The 27th Nonlinear Dynamics of Electronic Systems conference

NDES 2019

14-17 October 2019

Xi'an, China

Introduction

Welcome to NDES 2019

The 27th Nonlinear Dynamics of Electronic Systems Conference (NDES2019) will be held during Monday through Thursday, October 14-17, 2019, in Xi'an, China. The NDES encompasses all theoretical aspects of nonlinear science, with particular emphasis on their interdisciplinary applications to electronic, atomic and biological complex systems.

Xi'an, which was called Chang'an in ancient times, is the capital city of Shaanxi Province and the starting point of the Silk Road. Xi'an is one of the Four Great Ancient Capitals of China, with a history of more than 3100 years for it has been the capital of 13 dynasties. As one of the top seven regional central cities of China, Xi'an is a center of innovation, knowledge and technology in Asia and functions as the manufacturing base of large aircraft in China. The city has become the largest central city along the Chinese section of the new Eurasia Land Bridge across the Yellow River basin and the most important base of scientific research, education and industry in mid-western China.

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Information

General

Registration desk open: 08:00 a.m.
Registration desk: information, identification (NDES 2019 ID), material

Empark Grand Hotel in Xi'an

Hotel webpage: http://www.emparkgrandhotel.com/
Address: No.19 Jiangong Road, Xincheng District, Xi'an. (Figure 1).
Hotel plan: Figures 2, 3, and 4.

Figure 1: Empark Grand Hotel map.

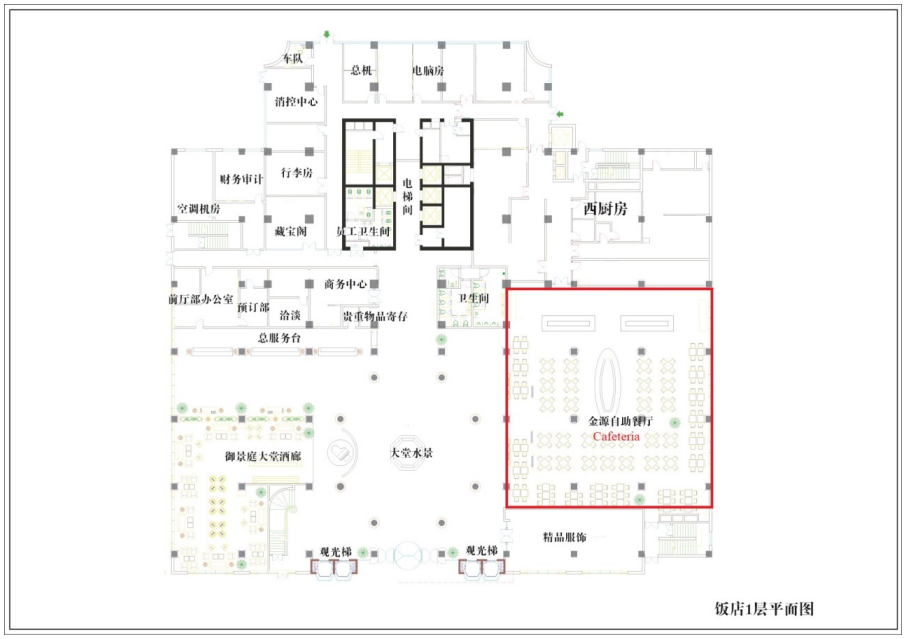

Figure 2: Floorplan of level 1 (cafeteria in red).

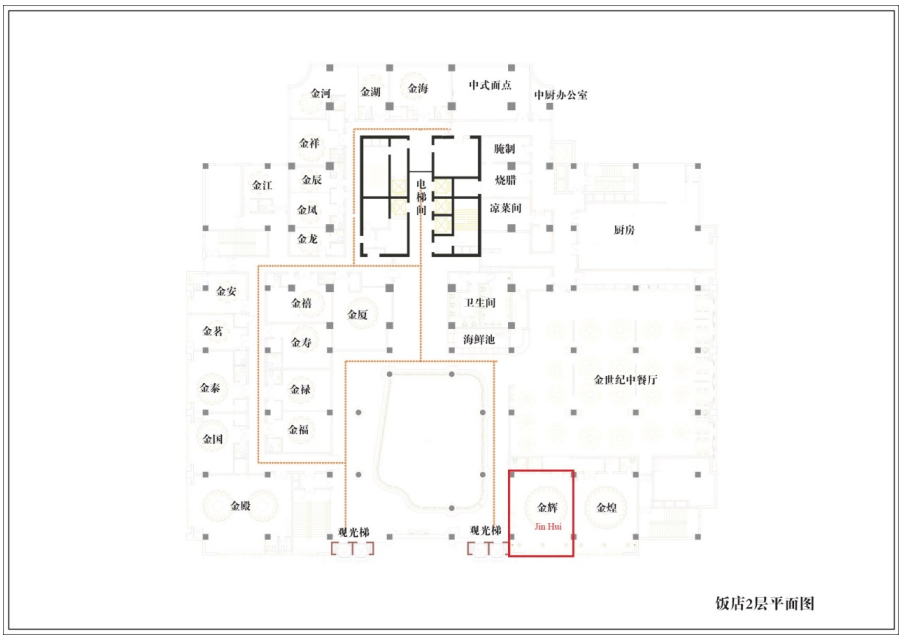

Figure 3: Floorplan of level 2 (JinHui banquet in red).

NDES 2019 photos on Facebook:

https://www.facebook.com/pg/105groupscience/photos/

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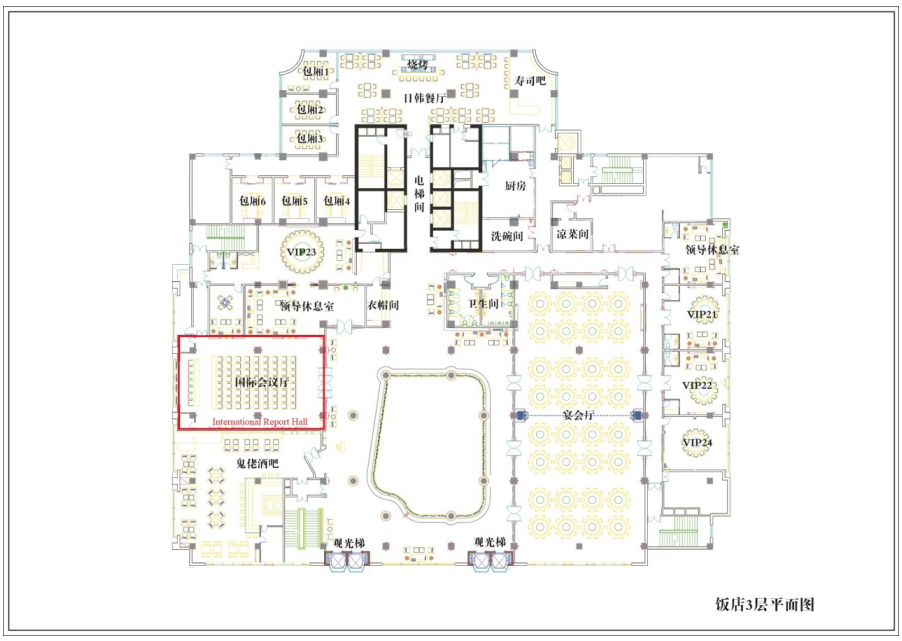

Figure 4: Floorplan of level 3 (International Report Hall in red).

Programme

14 October 2019

Session I

Chair: Celso Grebogi

08:00 - 09:00	Committee reception - registration desk
09:00 - 09:15	NDES Organisation committee - opening
09:20 - 09:50	**Ruedi Stoop** 1.1 - On the nature of computation by natural systems
09:55 - 10:20	**Meng Zhan** 1.2 - Nonlinear dynamics in power grids: challenge and recent progress
10:20 - 10:50	**Guo Xie** 1.3 - Railway train nonlinear dynamical modeling and identification
10:55 - 11:15	Coffee break

Session II

Chair: Qinglai Wei

11:20 - 11:50	**Zhen Wang** 1.4 - Data-drive study of cooperation
11:55 - 12:20	**Domenico Lippolis** 1.5 - Criticality in synaptic scaffolds: a matter of modelling
12:25 - 12:50	**Kelly Iarosz** **??** - Synchronisation in cortico-cortical network of the human brain
12:55 - 14:55	Lunch time

Session III

Chair: Henk Nijmeijer

14:55 - 15:25	**Celso Grebogi** 1.7 - Compressive sensing based prediction of dynamic systems and complex networks
15:30 - 15:55	**Qinglai Wei** 1.8 - Local Iterative Dynamic Programming for Self-Learning Optimal Control of Discrete-Time Nonlinear Systems
16:00 - 16:25	**Xin Guo** 1.9 - A Robust Model Predictive Control Method for Three-Phase AC/DC the Circuit Parameters Uncertainty and the Unbalanced Grid Condition
16:30 - 16:50	Coffee break

Session IV

Chair: Xin-Gang Wang

16:55 - 17:25	**Liang Huang** 1.10 - Massive Dirac Billiards - Quantization and Scar Unification
17:30 - 17:55	**Nan Yao** 1.11 - Self-adaptation of chimera states
18:00 - 18:25	**Asghar Taheri** 1.12 - Constrained Near-Time-Optimal Control of DC/DC Converters Based on Switched Affine Model Analysis
16:30	Closing session and dinner

15 October 2019

Session V

Chair: Liang Huang

08:00 - 08:05	NDES Organisation Committee - opening
08:10 - 08:40	**Zhigang Zheng** 1.13 - Local Iterative Dynamic Programming for Self-Learning Optimal Control of Discrete-Time Nonlinear Systems
08:45 - 09:10	**Yong Xu** 1.14 - Averaging principles and noise-induced dynamics in the presence of Non-Gaussian levy noise
09:15 - 09:40	**Meng Du** 1.15 - Oil-Water Two-Phase Flow Coalescence Detection with Stacked Auto-Encoder
10:15 - 10:40	**Zhong-Ke Gao** 1.16 - Complex network and deep learning analysis of time series
10:45 - 11:05	Coffee break

Session VI
Chair: Ruedi Stoop

11:10 - 11:40	**Henk Nijmeijer** 1.17 - Synchronization revisited: standing on the shoulders of Christian Huygens
11:45 - 14:00	Flash Poster Session
14:00	Closing session and time free

16 October 2019

Session VII
Chair: Gezá Kolumbán

08:00 - 08:05	NDES Organisation Committee - opening
08:10 - 08:40	**Wei Lin** 1.18 - Data analytics: causations detections and dynamics predictions
08:45 - 09:10	**Weiqing Liu** 1.19 - Coexistence of oscillation and quenching states: Effect of low-pass active filtering in coupled oscillator
09:15 - 09:40	**Xin-Gang Wang** 1.20 - Breathing Clusters in Complex Networks
09:45 - 10:10	Coffee break

Session VIII
Chair: Kelly Iarosz

10:40 - 11:10	**Shangbin Chen** 1.21 - Computational modelling of cortical spreading depression with different methods
11:15 - 11:40	**Zong-Hua Liu** 1.22 - Chimera States in Brain Networks
11:45 - 12:10	**Jin-Hu Lu** 1.23 - Some recent advances in complex dynamical networks
12:15	Lunch time

Session IX
Chair: Antonio Batista

14:45 - 15:15	**Guan-Rong Chen** 1.24 - Once again, the Equilibria and the Attractors of 3D Autonomous Chaotic Systems
15:20 - 15:45	**Jun Jiang** 1.25 - Self-excited Oscillations with Two different Mechanisms in a Piecewise Smooth nonlinear Rotor/Stator Rubbing System
15:50 - 16:15	Coffee break

Session X
Chair: Jun Jiang

16:50 - 17:20	**Gezá Kolumbán** 1.26 - New Ultra-Low Power and Low-Data Rate Applications for Chaos-Based Wireless Communications Systems
17:25 - 17:50	**Muhammad Usman Akhtan** 1.27 - A biohybrid robot by mimicking the gait mechanism of Aplysia californica actuated by skeletal muscle
17:55 - 18:20	**Bin Xu** 1.28 - Composite Learning Control of Strict-feedback Systems with Applications
18:25	Closing session

17 October 2019

Session XI
Chair: Domenico Lippolis

08:00 - 08:05	Openning - NDES Organisation Committee
08:10 - 08:40	**Peng Ji** 1.29 - Vulnerability and co-susceptibility on Brain cascading networks
08:45 - 09:10	**Antonio Batista** 1.30 - Extreme events in nonlinear wave interactions
09:15 - 09:40	**Wen-Jia Shi** 1.31 - Desing principles of adaptative neworks - the influence of regulatory process and network size
09:45 - 10:05	Coffee break

Session XII
Chair: Wen-Jia Shi

10:40 - 11:10	**Wenxu Wang** 1.32 - Collective prosocial behaviors and their neural basis: experiments and models
11:15 - 11:40	**Chao Bai** 1.33 - Double Sub-streams Differential Chaotic Shift Keying Scheme based on Chaotic Shape-Forming Filter and Noise Reduction Technology
11:45 - 12:00	Remarks
12:30	Closing Session - NDES Organisition Committee

16 October 2019

Flash poster session

1.34	**Arunas Tamasevicius** Controlling globally coupled FitzHugh-Nagumo cells
1.35	**Yuhao Peng** A class of uncertain fractional-order systems control with perturbation
1.36	**Yaya Zhao** Quadratic optimal control algorithm for fractional stochastic systems based on ant colony algorithm
1.37	**Hao Li** MPPT Algorithm Based on Improved PSO and Fuzzy Algorithm
1.38	**Xue Wu** Gesture recognition based on transfer learning
1.39	**Jichang Tu** Water Quality Prediction Model Based on CNN-GRU hybrid network
1.40	**Zepeng Gao** The Study For Path Following of Robot Fish Based on ADRC
1.41	**Xiaxia Wan** A Fast Diagnostic method of open-circuit fault in inverter
1.42	**Yue Wang** Study On ESO-Based LQR Controller In Pitch Control
1.43	**Xinyu Sha** Modeling and variable pitch control of doubly-fed induction generators
1.44	**Hui Yao** A low-complexity 2D DOA estimator for coherently distributed sources
1.45	**DI Ruo-hai** A New Qualitatively Maximum A Posteriori for Bayesian Network Parameter Learning Based on Computing the Center Point of Constrained Areas
1.46	**Zhiyuan Dai** Design Photoelectric analog signal acquisition system in shooting range
1.47	**Shuwei Yang** Graphic Recognition and Tracking Based on Python-OpenCV
1.48	**Guobin Gao** Internal Power Angle Control Strategy for Highpeed Sensorless BrushlessDC Motor
1.49	**Jiao Wu** Low-light-level image enhancement algorithm based on Integrated Network
1.50	**MengYu Sun** Convolution Operators for Visual Tracking based on Spatial-temporal Regularization
1.51	**Shuxian Cai** Optimizing Method of Explosion Point for Linear Array Scanning Laser Proximity Fuse
1.52	**Yanqing Qu** Power Regulation of V2G System for Grid Power Quality Improvement
1.53	**Jiaoyan Wang** Research on calibration method of pressure transmitter

1.54	**Liu Yueqi** The Motion Planning of a Six DOF Manipulator Based on ROS Platform
1.55	**Yao Hongjuan** An Improved Intelligent Clustering Algorithm for Irregular Wireless Network
1.56	**Zhao jijie** Photodetector based on PbSe quantum dots
1.57	**Lili Shi** Parameters estimation for chirp signal based on QPF-FRFT
1.58	**Qifeng Niu** High precision beam steering using a liquid crystal spatial light modulator
1.59	**Xueya Deng** Line-of-sight kinematics modeling and correction for precision pointing systems based on a two-axis fast steering mirror
1.60	**Xuan Wang** RBF Neural Network Based Adaptive Control of Nonlinear Unknown Systems: A Case Experiment Comparison
1.61	**Hong-Er Zhao** Artificial Intelligence Enhances the Performance of Chaos-based Wireless Communication
1.62	**Zhi-Wei Gao** Design of PCR Instrument Temperature Control System Based on Improved PID Algorithm
1.63	**Si-Long Guo** Multi-carrier Differential Chaos Shift Keying Wireless Communication Based on Chaotic Shape-forming Filter
1.64	**Yuan Gao** Frequency stability analysis and control of complex power grids
1.65	**Min-Rui Fu** Modeling and control of load side virtual synchronous machine
1.66	**Shan-Shan Jiao** Research on Adaptive Wavelet Neural Network Control Method for Pneumatic Position Servo System
1.67	**Zi-Xuan Zhou** Bifurcation and chaos in the flexible shaft rotating lifting system of siliconcrystal puller
1.68	**Hui-Ping Yin** Performance improvement of chaotic base band wireless communication using Echo State Network
1.69	**Kun Tian** Hyperchaos synchronization using univariate impulse control
1.70	**Xiao-Hui Zhao** PPM with Differential Chaos Shift Keying Modulation Based on Chaotic Shape Forming Filter
1.71	**Yi-Juan Ning** An Improved Switching Controller for Boost Converter Based on Hybrid Automata Model

1.72	**Chaobo Chen** Quadratic optimal control algorithm for fractional stochastic systems basedon ant colony algorithm
1.73	**Zhang Zhuoya** A New Approach to Calculate Resource Limits with Fairness in Kubernetes
1.74	**Jingshuai Ma** Key Technologies of Quantum Secure Communication
1.75	**Yunhang Zhang** Disturbance frequency adaptive control for photo electric stabilized platform based on improving extended state observation
1.76	**Qian Wang** Improved disturbance observer based control for airborne photoelectric stabilized platform

1. Abstract

1.1 On the nature of computation by natural systems

Ruedi Stoop

University of Zurich and ETH Zurich, Switzerland

Often it is argued that nature can serve as a blueprint of efficient computation, providing, in this way, an alternative to classical, including quantum, computation. Our counter position is that, for physics, such statements make little sense as long as no measure of computation cannot be provided. During our journey, we provide such a measure [1, 2] and explore and evaluate it in several contexts.

We then consider the dogma that for the cortex, cortical columns provide an elementary blueprint of a general fundamental computational unit and reconsider the hypothesis that the architecture of cortical columns follows a universal architecture providing the basis of the computational efficacy of the cortex [3].

We then investigate the computations performed in the pre-copulatory courtship of the fruit fly Drosophila [4] and show that the underlying compiler has the same strength compared to human language [5].

[1] R Stoop, N Stoop, and LA Bunimovich, J. Stat. Phys. 114, 1127-1137 (2004).
[2] R. Stoop, N. Stoop, CHAOS, 14: (3) 675-679 (2004).
[3] R Stoop, V Saase, C Wagner, B Stoop, R Stoop, PRL 110, 108105 (2013).
[4] R. Stoop and J. Joller, Chaos 21, 016112 (2011).
[5] R Stoop, P Nüesch, RL Stoop, LA Bunimovich, PloS one 8, e70284 (2013).

1.2 Nonlinear dynamics in power grids: challenge and recent progress

Meng Zhan

Huazhong University of Science and Technology, Wuhan, China

Power system is believed as one of the most complicated man-made complex systems. Currently the second great revolution of power system is emerging, characterized with traditional power electric devices replaced by power-electronic-based devices gradually and massively. Meanwhile

the dominant problems in power system dynamics, which are mainly related to electromechanical behavior of synchronous generator machine, have become more complicated, involved with much fast electromagnetism dynamics induced by power-electronic-based devices. Very recently, new power system oscillation induced by increase of renewable penetration have happened frequently in the world, which have not been fully solved and understood yet. In this talk, we will introduce some basic existing theories for the conventional power system dynamics and the newly power-electronic-based power system dynamics, and also introduce some of our recent works. We hope that this talk will stimulate broad interest of complex-system researchers on such a realistic important complex system, power system.

1.3 Railway train nonlinear dynamical modeling and identification

Guo Xie

Xi'an Technological University, Xi'an, China

The non-linear characteristics make an accurate dynamic model of high speed train difficult to be established. The existing research mainly focused on simplified dynamic models, without considering the impact of environmental factors, line condition, load difference. As the most critical system, the train braking mechanism is analyzed, and the single particle model and multi-particle model of train braking system are established. Then considering that the running state of the train are affected by the running environment in the actual running process, the different motion characteristics of the train running on the dry track and the wet track are analyzed, and the single particle braking modeling under different operating conditions is proposed. Further, aiming at the problem of system identification and parameter estimation of high speed train nonlinear model under non-Gaussian noise, the extended Kalman filter based on Gaussian sum theory is employed, and then aiming at the hidden variable parameters which are difficult to be observed in the train braking model, a sliding window for data recording and counting is designed.

1.4 Data-drive study of cooperation

Zhen Wang[1], Marko Jusup[2], Stefano Boccaletti[3], Lei Shi[4]

[1]**Northwestern Polytechnical University**, [2]**Tokyo Institute of Technology, Japan**, [3]**Institute for Complex Systems of the CNR, Italy**, and [4]**Yunnan Universty of Finaces and Economics, China**

One of the most elusive scientific challenges for over 150 years has been to explain why cooperation survives despite being a seemingly inferior strategy from an evolutionary point of view. Over the years, various theoretical scenarios aimed at solving the evolutionary puzzle of cooperation have been proposed, eventually identifying several cooperation-promoting mechanisms: kin selection, direct reciprocity, indirect reciprocity, network reciprocity, and group selection. We report the results of repeated Prisoner's Dilemma experiments with anonymous and onymous pairwise interactions among individuals. We find that onymity significantly increases the frequency of cooperation and the median payoff per round relative to anonymity. Furthermore, we also show that the correlation between players' ranks and the usage of strategies (cooperation, defection, or punishment) underwent a fundamental shift, whereby more pro-social actions are rewarded with a better ranking under onymity. Our findings prove that reducing anonymity is a valid promoter of cooperation, leading to higher payoffs for cooperators and thus suppressing an incentive-anonymity-that would ultimately favor defection.

1.5 Criticality in synaptic scaffolds: a matter of modelling

Domenico Lippolis

Jiangsu University

Experiments in recent years suggest that synapses, the points of connection between neurons, are assemblies of molecules, which diffuse in an aqueous environment and aggregate through a dynamical process of binding and removal. In this talk, I will review two different approaches in modelling this phenomenon, and their effects on the emergence of self-organized criticality in the system.

1.6 Review of synchronisation in network - from base to diseases interpretation

Kelly Iarosz[1], José Coninck[2], Fabiano Ferrari[3], Rafael Borges[2], Fernando Borges[4], Ewandson Lameu[5] Ricardo Viana[6], Hai Peng Ren[7], Antonio Batista[8], Murilo Baptista[9], Celso Grebogi[9], Jürgen Kurths[10], Iberê Caldas[1]

[1]**University of São Paulo**, [2]**Technological University of Paraná**, [3]**Federal University of the Valleys of Jequitinhonha and Mucuri**, [4]**Federal University of ABC**, [5]**National Institute for Space Research**, [6]**Federal University of Paraná**, [7]**Xi'an University of Techonology**, [8]**State University of Ponta Grossa**, [9]**University of Aberdeen**, and [10]**Humboldt University**

The human brain controls many body functions, manages our thoughts, memory, speech, movement and all the organs of our body. It is estimated that the human brain contains about 10^{11} neurons, where each neuron is connected to approximately 10^4 other neurons. The occurrence of synchronisation in some specific areas of the brain may be associated with some diseases, such as epilepsy, lesions, Alzheimer and Parkinsons disease. On the other hand, it is also responsible for some vital brain functions, such as processing of sensory information and motor function. With this in mind, We will present a network topology according to the cortico-cortical connection network of the human brain, where each cortical area is composed of a random network of adaptive exponential integrate-and-fire neurons. Depending on the parameters, this neuron model can exhibit spike or burst patterns. As a diagnostic tool to identify spike and burst patterns, we utilise the coefficient of variation of the neuronal inter-spike interval. In our neuronal network, we verify the existence of spike and burst synchronisation in different cortical areas. Our simulations show that the network arrangement, i.e., its rich-club organisation, plays an important role in the transition of the areas from desynchronous to synchronous behaviours.

1.7 Compressive sensing in Nonlinear Complex Systems and Complex Networks

Celso Grebogi[1,2]

[1]**Institute for Complex Systems and Mathematical Biology King's College, University of Aberdeen Aberdeen, UK**, and [2]**Shaanxi Key Laboratory of Complex System Control and Intelligent Information Processing, Xi'an University of Technology, Xi'an, China**

In the fields of complex dynamics and complex networks, the reverse engineering, systems identification, or inverse problem is generally regarded as hard and extremely challenging mathematically as complex dynamical systems and networks consists of a large number of interacting units. However, our ideas based on compressive sensing, in combination with innovative approaches, generates a new paradigm that offers the possibility to address the fundamental inverse problem in complex dynamics and networks. In particular, in this talk, I will argue that evolutionary games model a common type of interactions in a variety of complex, networked, natural systems and social systems. Given such a system, uncovering the interacting structure of the underlying network is key to understanding its collective dynamics. Based on compressive sensing, we develop an efficient

approach to reconstructing complex networks under game-based interactions from small amounts of data. The method is validated by using a variety of model networks and by conducting an actual experiment to reconstruct a social network. While most existing methods in this area assume oscillator networks that generate continuous-time data, our work successfully demonstrates that the extremely challenging problem of reverse engineering of complex networks can also be addressed even when the underlying dynamical processes are governed by realistic, evolutionary-game type of interactions in discrete time. I will also touch on the issue of detecting hidden nodes, on how to ascertain its existence and its location in the network, this being highly relevant to metabolic networks.

W.-X. Wang, Y.-C. Lai, and C. Grebogi. Data based identification and prediction of nonlinear and complex dynamical systems. Phys. Reports 644, 1-76 (2016).
W.-X. Wang, R. Yang, Y.-C. Lai, V. Kovanis, and C. Grebogi. Predicting catastrophe in nonlinear dynamical systems by compressive sensing. Phys. Rev. Lett. 106, 154101 (2011).
W.-X. Wang, Y.-C. Lai, C. Grebogi, and J. Ye. Network reconstruction based on evolutionary-game data via compressive sensing. Phys. Rev. X 1, 021021 (2011).
R. Yang, Y.-C. Lai, and C. Grebogi. Forecasting the future: Is it possible for adiabatically time-varying nonlinear dynamical systems? Chaos 22, 033119 (2012).
W.-X. Wang, X. Ni, Y.-C. Lai, and C. Grebogi. Optimizing controllability of complex networks by minimum structural perturbations. Phys. Rev. E 85, 026115 (2012).

1.8 Local Iterative Dynamic Programming for Self-Learning Optimal Control of Discrete-Time Nonlinear Systems

Qinglai Wei

Institute of Automation, Chinese Academy of Science

In this talk, a new self-learning adaptive dynamic programming (ADP) is introduced for optimal control for nonlinear systems. First, the principle of ADP is introduced. Next, the implementation of value iterative ADP algorithm is discussed. Then, a local value iteration based adaptive dynamic programming (ADP) algorithm. The local value iteration algorithm permits an arbitrary positive semi-definite function to initialize the algorithm. In the present local value iteration algorithm, the iterative value function and iterative control law are updated by a subset of the state space. A new analysis method of the convergence property is presented to show that the iterative value functions will converge to the optimum. The convergence criterion for the local value iteration algorithm is established. Simulation examples are given to demonstrate the validity of the present optimal control scheme.

1.9 A Robust Model Predictive Control Method for Three-Phase AC/DC Converter Under the Circuit Parameters Uncertainty and the Unbalanced Grid Condition

Xin Guo

Xi'an University of Technology

The model predictive control (MPC) Method, due to this advantages of fast dynamic response, simple to apply in multivariable systems and it allows for nonlinearities and constraints to be incorporated into the control law in a straightforward manner, are widely used in the control of power converters and drives. However, the robustness and control performance improvement of the predictive control technique under different operating conditions, which includes the circuit parameters uncertainty and unbalanced grid condition, are still challenges of MPC in actual power applications. In this speech, a robust model predictive control method is proposed to improve the

robustness and control performance of MPC controller, where the circuit parameters uncertainty and unbalanced grid condition are considered simultaneously in the MPC controller design process of three-phase AC/DC converter. The simulation and experiment results show that, comparing with the traditional MPC method, the proposed robust model predictive control method decreases the total harmonic distortion of converter under the unbalanced grid condition and improves the robustness of the system with respect to the parameters uncertainty.

1.10 Massive Dirac Billiards - Quantization and Scar Unification

Liang Huang

Lanzhou University

In relativistic quantum systems, chiral scars have been discovered recently, whose wavefunctions concentrate on odd periodic orbits and break the time reversal symmetry, in contrary to the nonrelativistic case. We exploit massive Dirac billiard systems and derive semiclassic of reflection. We demonstrate that this phase plays a key role in transforming the chiral scars and in bridging the relativistic and nonrelativistic quantum scars. In the large-mass limit, time-reversal symmetry is restored, as evidenced by a spectral analysis.al quantization rules to bridge the two opposite limits. A nontrivial phase is uncovered, which depends on the mass, the wavenumber, and the angle of reflection. We demonstrate that this phase plays a key role in transforming the chiral scars and in bridging the relativistic and nonrelativistic quantum scars. In the large-mass limit, time-reversal symmetry is restored, as evidenced by a spectral analysis.

1.11 Self-adaptation of chimera states

Yao Nan[1], Zi-Gang Huang[2], Hai-Peng Ren[1], Celso Grebogi[3], Ying-Cheng Lai[4]

[1]**Xi'an University of Technology**, [2]**Xi'an Jiaotong University**, [3]**University of Aberdeen**, and [4]**Arizona State University**

Chimera states in spatiotemporal dynamical systems have been investigated in physical, chemical, and biological systems, and have been shown to be robust against random perturbations. How do chimera states achieve their robustness? We uncover a self-adaptation behavior by which, upon a spatially localized perturbation, the coherent component of the chimera state spontaneously drifts to an optimal location as far away from the perturbation as possible, exposing only its incoherent component to the perturbation to minimize the disturbance. A systematic numerical analysis of the evolution of the spatiotemporal pattern of the chimera state towards the optimal stable state reveals an exponential relaxation process independent of the spatial location of the perturbation, implying that its effects can be modeled as restoring and damping forces in a mechanical system and enabling the articulation of a phenomenological model. Not only is the model able to reproduce the numerical results, it can also predict the trajectory of drifting. Our finding is striking as it reveals that, inherently, chimera states possess a kind of "intelligence" in achieving robustness through self-adaptation. The behavior can be exploited for the controlled generation of chimera states with their coherent component placed in any desired spatial region of the system.

1.12 Constrained Near-Time-Optimal Control of DC/DC Converters Based on Switched Affine Model Analysis

Asghar Taheri[1], Hai-Peng Ren[1,2], Amir Ghasemian[3]

[1]**Xi'an Technological University**, [2]**Xi'an University of Technological**, and [3]**University of Zanjan**

The common approaches to control DC-DC power converters are linearized averaged models and

standard frequency-domain design methods. Nonlinear state space averaged models are also used in many works to achieve better response. An important assumption in state space averaging is that the switching signal varies slowly compared with the changes in state variables. This assumption causes slower time response. Hybrid dynamical system modeling of converters which directly takes into account the switching nature of the DC-DC converters can lead to better transient response, and large signal stability. A useful outcome of considering the switching nature of DC-DC converters is studies of time-optimal control (TOC) of the converters. It is well known in the literature that the theoretical time-optimal control of DC/DC converters can be achieved using switching surfaces based on the converter's natural state trajectories. Studies show that such controllers are of a minimum-switching and bang–bang nature and have the fastest possible response time. However, this method has three drawbacks: First, the inductors' maximum current goes beyond practical limits. Second, due to a marginal status in existence condition of the switching surface, stability of the controller is sensitive to parameter changes. Third, its nonlinear switching surface needs high computational power and is hard to implement. To overcome these problems, the switched affine model of DC/DC converters is used in this presentation to study the time response and equilibrium states. Based on the hybrid dynamical model of the converter and geometrical representation of their corresponding vector fields, a proximate constrained time-optimal sliding mode controller is proposed. The proposed method and its relevant theoretical framework are validated on an experimental setup. In DC-DC converters, the Equivalent Series Resistance of the output capacitor may cause output voltage jumps. These jump discontinuities in output voltage, lead to performance issues in Switching Surface controllers. These ESR effects can be modeled using switched systems with state jumps, or Jump-Flow Switched (JFS) systems. To resolve these issues, a non-jumping normal switched system is defined for JFS systems, that is equivalent to the internal continuous dynamics.

1.13 Synchronization of phase oscillators: generalizes Kuramoto models

Zhigang Zheng

Institute of Systems Science & College of information Science and Engineering National Huaqiao University

We study the synchronization transition in the frequency-weighted Kuramoto model by considering the phase shift coupling scheme. Both the macroscopic and microscopic dynamical features are characterized in the system. We identify different asymptotic coherent states for the long-term evolution of the system and reveal various phase transitions among them. Theoretically, the self-consistency approach is developed to get analytical insights, the critical coupling strength for the onset of synchronization and the effective average frequencies of oscillators can be obtained. Physically, the plateau effect essentially arises from the periodic behavior of the mean field. Our theoretical analysis and numerical results are consistent with each other, which can help us understand the synchronization transition in general networks with heterogenous couplings.

1.14 Averaging principles and noise-induced dynamics in the presence of Non-Gaussian levy noise

Yong Xu

Northwestern Polytechnical University

Averaging principle is a kind of theorem that can simplify the original system with its solution converging to the so-called averaged system in the sense of probability. The stochastic averaging method is developed to obtain the response solutions including the probability density function and sample path solutions where the reduced system is usually established via the stochastic averaging

technique. Then the noise-induced dynamics for different conceptual dynamical system will be presented. In this talk, we will talk about the Non-Gaussian Levy noise which describes the model of random fluctuations beyond the Gaussian noise. The averaging principle in the presence of Levy noise will be proposed mathematically for SDEs/SPDEs under (non) Lipschitz conditions, and here these main results will support the method of stochastic averaging theoretically. Based on the developed techniques we will further talk the levy noise-induced dynamics including the stochastic bifurcation and transitions. The different effects of levy noise from Gaussian case will be demonstrated especially for the alpha stable Levy noise.
This is a joint work with Yongge Li, Bin Pei, Qi Liu, Wei Xu and Juergen Kurths.

1.15 Oil-Water Two-Phase Flow Coalescence Detection with Stacked Auto-Encoder

Meng Du[1], **Celso Grebogi**[2]

[1]**Tianjin University of Science & Technology**, [2]**University of Aberdeen**

The coalescence phenomenon often occurs in the oil-water two-phase system. When the two-phase mixed velocity is extremely low, small oil droplets often coalesce into lager oil bubbles which will greatly interfere with the measurements of flow parameter. Hence, how to detect the coalescence phenomena of oil-water two-phase system became a quite necessary issue. In this study, we firstly carry out an oil-water two-phase flow experiment to collect the flow fluctuations under different flow conditions. We find that there exist fluctuation anomalies when the coalescence occurs. Then we train an unsupervised stacked auto encoder model to detect these anomalies in the fluctuation signals which could reflect the oil droplets coalescence. Also, we study the flow coalescence dynamics with the detection results and the fluctuation time-frequency distributions. This research provides a novel application of machine learning technique to the two-phase flow system modelling.

1.16 Complex network and deep learning analysis of time series

Zhong-Ke Gao

Tianjin University

Revealing complicated behaviors from time series constitutes a fundamental problem of continuing interest and it has attracted a great deal of attention from a wide variety of fields on account of its significant importance. The past decade has witnessed a rapid development of complex network studies, which allow to characterize many types of systems in nature and technology that contain a large number of components interacting with each other in a complicated manner. Recently, the complex network and deep learning have been incorporated into the analysis of time series and fruitful achievements have been obtained. Complex network and deep learning analysis of time series open up new venues to address interdisciplinary challenges in climate dynamics, multi-phase flow, brain functions, artificial intelligence.

1.17 Synchronization revisited: standing on the shoulders of Christiaan Huygens

Henk Nijmeijer

Eindhoven University of Technology

In 1665 the Dutch scientist Christiaan Huygens discovered the in-phase and anti-phase synchronization of two pendulum clocks hanging on the wall. This ‘sympathy’ of clocks, as Huygens called such coordinated motion, has been observed in different areas like physics, nature, biology and engineering. The study of synchronization relies on a thorough understanding of the underlying dynamics of (time-delayed) coupled systems and extends also to larger groups of coupled systems. The purpose of the talk is to review a range of exiting and interesting examples of synchronized

systems and in particular to focus on the means why pairs of coupled identical (oscillating) systems may exhibit identical oscillatory motion. Moreover, a framework is developed that allows the analysis of synchronization and partial synchronization in a network of coupled identical systems. Particular focus in this regard will be given to real-world networks of coupled identical systems – like a brain or traffic or an ensemble of robots- and how synchrony can be enforced in such a system. Specifically, newer results on scaling networks of oscillators –i.e. to derive synchronization conditions in larger networks based on a smaller network of the same oscillators- as well as on enlarging the class of (linear) diffusive couplings are given.
Laboratory experiments with metronomes (clocks) and field tests with multiple wirelessly connected cars will be given.
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J.Pena Ramirez, A.Arellano-Delgado, H.Nijmeijer, Enhancing master slave synchronization, the effect of using a dynamic coupling, Phys Review E 98, 2018.

1.18 Data analytics: causations detections and dynamics predictions

Wei Lin

Fudan University

In this plenary talk, I will introduce some of our recent works on time series analytics, including directional interactions detections and dynamics predictions. Based on the theory of nonlinear dynamical systems as well as machine learning techniques, we develop several data-driven and model-free frameworks for realizing detections and predictions. Through comparing our frameworks with other existing methods in the literature, we show the advantages of our frameworks when they are used to deal with the data produced numerically by dynamical oscillators and collected by real experiments as well.

1.19 Coexistence of oscillation and quenching states: Effect of low-pass active filtering in coupled oscillators

Weiqing Liu

Jiangxi University of Science and Technology

Effects of a low-pass active filter (LPAF) on the transition processes from oscillation quenching to asymmetrical oscillation are explored for diffusely coupled oscillators. The low-pass filter part and the active part of LPAF exhibit different effects on the dynamics of these coupled oscillators. With the amplifying active part only, LPAF keeps the coupled oscillators staying in a nontrivial amplitude death (NTAD) and oscillation state. However, the additional filter is beneficial to induce a transition from a symmetrical oscillation death to an asymmetrical oscillation death and then to an asymmetrical oscillation state which is oscillating with different amplitude for two oscillators. Asymmetrical oscillation state is coexisting with a synchronous oscillation state for properly presented parameters. With the attenuating active part only, LPAF keeps the coupled oscillators in rich oscillation quenching states such as amplitude death (AD), symmetrical OD, and NTAD. The additional filter tends to enlarge the AD domains but to shrink the symmetrical OD domains by increasing the areas of coexistence of the oscillation state and symmetrical OD state. The stronger filter effects enlarge the basin of the symmetrical OD state which is coexisting with the synchronous oscillation state. Moreover, the effects of the filter are general in globally coupled oscillators. Our results are important for understanding and controlling the multi-stability of coupled systems.

1.20 Breathing Clusters in Complex Networks

Xin-Gang Wang

Shaanxi Normal University

A new phenomenon, namely breathing synchronization cluster, is observed in complex network of coupled chaotic oscillators. In specific, it is found that a fraction of the oscillators in a large-size complex network may form a synchronization cluster and, as the system evolves, the cluster could be switching alternatively between the synchronization and desynchronization states. In the meantime, the other oscillators in the network are always in the desynchronization states. We demonstrate this intriguing phenomenon in different network models and conduct a theoretical analysis on the underlying mechanism. Finally, the implications of breathing cluster to brain functions, e.g., memory and sleep, will be briefly discussed.

1.21 Computational modelling of cortical spreading depression with different methods

Shangbin Chen

Huazhong University of Science and Technology

Cortical spreading depression (CSD) is an enigma of pathophysiological phenomenon, which underlies some neurological disorders, such as migraine, epilepsy and stroke. Previous experiments revealed that the spatiotemporal evolution (including amplitude, speed, extent and pattern) of a series CSD waves is time-varying. To better interpret the observations, we have applied a 2D reaction-diffusion (RD) equation and cellular automaton (CA) to study the spatiotemporal evolution of CSD in the current work. By modulating the recovery rate (i.e. mimicking the effect of refractory period) from CSD in the modeled cortex with RD equation, the simulated successive CSD waves were present with different spatiotemporal evolutions, either bypassing some areas or propagating slowly in these areas. In addition, spiral CSD waves could also be induced in case of the transiently altered recovery rate, i.e. block release from the absolute refractory period. In another parallel simulation study, we simulated that continuous injection of KCl solution can induce repetitive CSD waves. The first CSD wave often has a larger amplitude and faster velocity than those of the succeeding secondary waves. If the induction interval is long enough for recovery, a series of CSD waves would have the same profile as the first one. In the relative refractory period, an early stimulation might lead to a late initiation of CSD, i.e., “haste makes waste”. The amplitude and velocity of CSD waves were found increasing with the initiation interval and asymptotic to those of the first CSD wave. With another CA model, we replicated the common dynamics of CSD wave, such as circular or inhomogeneous wave front, reverberating and spiral wave, collision of double CSD waves. By setting different refractory period in the CA lattice field, our model provided the similar observation revealed by optical imaging. These results suggested that the propagation dynamics of CSD waves is modulated by the refractory period. The refractory period is critical for preventing undesirable CSD waves. This modelling work is helpful to interpret the mechanisms of CSD propagation.

1.22 Chimera states in brain networks

Zong Hua Liu

East China Normal University

Based on the real brain network, we will discuss its collective behaviors and its connection to brain functions.

1.23 Some recent advances in complex dynamical networks

Jin-Hu Lu

Academy of Mathematics and Systems Sciences, Chinese Academy of Science

Over the last decade, complex networks have been intensively studied across many fields, especially in internet technology, biological engineering and nonlinear science. This paper will briefly review the main advances in the investigation of complex networks, with emphasis on the recent progress of complex networks in control and synchronization.

It includes five parts: Introduction; Modeling of Complex Networks; Control of Complex Networks; Synchronization of Complex Networks and Conclusion. Introduction will briefly introduce the background of complex network. Modeling of Complex Networks will briefly present small-world network model, scale-free network model, time-varying discrete time network model, and time-varying continuous time network model. Control of Complex Networks will explain the main approaches of the control of complex networks. It is well known that there are many control approaches, such as coordinated control, data traffic control, adaptive control, pinning control, and controllability. In this part, we will focus on the pinning control of complex networks. It is often impossible to realize the control goal by controlling every node since complex networks has a large number of nodes, such as 5% to achieve the same effect? The key factors in pinning control include network structures, coupling strengths, number of pinning controllers, and pinning strategies. There are two challenging and fundamental questions in pinning control as follows: How many and which nodes should a network with fixed network structure and coupling strength be pinned to reach network synchronization? How large the coupling strength should a network with fixed network structure and pinning nodes be applied to reach network synchronization? An answer is necessary and important for the real-world applications. Network synchronization of complex network includes two main factors: network topology and network dynamics. There are two critical cases: No matter how small the coupling strength is, a global coupled network will synchronize if its size is sufficiently large; No matter how large the coupling strength is, a locally coupled network will not synchronize if its size is sufficiently large. It is well known that there are many existing methods, such as connection graph approach, local and global synchronization, adaptive synchronization, pinning synchronization and synchronizability. As a result, the control and synchronization of complex networks are two challenging research fields in complex network over the last ten years.

1.24 Once again, the Equilibria and the Attractors of 3D Autonomous Chaotic Systems

Guan-Rong Chen

City University of Hong Kong

In a typical 3D hyperbolic autonomous chaotic system, such as the Lorenz or the Rössler system, the number of equilibria is three or two. Today, we are able to find or construct a relatively simple 3D autonomous chaotic system that can have any desired number of equilibria, including simple systems without equilibrium or with infinitely many. Furthermore, we are able to find or construct a relatively simple 3D system that can have infinitely many chaotic attractors. This talk will introduce the main ideas and methodologies. Since these are non-hyperbolic systems, their theoretical analyses pose great challenges for future research studies in dynamical systems and chaos theory.

1.25 Self-excited Oscillations with Two different Mechanisms in a Piecewise Smooth nonlinear Rotor/Stator Rubbing System

Jun Jiang

Xi'an Jiaotong University

The dynamics of engineering systems, which are generally governed by nonlinear, sometimes also non-smooth, differential equations, are very complicated. Rotor-to-stator rubbing, which is usually modeled by multiple degree-of-freedom non-smooth nonlinear systems, is one of such examples and of great practical interests, i.e., for the safety of operation of turbomachinery. Actually, two instability mechanisms may appear simultaneously during rotor-to-stator rubbing, namely, dry friction effect and cross-coupling effect, which might induce a self-excited dry friction backward whirl or a self-excited forward whirling motion of the rotor system. In this work, a piece wise smooth nonlinear rotor/stator rubbing system with cross-coupling stiffness is investigated with the focus on unveiling the characteristics of the two kinds of self-excited oscillations. Especially, the existence boundaries and the onset conditions of the self-excited oscillations are derived on basis of the nonlinear modal analysis by employing the methods of Nonlinear Normal Modes (NNMs). Furthermore, the characteristics of stick-slip oscillations exhibited in the self-excited dry friction backward whirl is also explored from a point of view of non-smooth sliding bifurcations based on the Filippov's convex method. On the other hand, the methodology of spectral-submanifold (SSM)-based reduction is adopted to construct a reduced-order model and predict the response of the self-excited forward whirling motion of the rotor/stator rubbing system.

1.26 New Ultra-Low Power and Low-Data Rate Applications for Chaos-Based Wireless Communications Systems

Géza Kolumbán

Pázmány Péter Catholic University

In conventional wireless communications the main research goals are to increase the data rate and reduce the latency. The complexity and the power consumption is not a real issue, even recharging on a daily basis is tolerated. Many researchers in chaos communications are proposing new and very complex modulation schemes in order to achieve or even exceed the performance of OFDM systems. Unfortunately, the high complexity means high power consumption.

There are emerging brand new application fields where the ultra-low power consumption is a must. These are the cyber-physical systems where only a small amount of information has to be transmitted, the human implants and other biomedical applications where the data rate to be provided is relatively low, even some latency is tolerated. However, these devices have to operate without infrastructure and maintenance and nobody is going to re-charge or change the batteries. These devices are expected to operate for more than 10 years with the original battery. The ultra-low power consumption and the simplicity are must in these applications.

In the first part of the talk these new applications from cyber-physical systems to biomedical applications will be surveyed. The UWB communications, a new technology which can re-use the already occupied frequency bands will be discussed and its limits will be explained. It will be shown that due to their simple operation principle, the chaos-based wireless communications systems can be used to implement the ultra-low power radio devices which are badly needed in these applications.

Because off-the-shelf circuits are not available for chaotic systems, typically only computer simulations are used for verification in chaos-based communications. The lack of real field tests blocks the use of chaos-based communications systems in real applications. The idea of software defined electronics (SDE) solves this problem because it can turn a base band computer simulator directly into a working ICT system. In SDE every application is implemented in SW and the transformation

between the digital data sequences and real-world RF analog signals is performed by a universal hardware transformer. Chaos-based systems implemented on SDE platforms are fully functional, consequently, they can be used as prototypes and their performances can be evaluated in real working environments. The second part of the talk will discuss the idea of SDE approach and will show how a computer simulator developed in the research phase can be turned directly into an operating telecommunications system.

1.27 A biohybrid robot by mimicking the gait mechanism of Aplysia californica actuated by skeletal muscle

Muhammad Usman Akhtan

Xi'an Jiaotong University

This study presents the design principles, structure, manufacture, theoretical, kinetic and dynamic analysis to mimic the gait mechanism of Aplysia in the robot. Aplysia is a marine gastropod with stable movement through pedal waves due to viscoelastic properties of the mucus which result in resistance variation. Asymmetry in the resistance in Aplysia is introduced through the structural variation. Friction anchoring and elastomer relaxation as the propulsion force result in moving the robot forward. The mechanical part is manufactured by 3D printing, and the robot is actuated by skeletal muscle under the electrical stimulation. The 3D printed robot undergoes forward motion toward the side with lower resistance upon electrical stimulation with the speed of 2mm per pulse. This study provides a paradigm for the movement design of the bio-hybrid robots.

1.28 Composite Learning Control of Strict-feedback Systems with Applications

Bin Xu

Northwestern Polytechnical University

This talk addresses the dynamic surface control of uncertain nonlinear systems on the basis of composite intelligent learning and disturbance observer in presence of system uncertainty and time-varying disturbance. The serial-parallel estimation model with intelligent approximation and disturbance estimation is built to obtain the prediction error. The highlight is that different from previous work directly towards asymptotic stability, the transparency of the intelligent approximation and disturbance estimation is included in the control scheme. The uniformly ultimate boundedness stability is analyzed via Lyapunov method. Through simulation verification, the composite intelligent learning with disturbance observer can efficiently estimate the uncertainty and disturbance while the proposed approach obtains better performance with higher accuracy. The method is also applied to aircraft and manipulator dynamics to show the effectiveness.

1.29 Vulnerability and co-susceptibility on Brain cascading networks

Peng Ji[1], Jianchen Ye[1], Wei Lin[1], Jürgen Kurths[2]

[1]**Fudan University**, [2]**Potsdam Institute for Climate Impact Research**

In networked systems, a local perturbation can propagate by following paths along the network of interactions between the system's units. Such behaviour can lead to a large-scale cascade of interaction failures. We adapt a classical load-redistribution model and based on brain networks that have been investigated with diffusion MRI, conduct an analysis of the vulnerability and co-susceptibility of the corresponding brain networks. We find a group of nodes that can, potentially, fail simultaneously. The cascade model advances our understanding of linked failures in brain networks, and our results provide new insights in understanding disease progression in, e.g., Dementia.

1.30 Extreme events in nonlinear wave interactions

Antonio Marcos Batista[1], **Moises Santos**[1], **José Szezech Jr**[1], **Kelly Iarosz**[2], **Iberê Caldas**[2], **Ricardo Viana**[3]

[1]**State University of Ponta Grossa**, [2]**University of São Paulo**, and [3]**Federal University of Paraná**

Extreme events are characterised by low probabilities and high impact on the systems. They have been estimated through the extrapolation of power law frequency-size distributions. Extreme dragon-kings events do not belong to a power law distribution and correspond to meaningful outliers. Dragon-kings events are characterised by frequency distribution with extreme valued outliers about the power law tails. They were reported in distributions of financial draw downs, as well as in neuronal networks. We demonstrate the existence of dragon-kings extreme events in nonlinear three-wave interactions. The nonlinear three-wave interaction is the lowest order effect in systems described by waves superposition. Three-wave coupling was used to analyse drift wave turbulence and transport in magnetised plasma. We focus on the suppress of the dragon-kings through a fourth wave. In this work, we show that a fourth wave is able to kill the dragon-kings in nonlinear three-wave interactions.

1.31

Wei-Jia Shi[1], **Wenzhe Ma**[2], **Liyang Xiong**[3], **Chao Tang**[4]

[1]**Xi'an University of Technology**, [2]**Harvard Medical School**, [3]**Peking University**, and [4]**Peking University**

Understanding how complex biological networks carry out sophisticated regulatory functions is a major goal in systems biology, in which the nonlinearity in biological systems brings us inevitable challenges. Now, we have figured out some simple design principles of many network motifs, i.e. the close relationship between function, topology and dynamics. Among them, the linear stability analysis and simulation played important roles.

In this talk, we focused on an ubiquitous biological function – adaptation, using linear stability analysis and simulation, we explored how different regulatory process (transcriptional and enzymatic regulations), and network size affect the topological constructions as well as parameter restrictions, including: 1) identified all 3-node transcriptional networks that can achieve perfect adaptation, 2) developed a general framework and a systematic method to construct enzymatic adaptation networks of arbitrary size with flexibility.

Compared with the previous results we published about 3-node biochemical adaptive networks, we obtained a wealthy of "sub-types" of networks originated by the change of the two factors we mentioned above.The results differ mainly on the control node of the topology. For transcriptional adaptive networks, the control node can be an exponential integrator in addition to an integrator existed in enzymatic networks, or can be an inversely-proportional node in addition to a proportional node. For larger biochemical networks, the control node can couple with feedback loops and even can change the main skeleton of the adaptive topology that is predicted must be there.

1.32 Collective prosocial behaviors and their neural basis: experiments and models

Wenxu Wang

Prosocial behaviors, such as cooperation, fairness, altruism and punishment, are fundamental to the human society, and are crucial to the success of human species in the biological evolution on earth. However, prosocial behaviors, as a result of bounded rationality, cannot be explained by traditional economic theories based on rational agent assumption, and cannot be explained by

the inclusive fitness theory as well. The emergence and persistence of prosocial behaviors are yet elusive and have been listed one of the most significant problems in 21 century by Science magazine. This talk will focus on collective prosocial behaviors in terms of the integration and coordination of behavioral diversity and structural diversity. We uncover the underlying mechanisms of group cooperation and fairness by virtue of behavioral experiments, modeling and theoretical analyses. Further, we implement neuropeptide modulation experiments to reveal neuropeptide basis of prosocial behaviors. Our work may be valuable for brain-like computation and the development of future AI algorithms.

1.33 Double Sub-streams Differential Chaotic Shift Keying Scheme based on Chaotic Shape-Forming Filter and Noise Reduction Technology

Bai Chao

Xi'an Technological University

New findings of chaotic signal have been identified recently for chaotic communication, including a chaotic shape-forming filter (CSF) to modulate the chaotic carrier signal at the transmitter, providing an additional sub-stream transmission; a simplest Matched Filter (MF) to maximize the signal to noise ratio at the receiver, improving noise and multi-path effect resistance. In this talk, a Differential Chaos Shift Keying based on Chaotic Shape-forming Filter and Noise Reduction technology (CSF-NR-DCSK) is proposed to obtain lower Bit Error Rate (BER) and higher bit transmission rate with respected to conventional differential chaos shift keying (DCSK). In each transmission slot, one sub-stream is mapped into a predefined spread sequence and modulated into the chaotic signal by using a Chaotic Shape-forming Filter (CSF). The modulated chaotic signal is used as the reference signal and the information bearing signal after multiplying with the information bit from the other sub-stream, which improves the bit transmission rate and enhances spectral efficiency. A corresponding matched filter is used to decrease the effect of multipath, ambient noises at the receiver. The simulation and experiment results show a better BER performance of the proposed scheme as compared to other DCSKs.

1.34 Controlling globally coupled FitzHugh-Nagumo cells

Arunas Tamasevicius, Elena Adomaitiene, Skaidra Bumeliene

Center for Physycal Sciences and Technology

Synchronization is widely observed in nature and artificial systems. In most cases synchrony is a desirable state. However, sometimes it has an unfavourable impact. Synchronization of neurons in human brain is an example. It is assumed that strong synchrony of neurons can cause the symptoms of the Parkinson's disease. A large number of methods to avoid synchrony have been suggested in literature. In the present paper, we describe four new methods for controlling globally coupled FitzHugh–Nagumo oscillators. There are two global coupling configurations - the star and the all-to-all couplings, both leading to the mean-field mechanism of interaction. The control techniques can be either global or local. The 1st technique is a global one, based on filtering the mean field at the central node. The RC filter includes a single capacitor only. It desynchronizes the oscillators in a wide range of coupling strength between the individual oscillators. A straightforward way to get around the problem of undesirable synchrony is to suppress the activity of the oscillators by stabilizing their steady states. The 2*nd* technique is also a global one, employing separate networks of global coupling and global control. The steady states of the oscillators can be stabilized independently on the coupling strength. In natural systems, either the central node does not exist, or it is difficult to access. Simultaneous control of the all individual oscillators is complicated in larger arrays. The 3rd technique is a local one. It stabilizes the steady states of the all oscillators in an

array via a single randomly chosen (or accidentally accessed) oscillator. The $4th$ technique is also a local one. It uses a single oscillator, intentionally corrupted by coupling to it either an adjustable DC voltage source or a large capacitor. We have performed mathematical analysis, numerical simulations, and hardware experiments with an electrical circuit.

1.35 A class of uncertain fractional-order systems control with perturbation

Yuhao Peng, Chaobo Cheng, Jiaoru Huang

Xi'an Technological University

In this paper, we research the robust control of fractional-order uncertain systems with order 0-1 and perturbation. Firstly, sufficient conditions for asymptotic stability of closed-loop control system are derived by fractional Lyapunov direct method. Secondly, the feasible solution of the controller parameters that satisfy the stability of the fractional-order system is calculated by using the solution method of linear matrix inequality. Then, the system is controlled by state feedback controller. In this paper, the sufficient condition is given in the form of linear matrix inequality, which makes the result simple and clear. The control method is not only simple in structure and operation, but also fast and robust. Finally, numerical examples are used to verify the effectiveness and practicability of this method.

1.36 Quadratic optimal control algorithm for fractional stochastic systems based on ant colony algorithm

Jiaoru Huang, Yaya Zhao, Song Gao, Fucai Qian, Chaobo Chen

Xi'an Technological University

For the optimal control problem of fractional-order stochastic dynamic systems, the state response no longer has Markov property, which leads to the Bellman dynamic programming optimally principle is no longer valid, so the traditional control method is no longer applicable. In this paper, an optimal linear quadratic regulator is designed for a fractional-order stochastic linear system with state information completely measurable. The quadratic performance index consisting of the expectation of the sum of state variable and the control variable has only one optimal value. Then the ant colony algorithm is used to optimize the performance index to obtain the optimal state feedback gain, and the design of the linear quadratic regulator is realized.The simulation results show that the ant colony algorithm has better convergence effect and better versatility than the traditional gradient iterative optimization algorithm.

1.37 MPPT Algorithm Based on Improved PSO and Fuzzy Algorithm

Hao Li, Song Gao, Chaobo Chen, Melnikov S. N., Xueqin Yang, Jin Li

Xi'an Technological University

Under complex illumination conditions, photovoltaic cells in photovoltaic arrays will be occluded to varying degrees, and their overall output presents multi-peak characteristics. At this time, the traditional maximum power point tracking technology often falls into local maximum power point because it cannot achieve global judgment. Particle swarm optimization (PSO) can achieve global maximum power point search, but it tracking speed and environmental adaptability is not ideal. In order to solve this problem, this paper proposes a MPPT method which combines improved PSO algorithm with fuzzy algorithm. This method improves the speed and environmental adaptability of the algorithm by improving the motion mode of the optimal particle in the PSO algorithm based on the use of the fuzzy algorithm. The simulation model is built in MATLAB, and the simulation results show the effectiveness of the method.

1.38 Gesture recognition based on transfer learning

Xue Wu, Xiaoru Song, Song Gao, Chaobo Chen

Xi'an Technological University

At present, the general methods of gesture recognition are machine learning method and deep learning method. However, machine learning method has the disadvantage of extracting image features manually, while deep learning method requires high hardware requirements and is easy to over-fitting in small samples. To solve above problems, this paper proposes gesture recognition based on transfer learning. Firstly, transfer the pre-trained model and convolutional layer parameters on the Image-Net dataset to the gesture dataset with small samples. And then frozen the convolution layer as the feature extractor and fine-tune the output layer of the network to fit the target data. Finally, initialize the 3 fully connection layer of the network with improved normal distribution initialization method and retrain the net again .The simulation results show that the proposed method has a good recognition rate in the small sample gesture image dataset and avoid the over-fitting, which has a great significance for gesture recognition.

1.39 Water Quality Prediction Model Based on CNN-GRU hybrid network

Jichang Tu, Xueqin Yang, Chaobo Chen, Song Gao, Jingcheng Wang, Cheng Sun

Xi'an Technological University

In view of the characteristics of randomness, non- linearity, randomness and interdependence of water quality data in water environment, in order to improve the prediction accuracy and prediction efficiency of water quality prediction model,a hybrid water quality prediction model based on convolutional neural network (CNN) combined with gated recurrent neural network (GRU) is proposed. First, the potential characteristics between water quality continuous data are extracted efficiently through CNN network. Then, based on the potential characteristics, a GRU network with temporal memory capability is used to accurately predict water quality data. Finally, the real monitoring data of Shanghai Jinze Reservoir is combined, and a water quality prediction model based on CNN-GRU is established. The experimental results show that the hybrid prediction model proposed in this paper has higher prediction accuracy than the traditional SVR water quality prediction model and the standard GRU network water quality prediction model.

1.40 The Study For Path Following of Robot Fish Based on ADRC

Zepeng Gao, Xiaoru Song, Chaobo Chen, Song Gao, Fucai Qian

Xi'an Technological University

The multi-joint robot fish is often subject to unknown external and internal disturbances during path following in water areas. In this paper, a path following control method based on active disturbance rejection control (ADRC) is proposed for obtaining high-quality tracking effect. Combining the kinematics and dynamics equations of the three-joint robot fish, the model of error for path following is established in the Serret-Frenet coordinate system by setting the virtual mobile robot. Based on the introduction of expectation angle, the guidance of forwarding and steering control law are designed respectively. Then the second-order path following controller based on ADRC is established to improve the robustness and rapidity of the robot fish in the path following. For the control of such systems, a disturbance observer and related techniques have provided a powerful tool to dynamically estimate and compensated the diverse disturbances and offered desired control performances. The experiment shows that the method proposed in this paper enables the robot fish to follow the given path at around 3s, and the error of position maintained at positive or negative 0.1m. Compared with the conventional PID control method, the results show that path following

controller based the ADRC can restrain overshoot very well and follow the given path quickly, resulting in an improvement of path tracking time and accuracy.

1.41 A Fast Diagnostic method of open-circuit fault in inverter

Xiaxia Wan, Chenbo Chen, Song Ga, Xinyu Sha

Xi'an Technological University

To improve reliability of motor driving system, this paper presents a diagnostic method of open-circuit fault in inverter based on the measurements of phase voltage. The mixed logic dynamic model of inverter is established by the flow path of current when IGBTs work normally and occur open-circuit fault, using the residual among the normal phase voltage and the abnormally phase voltage to detect open-circuit fault, using the relationship between residuals of each phase to locate which IGBTs occur open-circuit fault. The influence of system noise and measurement error is eliminated by setting threshold. Finally, the validity and effectiveness of diagnostic method were verified through Matlab/Simulink simulation.

1.42 Study On ESO-Based LQR Controller In Pitch Control

Yue Wang, Chaobo Chen, Song Gao, Jing Guo

Xi'an Technological University

Under complex external conditions, due to the presence of such wind-speed-variation-induced factors of uncertainty an uncertain turbulence and the variation of model parameters on the wind turbine pitching system, using the traditional PI controller may give rise to the problems of getting an overly high overshoot and excessively long response time caused by the disturbance. Using a linear quadratic controller on its own may lead to the instability of the target under control, while the inability to measurable the state variable may present challenges for the model construction. This paper proposed an LQR control strategy based on the extended state observer (ESO),which estimated the wind speed variation and the total disturbance caused by the factors of mechanical vibration and so on by directly designing the extended state observer as well as removed the disturbance effect by feed forward control. Next, it calculated the state feedback matrix according to the LQR Control Theory in order to control the reliability of the operation of the target under control under complex circumstances. This paper also established the dynamic model of the wind turbine in the Matlab environment and carried on the simulation analysis according to the dynamic model. The result showed that the overshoot of LQR control method based on ESO has been minimized and possesses an eminent dynamic capability.

1.43 Modeling and variable pitch control of doubly-fed induction generators

Xinyu Sha, Chaobo Chen, Song Gao

Xi'an Technological University

The method of maximal power factor control under constant wind speed is mostly adopted in current researches on modeling of wind turbine generators. However, using this method to operate in the Matlab simulation platform cannot guarantee to complete the selection of the optimal power factor at variable wind speed. To address this issue, a mathematical model of DFIG consisting of a wind turbine, an electric generator, a back-to-back, a converter and variable pitch control is studied, while a simulation model is also established in the PSCAD simulation platform. In this paper, based on the operating principle of the variable-speed constant-frequency wind turbine system, it firstly describes the structure of the turbine and the mathematical model in details. Secondly, control methods of the converter side and the grid side are introduced after the mathematical model

of the wind turbine as well as the simulation model of the wind turbine and the transmission system is established. Finally, a variable pitch control strategy is studied in the case of the wind speed exceeding the rated wind speed. By changing the pitch angle of the wind turbine generators, the wind turbine can operate continuously at rated power, achieving the control of optimal power factor. And a simulation study is made on the whole wind power control system with the PSCAD simulation platform together with the doubly-fed induction generator and the converter. Based on observing the output of active power at variable wind speed, it proves the correctness of the model and shows that the pitch angle control can be implemented in this model.

1.44 A low-complexity 2D DOA estimator for coherently distributed sources

Hui Yao, Chao Wang

Xi'an Technological University

The paper proposes a low-complexity estimation algorithm of 2-dimentional direction-of-arrival (DOA) for coherently distributed sources. The nominal elevation can be estimated by using the TLS-ESPRIT algorithm based on the invariance structure, which is from the actual array and the virtual array. And utilizing the estimation of maximum eigenvalue algorithm and the nominal elevation obtained at the pre-steering stage, we can estimate nominal azimuth based on the eigenstructure between generalized steering vector and signal subspace. The proposed algorithm provides a sufficiently good estimation accuracy as well as computational simplicity which requiring only one-dimensional searches. In addition, the proposed algorithm requires a simpler hardware than that of SOS algorithm.

1.45 A New Qualitatively Maximum A Posteriori for Bayesian Network Parameter Learning Based on Computing the Center Point of Constrained Areas

DI Ruo-hai

Xi'an Technological University

Introducing the parameter constraints has become the mainstream method to learn Bayesian network parameters with small data sets. Qualitative Maximum A Posteriori (QMAP) has the best learning accuracy among the existing methods. However, the rejection-acceptance sampling method involved in the QMAP algorithm is time-consuming, especially when the number of parameter constraints is large. In order to enhance the learning efficiency of the QMAP algorithm without reducing the learning accuracy, in this paper, a new analytical method to calculate the center point of constrained region is proposed to replace the original rejection-acceptance sampling method. Firstly, a novel objective function is designed and a constrained objective optimization model is constructed with parameter constraints. Secondly, the boundary and center points of the constrained region are obtained with the constructed model. Finally, the existing QMAP algorithm is improved by the obtained center points. Through a large number of simulation experiments, it is found that the parameter learning accuracy of the proposed algorithm is slightly better than QMAP algorithm, and the computational efficiency is much better than that of the QMAP algorithm.

1.46 Design Photoelectric analog signal acquisition system in shooting range

Zhiyuan Dai

Xi'an Technological University

In order to obtain the signal of the photoelectric test equipment of the shooting range, a high-speed data acquisition system based on PCI interface is designed. The acquisition system consists of two parts: photoelectric test platform and data acquisition software. The photoelectric test platform

includes sky screen target, high-speed data acquisition card and industrial computer. The acquisition software mainly completes the functions of acquisition card control, photoelectric data acquisition, data processing and storage, and result display. The external field photoelectric signal acquisition test was carried out. The test results show that the system runs reliably, and the photoelectric analog signals are collected stably, and the test data acquisition is realized, which meets the specified design goals and requirements.

1.47 Graphic Recognition and Tracking Based on Python-OpenCV

Shuwei Yang

Xi'an Technological University

With the rapid development of machine vision, target tracking and recognition technology not only has a wide range of applications, but also has a long-term research significance. In life, video surveillance system uses tracking and recognition technology to identify and track the inappropriate behavior of moving objects; through tracking and recognition technology to complete the communication between us and computers, gradually out of the control of the mouse. In industry, robots track moving objects through tracking and recognition technology. In military affairs, the characteristic information of dynamic targets can be obtained by tracking and identifying technology, which plays an important role in war. In this paper, target detection algorithm, target recognition algorithm and tracking algorithm are analyzed, and a graphic recognition and tracking system based on OpenCV and Dlib is designed and implemented, which can recognize circles and faces. The graphic recognition and tracking system includes three modules: PC upper computer software, slave computer software based on Arduino and steering engine platform. The host computer receives the image in real time, pre processes the captured image, calls the function in OpenCV to detect the Hough circle of the image, calls the function in Dlib to detect and recognize the face of the image, and connects the computer with the Arduino development board through serial port to send the position information data in real time. According to the received position information, the rudder is controlled by Arduino. The rotation angle of the camera can accurately adjust the orientation and pitch posture of the camera to achieve real-time target tracking. After the system design of this paper is completed, many rounds of experiments have been done. The experimental results show that in the upper computer software developed by Python, the servo platform achieves a good control effect through dynamic target vision detection and angle output of PID control, so that the two-dimensional turntable can track specific targets and achieve the goal of graphic recognition and tracking.

1.48 Internal Power Angle Control Strategy for Highpeed Sensorless Brushless DC Motor

Guobin Gao, Bo Tan

Xi'an Technological University

High-speed brush less DC motor (BLDCM)usually adopts the sensor less control strategy and operates in three-phase six-state drive mode. However, the sampling errors of the rotor position and the driving method increase the internal power angle (IPA), which deteriorates the system power density. This paper proposed a new reducing strategy for the IPA and it is independent of motor parameters and does not require current sensors. Firstly, a non-filter back-EMF zero-crossing detection method is proposed to reduce the sampling errors of the rotor position. Secondly, the relationship between the terminal voltage and the zero-crossing of the corresponding back-EMF is analyzed. It is concluded that when IPA is zero, the results of integrating the difference between the effective terminal voltage and the one-half of the bus voltage before and after the zero-crossing

of the back-EMF are equal. Thirdly, a lead angle for reducing the IPA is obtained through a PI controller and it can eliminate the deviation between the two integrals. Finally, the simulation model and the experimental circuit are built to simulate and verify the proposed control strategy.

1.49 Low-light-level image enhancement algorithm based on Integrated Network

Peng Wang, Jiao Wu, Haiyan Wang, Xiaoyan Li, Yongxia Yang

Xi'an Technological University

In dark or poorly lit environments, it is often difficult for naked eyes to distinguish the low-light-level image because of the low brightness, the low contrast and noise, and it is difficult to achieve subsequent image processing (such as video surveillance, target detection and so on). To solve the above problems, this paper proposes a low-light-level image enhancement algorithm based on deep learning. Firstly, the low-light-level image is segmented into several super-pixels, and the noise level of each super-pixel is estimated by the ratio of local standard deviation to local gradient. Then, the image is inverted and smoothed by the BM3D filter and the structural filter adaptive method to obtain complete images without noise and texture. Finally, the noise-free image and texture-complete images are applied to the integrated network,which can not only enhance the contrast,but also effectively prevent the over-contrast enhancement. The experimental results show that the method is superior to traditional methods in both subjective and objective evaluation, and the PSNR and SSIM are 31.64 dB and 91.2% respectively.

1.50 Convolution Operators for Visual Tracking based on Spatial-temporal Regularization

MengYu Sun

Xi'an Technological University

In recent years, the method based on Discriminative Correlation Filter (DCF) has been shown excellent performance in short-term visual tracking. However, Discriminative Correlation Filter based method heavily suffer from the problem of the multiple peaks and model drift in responds maps incurred by occlusion and rotation. To solve the above problem, we proposed convolution operators for visual tracking based on spatial-temporal regularization. Firstly, we add spatial-temporal regularization in loss function, which will guarantee continuity of the model in time. And we use Preconditioned Conjugate Gradient Algorithm to obtain filter coefficients. Secondly, we proposed channel reliability to estimate quality of the learned filter and fuse the different reliability coefficients to weight response map in location. We set a threshold to reduce the number of iteration in location. Finally, we use two different correlation filters to estimate location and scale of target, respectively. Extensively experiment in 5 video sequences show that our tracker has been significantly improved performance in case of occlusion and rotation.

1.51 Optimizing Method of Explosion Point for Linear Array Scanning Laser Proximity Fuse

Shuxian Cai

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In view of the els SEC difficult to precise control ZhaDian problem, in the process of using in projectile horizontally rotating scanning head as a detection device, the linear array laser fuze is analyzed under the projectile coordinate els SEC projectile and target rendezvous conditions, in the process of determining the els SEC after firing tiny broken in the process of the relationship

between the effective area with the target set, this paper expounds the influences of the fragment number of target damage. Measured by linear array laser fuze target warhead contour information compared with the database have detonated conditions, and USES the Monte - Carlo algorithm for els SEC process in mathematical statistics, the fragment ballistic random sampling, calculation and analysis the fragment number and target effective intersection area of target damage, the effects of determined to realize the optimization of ZhaDian. It lays a foundation for further research on damage assessment of target warhead in the stage of warhead rendezvous.

1.52 Power Regulation of V2G System for Grid Power Quality Improvement

Yanqing Qu

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Electric vehicles (EVs) are likely to have a continued presence in the light-vehicle market in the next few decades. There will be an extra burden on the distribution grid when EVs are charging. On the other hand, the EVs have the potential to support the grid. Vehicle to grid (V2G) is being introduced by new researches as one of the new future resources which make them more noticeable than ever. This paper presents the grid support from the vehicles for power quality improvement based on V2G system. Among these services, it studies the possibility to afford the active power and reactive power when there is voltage and frequency fluctuation caused by variation of the load. It also presents the four quadrants operation for converter power flow control based on the grid and EV owners requirements. The studies are performed using Simulink and PSCAD/EMTDC simulations. The results demonstrate the effectiveness of power quality improvement from V2G services with good results.

1.53 Research on calibration method of pressure transmitter

Jiaoyan Wang

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Pressure transmitter refers to a pressure sensor whose output is a standardized signal. The default memory value of the memory used to store the adjustment information in the internal signal conditioning chip is unknown, so the input and output curves of the pressure transmitter are unknown. The pressure transmitter must be calibrated to adjust the pressure transmitter input and output curves to standard input and output curves. Therefore, this paper studies a calibration method of the current output type pressure transmitter pressure based on the programmable gain amplifier PGA308. The method uses the average slope method to fit the pressure transmitter output output curve, which can realize the calibration of the pressure transmitter. The calibration accuracy can reach 0.0063%, and the calibration rate can reach 9.9 seconds/piece.

1.54 The Motion Planning of a Six DOF Manipulator Based on ROS Platform

Liu Yueqi, Xin Daxin, Hua Jin

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In view of the safety problems and motion planning problems of traditional robots in complex environments, the open source robot operating system ROS is adopted to build the robot simulation platform, and the motion planning is carried out. In the ROS platform, 3D modeling of mechanical arm was completed by using URDF file. Make a series of configurations for the robot model with the MoveIt setup Assistant and generate a startup file. And the 3d model was displayed in Rviz; Using MoveIt to complete the motion planning of the six-degree-of-freedom manipulator and the obstacle avoidance trajectory planning. The results show that the velocity and position relationship

of the six joints in the motion process of the manipulator can be derived by MoveIt, which can provide a more intuitive method for further improvement and research on the trajectory planning of the manipulator.

1.55 An Improved Intelligent Clustering Algorithm for Irregular Wireless Network

Yao Hongjuan, Wang Zhao, Li Baohua, Shu Lili, Hua Xiang

Xi'an Technological University

The topology management classifiers consist of several methods, such as the typical clustering-based method excelled in wireless network partitioning. However, most algorithms appear load unbalanced in the application of irregular networks, resulting the energy hot zone phenomenon. This paper proposes an improved intelligent clustering algorithm and applies it to the complex water system environment. Firstly, we build a new energy consumption model for wireless transmission network, and design a genetic clustering strategy via the minimum energy consumption principle. Secondly, we introduce the matrix coding approach considering the search scale, só as to avoid the squared increasing relationship between the searching space and the data calculation. Thirdly, we employ adaptive genetic operator to enhance directivity of the searching space, and utilize a fuzzy modified operator to enhance the accuracy of the cluster head selection, which may ensure the iterative efficiency. Through numerical simulations, empirical results show better performance than traditional methods in load balancing and clustering efficiency, which can effectively improve the network convergence speed and extend the network lifetime.

1.56 Photodetector based on PbSe quantum dots

Zhao jijie

Xi'an Technological University

In order to further study the infrared photodetector to obtain high quality images. By thermal injection method to synthesize the high quality of narrow band gap PbSe quantum dots, quantity of using semiconductor contact excellent features such as size effect in quantum effect and crystallinity P3HT very good organic polymer blend as the active layer, in combination with field effect transistor current gain characteristics, and conducive to integration, the advantages of simple method by spin coating preparation of film, the preparation of the near-infrared light detector and the active layer of the battery in the P3HT PbSe quantum dots with different quality than the influence of the device into the analysis and discussion. The hot injection method is adopted, with lead oxide as the lead source of selenium powder as selenium source TMS2S for sulfur source synthesized size uniform size around 4 nm PbSe quantum dots, by controlling the proportion of different S and Se can make its absorption spectrum peak position between 1100-1 SOO nm continuous adjustable experiments confirmed that can be controlled by synthesis conditions to control the size of the semiconductor quantum dot and absorption spectrum peak position.

1.57 Parameters estimation for chirp signal based on QPF-FRFT

Lili Shi

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Accuracy and speed of parameters estimation for radar signal is very important in optical wireless communications. In order to implement high accuracy and fast speed of parameters estimation, a new estimation algorithm is presented in the paper. The method is based on quadratic phase function (QPF) and fractional Fourier transform (FRFT), which is used to estimate parameters for the chirp signal. In order to avoid two-dimensional searching during FRFT, chirp rate is directly estimated by

QPF method, and then the optimum transform order of FRFT is calculated by estimating the chirp rate. Finally, center frequency and amplitude of the chirp signal are estimated by FRFT. Simulation results show that the proposed QPF-FRFT method is faster than the FRFT method and two step maximum modulus searching method. Otherwise, when the SNR is higher than -4dB, the center frequency, chirp rate and amplitude of chirp signal can be estimated by QPF-FRFT method more accurately than FRFT method. In conclusion, results on experimental of chirp signal illustrate the efficient performance of the algorithm.

1.58 High precision beam steering using a liquid crystal spatial light modulator

Zhao Wang, Qifeng Niu, Chunyang Wang

Xi'an Technological University

Liquid crystal spatial light modulators (LCSLMs) are novel phase modulation devices. Due to the dielectric properties of the orientation layer, the orientation layer has a voltage division effect on the driving voltage. A more effective analysis of the relationship between the driving voltage and phase modulation properties of LCSLMs is needed, as well as improved beam steering accuracy. In this paper, we establish an electrical model of an LCSLM, and propose a method for quantitatively calculating the liquid crystal (LC) layer voltage. This differential iterative method based on nonlinear least squares is used to analyze the LC molecular directors. Considering the thickness of the orientation layer, we calculate the LC director distribution and the voltage division effect of the LC layer, obtaining a more accurate electro-optic characteristic curve of the LCSLM, and verify the calculations by experiment. Experimentally, the average beam pointing error of the LCSLM was 0.0098 at 532 nm, representing a significant improvement of the beam steering accuracy.

1.59 Line-of-sight kinematics modeling and correction for precision pointing systems based on a two-axis fast steering mirror

Lin Wang, Xuelian Liu, Chunyang Wang, Xueya Deng

Xi'an Technological University

To improve the control accuracy of optoelectronic imaging equipment, the factors that affect the accuracy of the optoelectronic axis pointing are analyzed. Following Snell law, the kinematic coupling equation of the line-of-sight (LOS) angle based on the fast steering mirror (FSM) is established. The calibration method of the FSM system is designed according to the obtained motion characteristics, and a nonlinear correction method is designed to decouple the LOS equation. For a two-axis fast mirror with a stroke of 20 mrad, the LOS pointing error is <1 rad when the incident angle is 45 deg, which equates to an improvement of at least 78.9 times compared with linear correction methods. The nonlinear correction method is verified by practical experiments. The method provides a theoretical basis for generating position instructions and thus enables a precise FSMbased pointing system.

1.60 RBF Neural Network Based Adaptive Control of Nonlinear Unknown Systems: A Case Experiment Comparison

Xuan Wang

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As a typical nonlinear system, hydraulic servo system has been widely used in many industrial fields, due to the advantages of strong carrying capacity and fast response. However, it is difficult to obtain the exact system model due to both structure complexity and time-varying nature. Moreover, in some application, the control direction is uncertain. Therefore, taking the hydraulic position servo

system as the case study object, a systematic backstepping way to design an adaptive controller based on RBF neural network considering three obstacles including: unknown mathematical model; unknown control direction information; inaccurate valve zero point. The proposed adaptive neural network dynamic surface controller and the adaptive backstepping neural network controller can track the references for both control directions. However, compared with adaptive backstepping neural network control, the adaptive neural network dynamic surface control is not better, which is surprisingly opposite to what is commonly believed opinion.

1.61 Artificial Intelligence Enhances the Performance of Chaos-based Wireless Communication

Hong-Er Zhao

Xi'an University Technological

Some new findings for chaos-based wireless communication systems have been identified recently. First, chaos has proven to be the optimal communication waveform because chaotic signals can achieve the maximum signal to noise ratio at receiver with the simplest matched filter. Second, the information transmitted in chaotic signals is not modified by the multipath wireless channel. Third, chaos properties can be used to relieve inter-symbol interference (ISI) caused by multipath propagation. Now we only know the past (received) symbols, so we can eliminate the ISI caused by them. But the ISI is composed by the received symbols and the future (unreceived) symbols. Owning to Artificial intelligence (AI) recent developments, Convolutional Neural Network (CNN) with deep learning structure is being proposed to predict future symbols based on the received signal, so as to further reduce ISI and obtain better bit error rate (BER) performance as compared to that used the existing sub optimal threshold.

1.62 Design of PCR Instrument Temperature Control System Based on Improved PID Algorithm

Zhi-Wei Gao

Xi'an University Technological

Due to the characteristics of nonlinearity, time-dependent parameter variation, pure hysteresis, and model uncertainty, the temperature control system of the PCR instrument can not achieve ideal control effect only by using traditional PID. Therefore, an indirect method-2PID is proposed to control the temperature intelligently. It adds a control parameter Φ in comparison with the original PID, which reduces the modulation in the temperature control process and increases the robustness.

1.63 Multi-carrier Differential Chaos Shift Keying Wireless Communication Based On Chaotic Shape-forming Filter

Si-Long Guo

Xi'an University Technological

In recent years, chaotic communication has shown advantages, including the simplest matched filter to get maximum signal-to-noise ratio (SNR) and the ability to resist multi-path propagation effect. The chaotic shape-forming filter (CSF) has been proposed to generate the chaotic base band signal in the wireless communication, the additional advantage of the chaotic shape-forming filter is able to generate the chaotic signal as spread sequence in Differential Chaotic Shift Key (DCSK), which encodes information in the sequence. In this method, the chaotic signal generated by CSF is used in DCSK and combined with multi-carrier frequency to improve the bit transmission rate. Because of CSF used, it helps to improve both Bit Error Rate (BER) performance and provide an additional information flow in the spread sequence itself.

1.64 Frequency stability analysis and control of complex power grids

Yuan Gao

Xi'an University Technological

In order to solve the problems caused by traditional fossil energy power generation, the proportion of renewable energy power generation in the power grid is increasing, but it also brings great challenges to the frequency stability of modern power grid. The purpose of this work is to establish a complex network model about modern power grid, and obtain the stability conditions of the complex network by using the multi-agent linear time-invariant consistent protocol, then a local control method for power grid is proposed. Finally, the effectiveness of method is verified by the northern Shaanxi power grid.

1.65 Modeling and control of load side virtual synchronous machine

Min-Rui Fu

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With the increasing proportion of clean energy in the power grid, however, these energies need to be connected to the power grid through power electronic converters. Compared with synchronous motors, power electronic converters lack inertia and damping, which will lead to the decline of the stability of the power grid. Recently, some scholars put forward the concept of autonomous power grid based on virtual synchronous machine. This paper puts forward a modeling method of virtual synchronous machine and introduces the corresponding control strategy. The simulation verifies the correctness of modeling and the effectiveness of control strategy, and further proves that the virtual synchronous machine has natural friendliness to power grid.

1.66 Research on Adaptive Wavelet Neural Network Control Method for Pneumatic Position Servo System

Shan-Shan Jiao

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With the development of control theory, various pneumatic control components with excellent performance have been developed, which greatly promoted the application of pneumatic systems. However, the nonlinearity of the pneumatic system model and the uncertainty of the parameters cause difficulties in the tracking control of the system. In order to solve the existing problems, this paper combines the adaptive wavelet neural network control method with the BP algorithm, and effectively utilizes the function approximation ability of the wavelet neural network and its self-learning ability for complex uncertain systems to solve the lack of accurate models of the pneumatic system,The problem is to use BP algorithm to adjust the weight and threshold of neural network, so as to solve the problem of system parameter uncertainty, and then use Lyapunov function to prove the stability of the designed controller. Finally, the experimental results show the effectiveness and superiority of the proposed method, which improves the tracking control performance of the pneumatic system.

1.67 Bifurcation and chaos in the flexible shaft rotating-lifting system of silicon crystal puller

Zi-Xuan Zhou

Xi'an University Technological

Silicon crystal puller (SCP) is a key equipment in silicon wafer manufacture, which is, in turn, the base material for the most currently used integrated circuit (IC) chips. In the near vacuum

environment in the SCP, the atoms in the silicon melt within a crucible grow along a mono-silicon seed hanged at the end of the flexible shaft rotating-lifting system (FSRL). The growing silicon crystal keeps lifting up to allow the new crystal to grow at the fixed level of the silicon melt. At the same time, the solidified crystal rod is rotating along the shaft in order to mix the silicon melt for improving the radius uniformity of the melt in the crucible. With the development of the techniques, the demand for longer mono-silicon crystal rod with larger diameter is continuously increasing in order to reduce the manufacture time and the price of the wafer. This demand calls for larger SCP with increasing height, however, in turn, it causes serious swing phenomenon of the crystal seed. The strong swing of the seed causes difficulty in the solidification and increases the risk of mono-silicon growth failure. The main aim of this paper is to analyze the nonlinear dynamics in the FSRL system of the SCP. A mathematical model for the swing motion of the FSRL system is derived. The influence of relevant parameters, such as system damping, excitation amplitude and rotation speed, on the stability and the responses of the system are analyzed. The stability of the equilibrium, bifurcation and chaotic motion are demonstrated, which are often observed in practical situations. Three routes to chaos are identified in the FSRL system, including period doubling, symmetry-breaking bifurcation and interior crisis. The work in this paper explains the complex dynamics in the FSRL system of the SCP, which will be helpful for the SCP designers in order to avoid the swing phenomenon in the SCP.

1.68 Performance improvement of chaotic base band wireless communication using Echo State Network

Hui-Ping Yin

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The inter-symbol interference (ISI) caused by multipath propagation is one of the main factors for high bit-error rate (BER) in wireless communication system, it is promised to be eliminated by using the optimal symbol detection threshold, but the information about future symbols is not available at the current time. To deal with such problem, ESN is employed to predict the future time series in chaotic baseband wireless communication system (CBWCS). By using this method, the future symbol is predicted and used in calculating the more accurate threshold to improve the CBWCS performance in sense of lower BER as compared to the current used counterpart.

1.69 Hyperchaos synchronization using univariate impulse control

Kun Tian

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Rössler and Chen systems with time delay are shown to be hyperchaotic, which exhibits a more complex dynamics, including multiple positive Lyapunov exponents and infinite dimension. The hyperchaos has better application potential when hyperchaos synchronization is concerned. The univariate impulse control requires smaller perturbation to the response system, thus promising better performance. However, synchronization of two hyperchaotic systems using univariate is a challenging task due to the difficulty to guarantee synchronization stability using minimum number of manipulated variable. In this paper, an univariate impulse control method is proposed for the synchronization of two hyperchaotic dynamics generated by time delay. A Theorem is developed and proved to provide the sufficient conditions for the synchronization of time delay systems using the univariate impulse control. The upper bound of the impulse interval is proved to guarantee the asymptotic synchronization. Simulation and circuit experiment show the correctness of the analysis and the feasibility of the proposed method.

1.70 PPM with Differential Chaos Shift Keying Modulation Based on Chaotic Shape Forming Filter

Xiao-Hui Zhao

Xi'an University Technological

In traditional M-ary Differential Chaos Shift Keying (DCSK) modulation system, with the increasing of M, the distance between constellation points decreases, which results in poor decision performance. In this paper, we proposed a method combining pulse position modulation (PPM) with matched filter to improve the transmitted rate and bit error rate (BER) performance. At the transmitter, the hybrid system is used to generate chaotic signal as reference signal of DCSK. According to the mapping rule of PPM, the chaotic carrier is orthogonal, which can achieve multi-speed transmission results. Simulation and experiment results show the effectiveness of the proposed method compared with other methods.

1.71 An Improved Switching Controller for Boost Converter Based on Hybrid Automata Model

Yi-Juan Ning

Xi'an University Technological

The inter-symbol interference (ISI) caused by multipath propagation is one of the main factors for high bit-error rate (BER) in wireless communication system, it is promised to be eliminated by using the optimal symbol detection threshold, but the information about future symbols is not available at the current time. To deal with such problem, ESN is employed to predict the future time series in chaotic baseband wireless communication system (CBWCS). By using this method, the future symbol is predicted and used in calculating the more accurate threshold to improve the CBWCS performance in sense of lower BER as compared to the current used counterpart.

1.72 Quadratic optimal control algorithm for fractional stochastic systems based on ant colony algorithm

Jiaoru Huang, Yaya Zhao, Song Gao, Fucai Qian, Chaobo Chen

Xi'an Technological University

Or the optimal control problem of fractional-order stochastic dynamic systems, the state response no longer has Markov property, which leads to the Bellman dynamic programming optimally principle is no longer valid, só the traditional control method is no longer applicable. In this paper, an optimal linear quadratic regulator is designed for a fractional-order stochastic linear system with state information completely measurable. The quadratic performance index consisting of the expectation of the sum of state variable and the control variable has only one optimal value. Then the ant colony algorithm is used to optimize the performance index to obtain the optimal state feedback gain, and the design of the linear quadratic regulator is realized. The simulation results show that the ant colony algorithm has better convergence effect and better versatility than the traditional gradient iterative optimization algorithm. Key Words :fractional stochastic systems fractional order optimal control quadratic performance index ant colony algorithm

1.73 A New Approach to Calculate Resource Limits with Fairness in Kubernetes

Zhang Zhuoya

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Containerization has become a new approach that facilitates application deployment and delivers scalability, productivity, security, and portability. As a first promising platform, Docker was

proposed in 2013 to automate the deployment of applications. There are many advantages of Docker for delivering cloud native services. However, its widespread use has revealed problems such as performance overhead. In order to deal with those problems, Kubernetes was introduced in 2015 as a container orchestration platform to simplify the management of containers. Kubernetes simplififies managing a large scale number of docker containers, however, the fairness is a missing point in the Kubernetes that has been applied in other platforms such as Apache Hadoop, YARN and Mesos. Assigning resource limits fairly among the pods in kubernetes becomes a challenging issue as some applications may require intensive resources such as CPU and memory that should be maximized to satisfy them. In order to do that, in this paper, we practice a novel way to assign resource limits fairly among the pods in the Kubernetes environment.

1.74 Key Technologies of Quantum Secure Communication

Ma Jingshuai[1], **Yu Xun**[2]

Xi'an Technological University

Quantum communication refers to the use of the special effects of quantum in quantum theory as a carrier to achieve information acquisition, coding, transmission and processing. Rely on physical quantum mechanics. It has the characteristics of large channel capacity and high security and confidentiality. In order to realize the state transmission of unknown particles, quantum entanglement theory can be utilized, and the entangled particle pairs distributed by quantum teleportation before transmission. The encoding allows only two particles to be transmitted to transfer information between the two particles. Quantum communication includes quantum key distribution, quantum teleportation, quantum secure direct communication, and quantum secret sharing. This paper briefly describes the basic principles and significance of quantum secure communication, analyzes the key technologies in quantum secure communication, and discusses the future research and development direction.

Keywords: quantum communication, quantum key distribution, quantum entangled state, teleportation, quantum security direct communication

1.75 Disturbance frequency adaptive control for photo-electric stabilized platform based on improving extended state observation

Yunhang Zhang

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Aiming at the problem of disturbance in the working process of a photoelectric stabilized platform, an improved algorithm based on improving extended state observer (ESO) technology is proposed. An extended state observer based on disturbance frequency adaptation was designed to reduce phase delay when the extended state observer observes second-order and above systems. The simulation experiment tested the disturbance rejection ability of the improved algorithm and compared it with the existing classical control method. The results show that the ESO can effectively suppress the inuence of various frequency disturbances, and its anti-interference ability is clearly improved. Finally, an experiment was performed to test the disturbance rejection performance of the ESO when the speed disturbance rejection performance was between 0.1 Hz and 2.5 Hz. The results show that the improved algorithm has high practical value for improving the anti-disturbance performance of the system.

1.76 Improved disturbance observer based control for airborne photoelectric stabilized platform

Qian Wang

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The aim of this work was to solve the problem that the stabilization accuracy of photoelectric stabilized platforms is affected by disturbance. An improved disturbance observer was established to observe the disturbance. By using the ultra-high control bandwidth of the current loop, the observer was used as the input of the current loop. The design of the improved disturbance observer consists of an inverse model of the control object and an improved filter. The high-order disturbance observer not only has good suppression ability compared to the high order disturbance model, but also has good robustness, meeting the application requirements of photoelectric stabilized platforms.

2. Digital Memories

Figure 2.1: NDES organising committee - opening

Figure 2.2: Session I

Figure 2.3: Session II

Figure 2.4: Session III

Figure 2.5: Session IV

Figure 2.6: Session V

Figure 2.7: Session VI

Figure 2.8: Flash Poster Session

Figure 2.9: Flash Poster Session

Figure 2.10: Flash Poster Session

Figure 2.11: Flash Poster Session

Figure 2.12: Flash Poster Session

Figure 2.13: Flash Poster Session

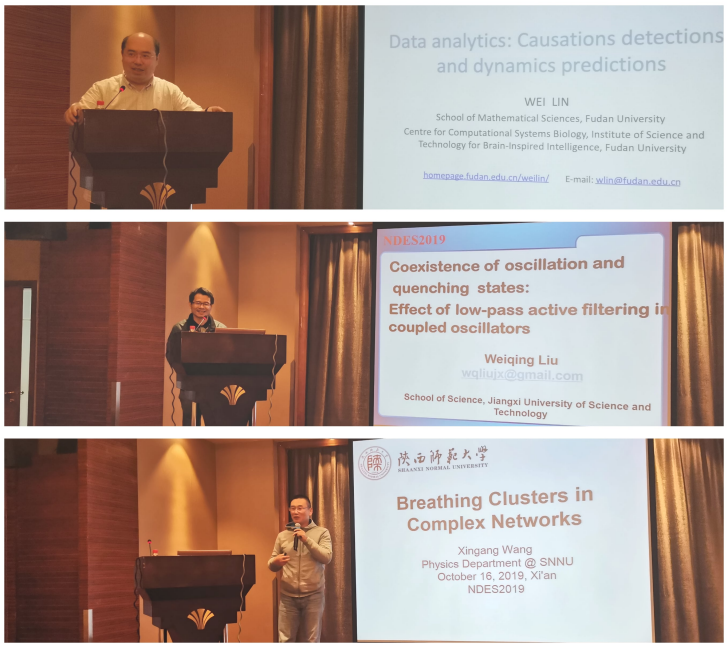

Figure 2.14: Session VII

Figure 2.15: Session VIII

Figure 2.16: Session IX

Figure 2.17: Session X

Figure 2.18: Session XI

Figure 2.19: Session XII

Figure 2.20: Best Poster Session

Figure 2.21: Final Remarks

Figure 2.22: Final Remarks