traffic control 2D radars with Cartesian state vector. The assumed motion of the aircraft is nearly constant velocity with nearly constant altitude. We use the cubature Kalman filter (CKF) for the nonlinear filtering problem and present three filter initialization algorithms. Using Monte Carlo simulations, we compare results from our proposed algorithms with those from existing height-parametrized unscented Kalman filter and bias-compensated pseudolinear estimator based CKF, and associated posterior Cram´er-Rao lower bound (PCRLB). CKF using two single-point filter initialization algorithms achieves accurate state estimation with low computational complexity.

pp. 405-410

Intelligent compensation for machining error in the batch production based on automatic line

NanYan Shen, GengSheng Zhu, Jing Li, Xing Wu and Kai Zhu (School of Mechatronic Engineering and Automation, Shanghai University, P.R. China)

In order to improve the machining accuracy and machining efficiency of workpieces in the batch production based on automatic line, an on-line intelligent compensation system adapting to this production pattern is studied. The system takes the machining error prediction model based on support vector machine and compensation coefficient adaptive correction method as the core, and the compensation value is corrected in real time. Aiming at the automatic production of the brake disc, the intelligent compensation software for machining error is developed based on BS architecture. On the basis of realizing the real-time acquisition of machine tool state information and error measurement data, the machining error prediction, compensation value calculation and feeding back to the machine tool are completed. The actual application results show that the qualified rate of the brake disc is improved, and the machining accuracy is guaranteed effectively.

pp. 411-416

Electricity Market Clearing Price Forecast Based on Adaptive Kalman Filter

Liang Ding and Quanbo Ge (Hangzhou Dianzi University, P.R. China)

In the competitive electricity market, in order to guarantee generators profits, they usually adopt bidding strategies to participate in the electricity market competition. The forecast of market clearing prices in the electricity market can provide a reference for the quotation behavior of generator companies. This paper develops a new day-ahead electricity price forecasting based on adaptive Kalman filter. Under the condition of unknown prediction model state transition matrix and the statistical characteristics of the observed noise, To estimate the unknown parameters of the prediction model according to the electricity market clearing electricity price data. According to the estimation, the generators will make a quotation with a slightly lower than the predicted market clearing price, ensuring their unit capacity can participate in the market bidding and achieve the goal of maximizing its own profit. The predicted price is applied to the PJM power market to verify its prediction accuracy.

pp. 417-421

Modeling and Simulation Analysis of Hybrid Energy Storage System Based on Wind Power Generation System

Jiancheng Wang and Yonghua Xu (Quzhou Guangming Power Investment Group Co., Ltd, P.R. China); Meilei Lv (Quzhou University, P.R. China); Xiaogang Huang (Shanghai Maritime University & Quzhou University, P.R. China)

In this paper, an energy management system (EMS) is presented for wind power system with Lithium-ion battery and ultra-capacitor (UC), and it is used to smooth the power fluctuations and optimize power distribution among each energy unit, according to their different characteristics. The model of wind power is built firstly. Then, the principle of bidirectional DC/DC converters for charging and discharging is introduced and a current control is designed. Lastly, the EMS based on two first-order low pass filters is applied to determine the reference power of different unit. A simulation model of the system is built in MATLAB/SIMULINK is built for wind power generation in lab. The results show that the proposed energy management strategy can be used to smooth power fluctuations, and optimize power distribution effectively.

pp. 422-427

Research on Optimization of Chiller Based on Adaptive Weight Particle Swarm Algorithm

Lu Anping, Ding Qiang and Aipeng Jiang (Hangzhou Dianzi University, P.R. China)

To study the parameters of minimum energy consumption and optimal performance of the system under specific load, the refrigeration mainframe of the cold-water system is analyzed and selected, the performance model of the main engine and the pumps are built according to the actual situation. The load limitation of the constant frequency compressor is analyzed, the load ratio can be adjusted in a larger range by frequency conversion compressor, the adaptive weight particle swarm optimization algorithm is used to optimize the solution, and the comparison with the traditional constant flow scheme is made. The maximum energy saving is 11.25%, which shows the advantage of the intelligent algorithm.

pp. 428-433

SatA02: Intelligent Systems

Room No.8

Chair: Tao Wen (Xi'an Jiaotong University, P.R. China)

Management-Control Integration for Safety-critical Discrete Operation System

Liang Ma (School of Information Science and Technology, Southwest Jiaotong University); Xiaomin Wang and Yadong Zhang (School of Information Science and Technology, Southwest Jiaotong University, P.R. China)

The safety-critical discrete operation system is safety-critical, discrete and flow driven. The application of dispatching command system and process control system reduces the work intensity. However, information isolation and human operation may lead to insecurity, inefficiency and high cost. In order to ensure production safety, reduce attrition and increase efficiency, firstly, based on the unified multi-dimensional information integration platform, a broader safety-critical management-control integration (SCMCI) theory was put forward. Then, the hierarchical information interlocking (HII) model of SCMCI was established. Finally, the principles, rules and constraints of SCMCI model were proposed. SCMCI technology can realize automatic management of operation planning, automatic execution of control system, and automatic feedback of execution status. The SCMCI technology has been used in production operations management of metro rolling stock base to validate the feasibility of structure, model and algorithm.

pp. 434-439

A Rotating Machinery Fault Diagnosis Method for High-speed Trains Based on Improved Deep Learning Network

Guo Xie (Xi'an University of Technology, P.R. China); Jing Yang (Tianshui Normal University, P.R. China); Yanxi Yang (Xi'an University of Technology, P.R. China)

Rotating machinery is an important part of high-speed train system. Any failure of such components will have a serious impact on the service itself and even jeopardize the safe and reliable operation of the train. However, the limited diagnostic accuracy has become the bottleneck of fault diagnosis. In this paper, an adaptive fault diagnosis method based on deep sparse autoencoder (SAE) network is proposed. Firstly, the original time domain signals collected by sensor are preprocessed and used as input to the diagnostic network. Secondly, the SAE fault diagnosis network model is built. Thirdly, the loss function of SAE is modified to improve the diagnostic accuracy and efficiency of network. Finally, experiments verify the feasibility and advantages of the proposed method.

pp. 440-444

Research on Integrity Monitoring Performance Test Method of GNSS-based Train Positioning Units

Yang Meihao (No3 Shangyuan Village Haidian District Beijing China, P.R. China); Jiang Liu, Bai-gen Cai and Tao Wen (Beijing Jiaotong University, P.R. China)

With the rapid increasing applications of Global Navigation Satellite System (GNSS) technology in railway train control systems, the specific performance test and evaluation methods and platforms for train positioning units have received more attention in recent years. Considering the varieties and uncertainties in the environmental conditions and critical requirement of safety for railway trains, commercial grade GNSS receivers may not meet specified requirements in safety-related railway operations. In this paper, composition of the GNSS-based train positioning units is presented, where an overlay module for autonomous integrity monitoring is integrated. It enables the implementation of GNSS-based train positioning units under different conditions, even with faults or failures in the raw measurements. Performance properties and the test process of the positioning units are introduced, and the integrity monitoring performance test method dedicated to the train positioning application is designed. Based on results from different testing objects, the feasibility of the frame for test and effectiveness of the presented performance evaluation method are demonstrated, which show the potentials in safety-related GNSS railway applications in the future.

pp. 445-450

Modeling of Train Braking based on Environment and Online Identification of Time Varying Parameters

Yongze Jin (Xi'an University of Technology, P.R. China); Tao Wen (Beijing Jiaotong University, P.R. China); Guo Xie, Qing Zang and Le Fan (Xi'an University of Technology, P.R. China); Linfu Zhu (China Academy of Railway Sciences Corporation Ltd, P.R. China)

In this paper, the mechanism of pure air emergency braking for high speed train is analyzed. Considering the influence of the actual train running environment on the braking performance, an emergency braking model based on the environment is established. The expectation maximization identification of braking model for high speed train based on sliding window is proposed, and the unobserved time varying adhesion coefficient is identified. Firstly, the position and size of the sliding window are determined. Then the adhesion coefficient is identified by expectation maximization based on sliding window. Finally, combined with gradient optimization, the optimal identification of adhesion coefficient is obtained. The simulation results show that the online identification proposed in this paper can be used to identify the adhesion coefficient quickly and accurately. Under uniform noise, the identification error and relative error of adhesion coefficient are ±0.0015 and 1.8705% respectively. The relative error and root mean square error of braking speed are 0.4038% and 0.1018 respectively. It is satisfied with the actual needs of the braking system, and the accuracy of the model and effectiveness of the online identification method can be verified.

pp. 451-455

On the price of European call option based on the Black Scholes model with fuzzy number coefficients

Guojing Zhang and Guixiang Wang (Hangzhou Dianzi University, P.R. China)

In this paper, some problems about Black-Scholes model with fuzzy number coefficients is studied. Firstly, by using the It^o formula, the asset prices at T or t times are obtained from the Black-Scholes model with fuzzy number coefficients. Then, by operation rules of fuzzy numbers, the expression of the price of European call option in form of level set of fuzzy number is obtained. At last, an example is given to show the feasibility of the method.

pp. 456-460

SatA03: Fault Diagnosis Ⅰ

Room No.9

Chairs: Yandong Hou (Henan University, P.R. China), Chuanbo Wen (Shanghai Dianji University, P.R. China)

Fault detection method based on improved Isomap and SVM in noise-containing nonlinear process

Yankun Han, Qianshuai Cheng and Yandong Hou (Henan University, P.R. China)

In order to solve the problem of high dimension and nonlinearity of monitoring data in chemical process, a fault detection method based on the combination of improved isometric mapping (Isomap) and Support Vector Machines (SVM) is proposed. Firstly, aiming at the problem that Isomap algorithm is easily affected by noise, a new method of Isomap improvement is proposed in this paper, called Standardized Residuals-Isomap (SR-Isomap).Based on the statistic- proximity ratio , the residuals are analyzed and the noise is separated within the confidence intervals [-2, 2] to accurately extract the low-dimensional principal components in the high-dimensional and Nonlinear manifold under the noisy environment, the robustness of Isomap algorithm to noise is enhanced. Then based on the feature of minimizing the structural risk of support vector machines, an SR-Isomap-SVM fault detection model is constructed and the radial basis function suitable for process monitoring signal is chosen to train and learn the low-dimensional clustering data to realize the fault detection of nonlinear monitoring data with noise. The simulation results of Tennessee Eastman(TE) Process show that this method can effectively realize the fault detection of non-linear chemical process with noise.

pp. 461-466

A Fault Diagnosis Method for Train Plug Doors Based on MNPE and IPSO-MSVM

Yongkui Sun (Beijing Jiaotong University, P.R. China); Guo Xie (Xi'an University of Technology, P.R. China); Yuan Cao and Tao Wen (Beijing Jiaotong University, P.R. China)

Train plug doors are a vital equipment to keep train operation safe and reliable. Taking the advantages of sound signals based fault diagnosis method into consideration, a novel fault diagnosis method for train plug doors based on multi-scale normalized permutation entropy (MNPE) and improved particle swarm optimization based multi-class SVM (IPSO-MSVM) is proposed. First, empirical mode decomposition (EMD) is used to decompose the sound signals into a series of IMFs and the residue for stationary processing. Then, MNPE features are extracted from the IMFs. And Fisher discrimination criterion is utilized to obtain the most significant features as feature vectors. After that, an improved PSO (IPSO) is used to search for the optimal parameters of multi-class SVM. Finally, the IPSO-MSVM model is trained and verified using training set and test set, respectively. The identification accuracy of the proposed method reaches to 90.54%, which is higher than backpropagation (BP) neural network classifier and 1 Nearest Neighbor (1NN) classifier, indicating the proposed method for fault diagnosis on train plug doors is feasible.

pp. 467-471

Off-line Fault Location for VSC-DC Distribution Network

Lun Li and Ke Jia (North China Electric Power University, P.R. China); Liang Hao and Miao Zhang (Beijing Electric Power Research Institute, P.R. China)

DC power distribution network has caused widespread concern of scholars and become one of the most important technologies for the future development of the power system in the world, because of its intelligent, flexible and efficient features, and the enormous potential in improving the power quality. However, the power electronic component in DC distribution network can't withstand high current, so the protection requires fast action to isolate the fault current, which causes the lack of fault data used for positioning. The existing positioning method called single ended transient current measurement can't accurately positioning with high fault resistance and noise. Considering the fault has occurred, and DC circuit breaker breaks off quickly, in the condition of loss of power system, this paper uses a detection device, which can accurately locate the fault location, with a certain ability of fault resistance and noise tolerance.

pp. 472-476

Hierarchical Evaluation and Fault Diagnose Strategy for the Active Distribution Network using the Incomplete Monitoring Information

Feilong Fan (Shanghai Jiao Tong University, P.R. China); Nengling Tai (Shanghai JiaoTong University, P.R. China); Jiayun Ni (Economics and Management, P.R. China); Qiu Sun (Shanghai Jiao Tong University, P.R. China); Zhoujun Ma (Hohai University, P.R. China); Peiyu Chen (State Grid Tianjin Electric Power Company, P.R. China)

The cost of monitoring facilities for the whole active distribution network challenges the electric power companies. This paper proposes a hierarchical evaluation and fault diagnose strategy using the incomplete monitoring information to decrease the cost of the monitoring facilities. The proposed strategy consists of three levels: the primary level, the middle level and the output level. The K-means clustering algorithm is employed at the primary level. Considering the local incomplete history information and the history fault record information, the K-means clustering algorithm assesses the failure probability of the target area in each cluster. A regional composite failure probability calculation algorithm is proposed at the middle level. Considering the distance from the monitoring area real-time sampling data matrix to each cluster, the proposed algorithm calculates the probability of the real-time monitoring data belonging to each cluster. Combining the cluster belonging probability and the failure probability of each cluster, the proposed algorithm calculate the composite failure probability of the each target area in the active distribution network. An evaluation algorithm based on the maximum composite probability is proposed at the output level. The maximum composite failure probability of each region is used as the overall operation state evaluation coefficient to evaluate the operation status level of the active distribution network. The proposed strategy is tested by the Matlab/Simulink model of a distribution network in Nanjing. Test results show that the proposed strategy can effectively detect the weak areas of the active distribution network. The real-time operating state of the active distribution network is evaluated scientifically.

pp. 477-481

Fault Diagnosis for Rotating Machinery with Scarce Labeled Samples: A Deep CNN Method based on Knowledge-Transferring from Shallow Models

Jing Zhang, Deqing Zhang, Mingyue Yang, Xiaobin Xu and Weifeng Liu (Hangzhou Dianzi Univerisity, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China)

Early and accurately detecting faults in rotating machineries is crucial for operation safety of modern manufacturing system. In this paper, we proposed a novel deep CNN method based on knowledge-transferring from shallow models for rotating machinery fault diagnosis with scarce labeled samples. It is based on the idea that shallow models trained with different hand-crafted features can reveal the latent prior knowledge and diagnostic expertise and have good generalization ability even with scarce labeled samples. First, The raw vibration signal is transformed into time-frequency domain by applying the short-time Fourier transform (STFT) and integral features are extracted accordingly. Then, we train the SVM model with scarce labeled samples and make predictions on unlabeled samples. The predicted labels can be regarded as the data format of expert knowledge, which are combined together with the scarce fine labeled samples. Finally, they are used to train a 2-d deep CNN model of better discriminative ability. Experimental results convince the effectiveness the proposed method that it achieves better performance than SVM model and original deep CNN model trained with only scarce labeled samples. Moreover, it is computational efficient and is promising for real-time rotating machinery fault diagnosis.

pp. 482-487

Saturday, October 27 2:00 - 3:15

SatB01: Nonlinear System and filtering Ⅳ

Room 207

Chair: Junfeng Zhang (Hangzhou Dianzi University, P.R. China)

Modeling and Estimation of Subsurface Transport Profile for Methane Release using H-infinity Filtering

Soumitra Keshari Nayak (Indian Institute of Technology Bombay, India); Prakash Kumar Tamboli (Indian Institute of Technology Bombay, Mumbai & Nuclear Power Corporation of India Ltd, India); S Duttagupta (Indian Institute of Technology Bombay, India)

In this paper, we propose an H-infinity filtering based algorithm to estimate the subsurface plume profile of Methane release in porous media. The model presented here is a modified Lagrangian dispersion model used to simulate the advective-dispersion of methane gas plume in porous media. The chemical gas sensors are mounted in an access tube placed vertically inside the subsurface. The media is assumed to be of non-heterogeneous in nature and a uniform plume release is presumed. The dispersion coefficients of the dusty gas model are used in the model to describe the gas transport.

pp. 488-493

Fixed-Time Output Feedback Control for a Class of Second-Order MIMO Nonlinear Systems

Anmin Zou (Shantou University, P.R. China)

This paper considers the problem of fixed-time output feedback control for a class of second-order multiple-input multiple-output (MIMO) nonlinear systems. With the help of the homogeneity property, a global observer is first proposed to obtain an accurate estimate of unmeasurable system states within fixed time. Then, with application of the observer derived here, a fixed-time output feedback controller is designed for tracking control of second-order MIMO nonlinear systems. Rigorous analysis is provided to show that the proposed control law can guarantee the system state tracking a time-varying reference within fixed time without using full state measurements.

pp. 494-499

Multivariable Composite Prediction Based on Kalman Filtering and Charging and Discharging Scheduling Strategy of Energy Storage System

Sun Xiaohui (Hangzhou Dianzi University, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China); Mingming Pan (China Electric Power Research Institute, P.R. China)

By estimating and predicting state variables of the distributed generation system and that of electric load in real time, the real-time state of energy storage system can be obtained, which will provide an important basis for the dispatching department of the power system to formulate the power generation plan and the transmission plan. In distributed PV generation and multi-load systems, both the power supply system and the power consumption system are multi-source and non-stationary. Firstly, based on the polynomial neural network framework, the model of state variables changing with time series is constructed. Further non-stationary of the model above is taken into consideration and is transformed into Kalman filter frame. Secondly, the block state model and prediction model of the related variables are established, which contributes to real-time block estimation and prediction of composite variables and is expected to overcome the shortcomings of existing methods. Finally, the performance of the new method is tested and verified by simulation.

pp. 500-505

Rapid Control Prototyping Based Design of Buck Converter Using RTW/MATLAB

Ali Mutahir and Zhaohui Gao (Northwestern Polytechnical University, P.R. China); Husan Ali (Northwestern Polytechnical University Xian Shaanxi P.R. China); Haider Zaman (NorthWestern Polytechnical University, P.R. China); Adnan Ashraf and Boyan Sun (Northwestern Polytechnical University, P.R. China)

In this paper, rapid control prototyping (RCP) design of buck converter based Real-Time workshop (RTW/MATLAB) has been presented. The small signal model of buck converter is deduced using voltage mode control technique. Using frequency response method the gain and phase margin are obtained for open-loop frequency response, then proportional-integral-derivative controller with first order derivative filter (PIDF) is employed to design the feedback controller for closed-loop system of buck converter. Discrete simulation is carried out in MATLAB/SIMULINK software. The digital PIDF controller is then implemented through RCP design technique for buck converter. As an advantage, RCP uses professional tools of Simulink model based on the ADC block sets for the closed-loop implementation of buck converter using DSP Kit processor. RTW Toolbox is used to convert the PIDF controller Simulink model into C-code and downloaded in the destination processor of DSP kit TMS320F2812 which is linked to the main circuit of buck converter composed of actual/experimental circuit. The simulation and experimental results are compared, which indicate that the RTW-based feedback controller designed by RCP technique can effectively control the buck converter in the presence of input line voltage and output load current variations.

pp. 506-511

A Novel Short Time H∞ Filtering for Discrete Linear Systems

Xiaoliang Feng (Henan University of Technology, P.R. China); Xian Peng Shi (National Deep Sea Center, P.R. China); Chenglin Wen (Hangzhou Dianzi University, Xiasha Higher Eduction Zone, Hangzhou City, P.R. China)

In this paper, a novel short time H∞ filtering methods is proposed for discrete linear systems. Firstly, a novel H∞ filtering performance criterion is given in a finite time window. Secondly, a sufficient condition to fulfill the given performance criterion function is deduced, and the short time H∞ filter is obtained through solving a linear matrix inequality (LMI). The obtained short time H∞ filter need not assume that the energy of the system noise is bounded for the whole time domain, which is more usual in practical applications. What's more, the filtering parameters can be changed with the system real-time running condition. The simulation illustrates the feasibility and effectiveness of the short time H∞ filters.

pp. 512-515

SatB02: Performance evaluation

Room No.8

Chair: Xiaobin Xu (Hangzhou Dianzi University, P.R. China)

Analysis on Non-strictly Identical Input of Safety Computer System Based on Fuzzy Theory

Yuan Cao, HongKang Lu and Tao Wen (Beijing Jiaotong University, P.R. China)

Due to the double two-vote-two structure of the safety computer in train control system, if these multiple input data have the problem of inconsistent such as speed data and air pressure data that are safety critical data, the output may have non-strictly identical problems. These kinds of problems will directly affect the decision making of the safety computer and even pose a serious threat to the safe operation of the train. This paper analyzes the non-strictly identical problems that exist in traditional safety computer. Classify data for data characteristics and safety computer characteristics, and model data that leads to non-strictly identical problem. This paper proposes an improved onboard safety computer platform adopting the architecture of double two-vote-two that combine an onboard safety computer with a consistency model for processing operational data, resulting in ef?ciency and high performance. The consistency model can be divided into two parts, improved fuzzy decision tree and fuzzy weighted fusion. Finally, based on speed data and air pressure data, it's verified that the consistency model can effectively reduce the non-strictly identical problems and improve the system efficiency on the premise of ensuring the reliability of the data.

pp. 516-521

Research on Comprehensive Performance Improvement of Laser-Guided Missile System

Fei Ma (Xi'an Modern Control Institute, P.R. China); Kai Yang (Xi' an Modern Control Technology Institute, P.R. China)

This paper focuses on the problems as the fault mechanism of the laser guided air-to-ground missile dropped at close range fault and flied over target fault. A temperature compensation algorithm on the seeker's output slope has been proposed, which can improve the missile hit accuracy. Mathematical simulation and hardware-in-the-loop simulation have shown that the algorithm can effectively solve the technical problems of the missile in practical applications and improve the comprehensive performance of the weapon system.

pp. 522-525

A Novel Incentive Mechanism Based on Reputation and Trust for Mobile Crowd Sensing Network

Huilin Wang and Chunxiao Liu (Bohai University, P.R. China); Dawei Sun (China University of Geosciences, P.R. China); Yanfeng Wang (Huzhou University, P.R. China)

In view of the negative influence of selfish nodes in Mobile Crowd Sensing, this paper proposes an incentive mechanism based on Reputation and Trust (RTM). Firstly, this paper analyzes the reputation incentive mechanism and trust incentive mechanism. Secondly, this paper constructs an incentive model, which is divided into user selection module and reward implementation module, and defines the service quality factor, link reliability factor and time heat factor as the pricing factors to calculate comprehensive pricing to reward service providers. Finally, the experimental results show that with successful package delivery rate, average delay and energy consumption as evaluation parameters, it is proved that RTM has better performance and feasibility than reputation incentive mechanism and trust incentive mechanism.

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Comprehensive Analysis on Safety and Reliability of Safety-Related Systems Considering Common Cause Failure

Siqi Du (Beijing Jiaotong University & School of Electronics and Information Engineering, P.R. China)

The common cause failure (CCF) has severe impacts on the safety and reliability of the system, and is the main cause of dangerous failure or function failure. The risk of CCF can be effectively reduced by adopting proper redundancy architectures in the design of safety-related system. In this paper, several common L-channel M-out-of-N parallel redundancy architectures are chosen for study. Firstly, the formulas of the redundancy architectures' safety and reliability indicators are derived respectively, and then the indicators are comprehensively analyzed. Secondly, by comparing the PFH and failure rate of the independent failure parts between that of the CCF parts of the single-channel architecture separately, it is verified that the CCF is the crucial cause of the system failure. Finally, through comprehensively analyzing the PFH and failure rate of all the redundancy architectures, it shows that the overall performance of the four-channel 2-out-of-4 architecture is optimal.

pp. 531-535

The Research of Hierarchical Synchronization Mechanism about 2-vote-2 Safety Computer

Yan Gao (Beijing JiaoTong University, P.R. China); Lianchuan Ma and Yuan Cao (Beijing Jiaotong University, P.R. China)

In order to improve the safety and reliability of the safety computer of the next generation train operation control system, the safety computer using the structure of 2-vote-2 is playing an increasingly important role, and the requirements for the performance and reliability are getting higher and higher. As a real-time system, the synchronization problem of the safety computer is the key to achieving reliability. Therefore, this paper focuses on the analysis and studies on the synchronization problems of the 2-vote-2 safety computer. First of all, the structure of the 2-vote-2 safety computer is analyzed and the synchronization mechanism is designed. A new hierarchical synchronization mechanism is proposed, the bidirectional timing supervision monitor is set up between different levels to achieve the synchronization process of the 2-vote-2 safety computer. Based on this, system software uses task cycle scheduling control and dual-module communication to process the input, calculation and output tasks, synchronize in each task point of the control cycle and achieve the task synchronization. The system's model is built by UPPAAL which based on timed automata, the model is verified and the verification results showed that the designed hierarchical synchronization mechanism conformed to the requirements of design specifications.

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SatB03: Fault Diagnosis II

Room No.9

Chair: Jianning Li (Hangzhou Dianzi University, P.R. China)

Sensor Fault Detection Based on State Estimation Observer in Discrete Nonlinear Systems

Xiangyi Jia, Qianshuai Cheng and Yandong Hou (Henan University, P.R. China)

This paper investigates discrete-time T-S fuzzy systems, uses fuzzy rules to model the system, then builds a system state estimation observer to detect sensor faults, and finally uses the