

## Morning, May 16

Time	Room/Chair			
8:00-8:30	Room A  Maoan Han	Opening Ceremony Speech by President Speech by Peter Bates Speech by Jianshe Yu		
8:30-8:40	<b>Group Photo</b>			
Time	Room/Chair	Speaker	Room/Chair	Speaker
8:40-9:20 9:20-10:00	Room A  Kening Lu	Peter Bates Chongqing Cheng	Room B  Pei Yu	Qiru Wang Xilin Fu
10:00-10:20	<b>Coffee/Tea Break</b>			
10:20-11:00 11:00-11:40 11:40-12:00	Room A  Valery Romanovskii	Pei Yu Wenxin Qin Regilene D. S. Oliveira	Room B  Yuncheng You	Michael Li Meng Fan Chuncheng Wang

## 12:00-14:00 Lunch Break

## Afternoon, May 16

Time	Room/Chair	Speaker	Room/Chair	Speaker
14:00-14:40 14:40-15:20 15:20-16:00	Room A  Hans-Otto Walther	Xiaobiao Lin Wenzhang Huang Peixuan Weng	Room B  Zhaosheng Feng	Zengji Du Xiaoying Han Qingjie Cao
16:00-16:20	<b>Coffee/Tea Break</b>			
16:20-17:00 17:00-17:40 17:40-18:00	Room A  Wenzhang Huang	Zhen Jin Xiaojie Hou Jian Fang	Room B  Xiaobiao Lin	Jianhua Shen Xinchu Fu Xu Zhang

## 18:10 Dinner

## Morning, May 17

Time	Room/Chair	Speaker	Room/Chair	Speaker
8:00-8:40 8:40-9:20 9:20-10:00	Room A  Peter Bates	Kening Lu Dongmei Xiao Huyi Hu	Room B  Jia Li	Zhaosheng Feng Wei Ding Xiaosong Yang
10:00-10:20	Coffee/Tea Break			
10:20-11:00 11:00-11:40 11:40-12:00	Room A  Huyi Hu	Yongluo Cao Wen Huang Yepeng Xing	Room B  Daoyi Xu	Yi Wang Fengjuan Chen Kanat Shakenov

**12:00-14:00 Lunch Break**

## Afternoon, May 17

Time	Room/Chair	Speaker	Room/Chair	Speaker
14:00-14:40 14:40-15:20 15:20-16:00	Room A  Huaiping Zhu	Jia Li Jifa Jiang Lin Wang	Room B  Dongmei Xiao	Valery Romanovskii Xiang Zhang Yuming Shi
16:00-16:20	Coffee/Tea Break			
16:20-17:00 17:00-17:40 17:40-18:00	Room A  Xingfu Zou	Huaiping Zhu Yun Kang Ying Su	Room B  Xiang Zhang	Yulin Zhao Dingbian Qian Simon Serovaisky

**18:10 Banquet**

## Morning, May 18

Time	Room/Chair	Speaker	Room/Chair	Speaker
8:00-8:40 8:40-9:20 9:20-10:00	Room A  Jianshe Yu	Hans-Otto Walther Xingfu Zou Junping Shi	Room B  Maoxun Tang	Daoyi Xu Ruyun Ma Xiaohua Zhao
10:00-10:20	<b>Tea Break</b>			
10:20-11:00 11:00-11:40 11:40-12:00	Room A  Junjie Wei	Jianshe Yu Moxun Tang Jinfeng Wang	Room B  Ruyun Ma	Fengxin Chen Shangjiang Guo Changjian Liu

**12:00-14:00 Lunch Break**

## Afternoon, May 18

Time	Room/Chair	Speaker	Room/Chair	Speaker
14:00-14:40 14:40-15:20 15:20-16:00	Room A  Fengxin Chen	Weinian Li Yuncheng You Shengfan Zhou	Room B  Junping Shi	Tiancheng Ouyang Weihua Jiang Weiming Wang
16:00-16:20	<b>Coffee/Tea Break</b>			
16:20-17:00 17:00-17:20 17:20-17:40	Room A  Tiancheng Ouyang	Yi Li Shiliang Wu Jianxin Liu	Room B  Michael Li	Maoan Han Indranil SenGupta Minghui Qi

**18:10 Dinner**

# Abstract of Talks

In the multiple authors case, the name with \* is the speaker.

1.

## Heirarchy of solutions to gradient elliptic systems with symmetry

Peter W. Bates

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**Abstract:** (Preliminary report) We examine the asymptotic states of symmetric solutions to  $\Delta u - \text{grad } W(u) = 0$ ,  $u : \mathbb{R}^n \rightarrow \mathbb{R}^n$  constructed by Alikakos and Fusco. Here  $W$  is equivariant under a finite reflection group and has  $n + 1$  nondegenerate minima. Passing to the limit as  $x \rightarrow \infty$  in certain direction gives lower dimensional solutions with symmetry. This is joint work with N. Alikakos.

2.

## Periodic Solutions of the Perturbed SD Oscillator

Qingjie Cao\*, Zhixin Li, Yushu Chen, Marian Wiercigroch

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**Abstract:** An oscillator with strong irrational nonlinearities, or a smooth and discontinuous (SD) oscillator was proposed and investigated by Cao *et al.* [1, 2, 3], previously, which allows one to study the transition from smooth to discontinuous dynamics depending on the value of the smoothness parameter  $\alpha$ . In this paper, we investigate the perturbed periodic motions near the hyperbolic and non-hyperbolic equilibria of SD Oscillator. Averaging technique is introduced to this strongly nonlinear system and the responses to both the external frequency and the amplitude are derived. The results presented in this paper are valid for both smooth and discontinuous regimes of the system.

## References

- [1] Q. Cao, M. Wiercigroch, E. E. Pavlovskaja, C. Grebogi, J.M.T. Thompson, Archetypal oscillator for smooth and discontinuous dynamics, *Physical Review E* 74(4), 046218, 2006.
- [2] Q. Cao, M. Wiercigroch, E. E. Pavlovskaja, C. Grebogi, J.M.T. Thompson, Piecewise linear approach to an archetypal oscillator for smooth and discontinuous dynamics, *Phi. Tran. Roy. Soc. A*, 366(1865), 635-652, 2008.
- [3] Q. Cao, M. Wiercigroch, E. E. Pavlovskaja, C. Grebogi, J.M.T. Thompson, The limit case response of the archetypal oscillator for smooth and discontinuous dynamics, *Inter. J. Non. Mech.* 43, pp. 462-473, 2008.

3.

## Dimension estimate and multifractal analysis of $C^1$ average conformal repeller

Yongluo Cao

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**Abstract:** In this talk,  $C^1$  average conformal repeller is considered. We give a direct proof of dimension formula of  $C^1$  average conformal repeller and we also consider pointwise dimension of invariant measure. Furthermore, we consider multifractal analysis of Lyapunov spectrum of asymptotically additive potential for  $C^1$  average conformal repeller.

4.

## Heteroclinic tangles in time-periodic equations

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**Abstract:** This is a study on periodically perturbed second order differential equations with dissipation. We prove that, when a heteroclinic loop is periodically perturbed, three types of heteroclinic tangles are created and they compete in the space of perturbed parameters. The three types are (a) transient heteroclinic tangles admitting no physical measures; (b) heteroclinic tangles for which the only physical measures admitted are sinks representing stable dynamical behavior; and (c) heteroclinic tangles with strange attractors admitting SRB measures representing chaos. We also prove that the organization of the three types of heteroclinic tangles depends sensitively on the ratio of the unstable eigenvalues of the saddle fixed points of the heteroclinic connections. The theory developed in this paper is explicitly applicable to the analysis of a given set of differential equations and the results obtained are well beyond the capacity of the classical Birkhoff-Melnikov-Smale method. This is a joint work with Maoan Han and Jibin Li.

5.

## Genetic Diversity and Anderson Localization

Fengxin Chen

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**Abstract:** Models for genotype diversity are analyzed. It is proved that the long time behavior of a class of genotype evolution models is governed by the principal eigenvectors

of sum of mutation and fitness matrices. It is proved that the components of principal eigenvectors are symmetric and monotonically decreasing in terms of Hamming distances. Anderson localization is compared to understand the genotype diversity.

6.

## Non-existence of KAM torus

Chong Qing Cheng

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**Abstract:** Given an integrable Hamiltonian  $h_0$  with  $n$ -degrees of freedom and a Diophantine frequency  $\omega$ , then, arbitrarily close to  $h_0$  in the  $C^r$  topology with  $r < 2n$ , there exists an analytical Hamiltonian  $h_\epsilon$  such that the Hamiltonian flow  $\Phi_{h_\epsilon}^t$  does not admit the KAM torus with rotation vector  $\omega$ . In contrast with it, KAM tori exist if perturbations are small in  $C^r$  topology with  $r > 2n$ .

7.

## Synchronization for fuzzy cellular neural networks

Wei Ding

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**Abstract:** In this letter, the synchronization schemes for delayed fuzzy cellular neural networks is considered. Based on the simple adaptive controller, a set of sufficient conditions to guarantee the synchronization are obtained. Moreover, the asymptotic behavior of the unknown parameters can be derived in the meanwhile. At last, some examples and their simulations are given to show the effectiveness of the main results.

8.

## Existence and Global Attractivity of Positive Periodic Solution to a Lotka-Volterra Model

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**Abstract:** In this paper, by using Mawhin's continuation theorem and constructing suitable Lyapunov functional, a Lotka-Volterra model with mutual interference and Holling type III functional response is studied. Some sufficient conditions are obtained for the existence, uniqueness and global attractivity of positive periodic solution of the model. Furthermore, the conditions are related to the interference constant  $m$ .

**Keywords** Global attractivity; Mawhin's construction theorem; Positive periodic solution; Lyapunov functional; Holling type III functional response.

9.

## Global asymptotic stability for predator-prey systems whose prey receives time-variation of the environment

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**Abstract:** A predator-prey model with prey receiving time-variation of the environment is considered. Such a system is shown to have a unique interior equilibrium that is globally asymptotically stable if the time-variation is bounded and weakly integrally positive. In particular, the result tells that the equilibrium point can be stabilized even by nonnegative functions that make the limiting system structurally unstable. The method that is used to obtain the result is an analysis of asymptotic behavior of the solutions of an equivalent system to the predator-prey model.

10.

## Uniqueness of traveling waves for a nonlocal lattice equation

Jian Fang

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**Abstract:** The uniqueness (up to translation) of traveling waves for a nonlocal lattice equation with time delay is obtained. Our approach is based on exact a priori asymptotics of the wave profiles. This is accomplished by establishing a structure theorem of entire solutions to a class of linear integral-differential equations. The talk is based on a joint work with Drs. Junjie Wei and Xiaoqiang Zhao.

11.

## Dynamical Analysis of Nonlinear Oscillator Systems

Zhaosheng Feng

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**Abstract:** In this talk, we are concerned with a Duffing-van der Pol nonlinear oscillator system, which includes the van der Pol oscillator and the damped Duffing oscillator etc as particular cases. We apply the bifurcation theory and the Lie symmetry method to analyze two nontrivial infinitesimal generators, and use them to construct canonical variables. Through the inverse analysis we establish some properties of nonlinear oscillator systems under the certain parametric conditions. Comparisons with the existing results by the Preme-Singer procedures are provided. Under the same parametric conditions various properties of proper solutions are presented accordingly.

12.

## Study on Impulsive Differential Systems with Applications

Xilin Fu

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**Abstract:**

13.

## Complex behavior of some singular dynamical systems

Xinchu Fu

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**Abstract:** Dynamics of discontinuous maps, even for low dimensional maps, are still important research topics in nonlinear community. This talk presents some new results with some open problems in the field, including complex dynamical behaviour of a class of singular maps, such as piecewise linear maps on the 2-torus and planar piecewise isometries, and symbolic dynamics approach to these maps. And some remarks and discussions about some open problems are also given.

14.

## Generalized Hopf Bifurcation in Functional Differential Equations

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**Abstract:** Here we employ the Lyapunov-Schmidt procedure to investigate bifurcations in a general delay differential equation (DDE) when the infinitesimal generator has, for a critical value of the parameter, a pair of non-semisimple purely imaginary eigenvalues with multiplicity  $k$ . We derive criteria, explicitly in terms of the system's parameter values, for the existence of two branches of bifurcating periodic solutions and for the description of the bifurcation direction of these branches. The general result is illustrated by a detailed case study of the van der Pol oscillator.

15.

## Small-amplitude limit cycles of polynomial Liénard systems

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**Abstract:** In this paper we study the number of limit cycles appeared in Hopf bifurcations of a Lienard system with multiple parameters. As an application to the polynomial Lienard system

$$\dot{x} = y, \quad \dot{y} = -\bar{g}_k(x) - \varepsilon g_m(x) - \varepsilon f_n(x)y,$$

where  $\varepsilon$  is small,  $g_m$ ,  $f_n$  and  $\bar{g}_k$  are polynomials of degrees  $m$ ,  $n$  and  $k$  respectively, and  $\bar{g}_k$  satisfies  $\bar{g}_k(0) = 0$  and  $\bar{g}'_k(0) > 0$ , we obtain

$$\widehat{H}_{n,m}^{(1)} \geq \lceil \frac{n+m-1}{2} \rceil, \quad \widehat{H}_{n,m}^{(2)} \geq \max\{\lceil \frac{m-2}{3} \rceil + \lceil \frac{2n+1}{3} \rceil, \lceil \frac{n-2}{3} \rceil + \lceil \frac{2m+1}{3} \rceil\},$$

where  $\widehat{H}_{n,m}^{(k)}$  denotes the maximal number of limit cycles near the origin of the system for all possible  $f_n$  and  $g_m$ .

**Keywords:** Limit cycle, Lienard system, Hopf bifurcation.

16.

## Random attractors for stochastic lattice dynamical systems in weighted spaces

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**Abstract:** We first provide some sufficient conditions for the existence of global compact random attractors for general random dynamical systems in weighted space  $l^p_\rho$  ( $p \geq 1$ ) of infinite sequences. We then consider the existence of global compact random attractors in weighted space  $l^2_\rho$  for stochastic lattice dynamical systems with random coupled coefficients and multiplicative/additive white noise. The results recover many existing ones on the existence of global random attractors for stochastic lattice dynamical systems with multiplicative/additive white noises in regular  $l^2$  space of infinite sequences.

17.

## Traveling waves and their stability in a coupled reaction diffusion system

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**Abstract:** We study the traveling wave solutions to a reaction diffusion system modeling the public goods game with altruistic behaviors. The existence of the waves is derived through monotone iteration of a pair of classical upper- and lower solutions. The waves are shown to be unique and strictly monotonic. A similar KPP wave like asymptotic behaviors are obtained by comparison principle and exponential dichotomy. The stability of the traveling waves with non-critical speed is investigated by spectral analysis in the weighted Banach spaces. (Joint work with W. Feng).

18.

## Coexistence of zero and nonzero Lyapunov exponents

Huyi Hu

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**Abstract:** We show that there exists a smooth volume preserving topologically transitive diffeomorphism of a compact smooth Riemannian manifold which is ergodic and has nonzero Lyapunov exponents on an open and dense subset of not full measure and has zero Lyapunov exponent on the complement. This confirms “essential” coexistence of “completely” chaotic and “absolutely” non-chaotic behavior in the class of smooth volume preserving systems.

19.

## Stable sets in $\mathbb{Z}^n$ -systems with positive entropy

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**Abstract:** In this talk, the chaoticity appearing in the  $\mathbb{Z}_+^n$ -stable sets of a  $\mathbb{Z}^N$ -dynamical system with positive entropy is investigated. It is shown that in any positive entropy  $\mathbb{Z}^n$ -system, there is a measure-theoretically “rather big” set such that the  $\mathbb{Z}^n$ -stable set of any point from the set contains a Mycielski Li-Yorke chaotic set under  $\mathbb{Z}_-^n$ .

20.

## Traveling Wave Solutions for a Class of Predator-Prey Systems

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**Abstract:** We develop a shooting method to show the existence of traveling wave solutions with an explicit expression of minimum wave speed for a class of predator-prey systems, including systems with traditional Holling types of functional responses. Our approach is a significant improvement of techniques introduced by Dunbar. The advantage of our method is that it does not require the construction of a corresponding, complicated Wazewski's set, which was one of major steps in Dunbar's approach. Our method is more efficient to study the existence of traveling wave solutions for general predator-prey systems.

21.

## Double Hopf bifurcation and chaos in Liu system via delayed feedback

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**Abstract:** In this paper, we consider the stability of equilibria, Hopf and double Hopf bifurcation in Liu system with delay feedback. Firstly, we identify the critical values for stability switches and Hopf bifurcation using the method of bifurcation analysis. When we choose appropriate feedback strength and delay, not only two symmetrical nontrivial equilibria of Liu system can be controlled to be stable at the same time, but also the stable bifurcating periodic solutions occur in the neighborhood of the two equilibria at the same time. Secondly, by applying the normal form method and center manifold theory, the normal form near the double Hopf bifurcation, as well as classifications of local dynamics are analyzed. Furthermore, we give the bifurcation diagram to illustrate numerically that a family of stable periodic solutions bifurcated from Hopf bifurcation occur in a large region of delay and the Liu system with delay can appear the phenomenon of "chaos switchover".

22.

## Convergence on Cooperative Cascade Systems with Length One

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**Abstract:** It has been proved by Sontag et al that any coherent system is dynamically equivalent to a cascade system which is quasicooperative and over a cooperative system. The convergence for solutions of such a cascade system is open so far, even a cascade system is cooperative, such a question is still unclear. As a beginning step, this paper investigates generic convergence for solutions of cooperative cascade systems. Fixing a solution of a base system converging to an equilibrium, we shall investigate nonordering of limit sets, limit set dichotomy for the solutions of the cascade system. Combining these tools with limiting equation idea, sequential limit set trichotomy and therefore quasiconvergence in generic meaning are proved. The generic convergent result is then obtained by improving limit set dichotomy.

23.

## Global stability of sexually transmitted disease spreading in heterosexual and homosexual populations

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**Abstract:** Global behavior about epidemic models with high dimensions, especially global asymptotical stability of the endemic equilibrium, is a very challenging problem. In the paper, we study an SIS model on sexual contact networks, in which the spreading of sexually transmitted diseases on heterosexual and homosexual contact networks is considered. We analytically prove the existence of the disease-free equilibrium and the endemic equilibrium, and we investigate their global asymptotical stability. Numerical simulations confirm the validity of the theoretical results.

24.

## Relative Permanence of Biological Systems

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**Abstract:** We start with the global dynamics of a discrete two-species Lottery-Ricker competition model. We give sufficient conditions on the persistence of one species and the existence of local asymptotically stable interior period-2 orbit for this system. More importantly, we show that for a certain parameter range, there exists a compact interior attractor that attracts all interior points except a Lebesgue measure zero set. This result gives a weaker form of coexistence which is referred to as relative permanence. This new concept of coexistence combined with numerical simulations strongly suggests that the basin of attraction of the locally asymptotically stable interior period-2 orbit is an infinite union of connected components. Our result may apply to many other ecological models including prey-predator models. Finally, we discuss the generic dynamical structure that gives relative permanence.

25.

## Discrete-Time Models for the Transmission of Mosquito-Borne Diseases and Their Dynamics

Jia Li

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**Abstract:** We formulate simple discrete-time SEIR (susceptible-exposed-infective-recovered) epidemic models for the transmission of mosquito-borne diseases, based on different time-steps and different selections of model dynamics in the absence of infection. Fundamental investigations for the dynamics of these models, such as the derivation of a formula for the reproductive number and the determination of existence of an endemic equilibrium, and numerical simulations to demonstrate the model dynamics are presented. The modeling and further research are also discussed.

26.

## Dynamical systems on networks

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**Abstract:** Many complex and interconnected systems of differential equations can be formulated as coupled systems defined on a network. The network will be given by a weighted and directed graph. A simple system is given at each vertex, and directed edges and their weights indicate interconnections among vertex systems. In this talk, we will focus on the control aspects of these systems on networks. We will show how results from graph theory can help us to systematically construct global Lyapunov functions for various control purposes. We present an application in the control of complex disease dynamics and another on flight formation problem.

27.

## Some integral inequalities useful in the theory of certain partial dynamic equations on time scales

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**Abstract:** Our aim in this paper is to investigate some integral inequalities in two independent variables on time scales, which unify and extend some integral inequalities and their corresponding discrete analogues. The inequalities given here can be used as handy tools to study the properties of certain partial dynamic equations on time scales.

28.

## Structure of Positive Solutions for the Generalized Lane-Emden-Fowler Problem and Their Stability

Yi Li

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**Abstract:** This talk is contributed to the Cauchy problem

$$(1) \quad \begin{cases} \frac{\partial u}{\partial t} = \Delta u + K(|x|)u^p + \mu f(|x|) & \text{in } \mathbb{R}^n \times (0, T), \\ u(x, 0) = \varphi(x) & \text{in } \mathbb{R}^n. \end{cases}$$

The monotonicity/separation property and stability of the positive radial steady states, which are positive solutions of

$$(2) \quad \Delta u + K(|x|)u^p + \mu f(|x|) = 0,$$

are discussed,  $\mu$  is some positive constant,  $0 \leq f \in C^1(\mathbb{R}^n \setminus \{0\})$ ,  $K(x)$  is a given local Hölder continuous function in  $\mathbb{R}^n \setminus \{0\}$ , and  $\varphi$  is a bounded non-negative continuous function in  $\mathbb{R}^n$ . (For most parts we will for simplicity concentrate on  $\frac{\partial u}{\partial t} = \Delta u + u^p$ .) Joint work with Yinbin Deng, Huazhong Normal University, Wuhan, China; Baishun Lai, Henan University, Kaifeng, China; Yi Liu, University of Rochester, Rochester, US; Fen Yang, Huazhong Normal University, Wuhan, China.

29.

## KPP type internal layer solutions in a bounded domain

– Can Sattinger’s weighted norms be used to prove the stability?

Xiao-Biao Lin

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**Abstract:** This talk is motivated by an ongoing work with Haitao Fan on phase transition waves in a nozzle. The singularly perturbed system consists of a KPP type reaction-diffusion equation that models the liquid-vapor phase transition coupled with a viscous p-system that models the fluid flow along the nozzle. In an unbounded domain, the stability of the KPP waves is usually treated by weighted norms introduced by Sattinger (1976). However, in a bounded domain, it is not possible to directly impose weights for the KPP type waves.

In this talk we study the boundary conditions for the well-posedness and stability of the KPP waves with convection. We show that the boundary conditions at both ends of the domain may be used to select the “correct weight” for the internal layer and Sattinger’s result can still be useful in proving the stability of internal layer solutions.

30.

## The polynomial estimate of zeros of a class of hyper-elliptic integrals

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**Abstract:** We consider the number of zeros of Abel integrals  $I(h) = \sum_{k=0}^{n-2} p_k(h)I_k(h)$  in  $(-1, 1)$ , where  $p_k(h)$  are the polynomials of degree no more than  $[\frac{n-1}{2} - \frac{k}{n+1}]$ ,  $I_k(h) = \int_{\Gamma_h} x^k y dx$ ,  $0 \leq k \leq n-1$ . Here  $\Gamma_h$  are the ovals defined by  $\{(x, y) | \frac{y^2}{2} + T_n(x) = h\}$ , where  $T_n(x)$ , which satisfies  $T_n(\cos \theta) = \cos n\theta$ , is the  $n$ th Chebyshev polynomial of the first kind.

Denote  $J(h) = (I_0(h), \dots, I_{n-1}(h))^T$ , it is well known that  $J(h)$  satisfies a Picard-Fuchs equation  $J(h) = P(h)J'(h)$ . If  $n$  is odd, then by using the theory of algebraic curve, we prove that after a linear transformation  $\tilde{J}(h) = AJ(h)$ ,  $\tilde{J}(h)$  will satisfy another Picard-Fuchs equation  $\tilde{J}(h) = \tilde{P}(h)\tilde{J}'(h)$ , where  $\tilde{P}(h)$  has the form

$$\tilde{P}(h) = \left\{ \begin{array}{ccc} P_0(h) & & \\ & \cdots & \\ & & P_{\frac{n-1}{2}}(h) \end{array} \right\}.$$

For each  $k \in [1, \frac{n-1}{2}]$ ,  $P_k(h)$  is a matrix of  $2 \times 2$ . Furthermore, by using the argument principle, we show that  $I(h)$  has at most  $cn^2$  zeros, where  $c$  is a constant independent of  $n$ .

31.

## On Hopf Bifurcation of Reaction-Diffusion Equations with Time Delays

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**Abstract:** A method of computing the coefficients of normal forms for a kind of partial functional differential equations near the equilibrium is presented. Some hypotheses are weaker than early papers. The analysis is based on the existence of center manifolds. An algorithm for determining the direction and stability of Hopf bifurcation to a predator-prey model with diffusion and a delay is derived. This is joint work with Prof. Junjie Wei.

32.

## Chaos in differential equations driven by a Brownian motion

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**Abstract:** In this paper, we investigate the chaotic behavior of ordinary differential equations with a homoclinic orbit to a saddle fixed point under an unbounded random forcing driven by a Brownian motion. We prove that, for almost all sample paths of the Brownian motion in the classical Wiener space, the forced equation admits a topological horseshoe of infinitely many branches. This result is then applied to the randomly forced Duffing equation and the pendulum equation.

33.

## Bifurcation of positive solutions of nonlinear second order PBVPs

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**Abstract:** I. Existence of periodic solutions of the second-order equation

$$x'' = f(t, x),$$

where  $f$  is a Carathéodory function. Main tools: a new expression of Green's function and Dancer's global bifurcation theorem. Our main results are sharp and improve the main results by Torres [Journal of Differential Equations, 190(2), 2003].

II. Global structure of the positive solutions of periodic boundary value problem

$$u''(t) + q(t)u(t) = \lambda a(t)f(u(t)), \quad u(0) = u(2\pi), \quad u'(0) = u'(2\pi),$$

where  $q \in C(\mathbb{R}, [0, \infty))$  is of periodic  $2\pi$  and  $q(t) \not\equiv 0$ ,  $t \in [0, 2\pi]$ ;  $a \in C(\mathbb{R}, \mathbb{R})$  is of periodic  $2\pi$  and changes sign. The main tool is global bifurcation theorem.

III. Existence of  $T$ -periodic solutions of differential equation

$$x'' + g(x') + \mu(x)\operatorname{sgn} x' + f(x) = \varphi(t)$$

with  $T$ -periodic right-hand side, which models e.g. a mechanical system with one degree of freedom subjected to dry friction and periodic external force.

34.

## On structural stability of quasi-homogeneous vector fields in the plane

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**Abstract:** Let  $H_{pqm}$  be the space of planar  $(p, q)$ -quasi-homogeneous polynomial vector fields of weight degree  $m$  endowed with the coefficient topology. In this talk we characterize the set  $\Omega_{pqm}$  of the vector fields of  $H_{pqm}$  that are structurally stable with respect to perturbations in  $H_{pqm}$ . We apply it to give an extension of Hartman-Grobmann Theorem for a kind of planar vector fields. This is a joint work with Yulin Zhao (Sun Yat-sen University).

35.

## Periodic Orbits of N-body Problem of Celestial Mechanics

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**Abstract:** N-body problem of celestial mechanics study the motion of  $n$  point masses in Euclidean spaces under the Newton's law of gravitation. It is perhaps the most famous and old of all problems in dynamical systems.

The motion of  $N$  point bodies with positive masses  $m_1, m_2, \dots, m_N$  located at positions  $x_1, x_2, \dots, x_N \in \mathbb{R}^3$  is governed by the system of second-order nonlinear vector differential equations

$$m_i \ddot{x}_i = \sum_{1 \leq i < j \leq N} G \frac{m_i m_j (x_j - x_i)}{\|x_i - x_j\|^3},$$

where the derivative is with respect to the time variable  $t$ , and  $G$  is the universal gravitational constant.

Quote from C. L. Siegel and J. K. Moser's Lectures on Celestial Mechanics:

"The N-body problem consists of describing the complete behavior of all solutions to these equations of motion for arbitrary preassigned initial conditions. Despite efforts by outstanding mathematicians for over 200 years, the problem for  $n > 2$  remains unsolved to this day."

In this talk we will introduce our new methods of variational approach combining numerical simulation for N-body problem. By using these methods we construct a series of new periodic orbits of three-body problems in  $\mathbb{R}^3$  and study their stability.

36.

## Dynamics in Multi-component Bose-Einstein Condensates via Topology and Averaging Methods

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**Abstract:** In this talk, we investigate the existence, stability and numerical analysis of the periodic and quasi-periodic modulation amplitude waves and dynamic behaviors in multi-component Bose-Einstein condensates with periodic or quasi-periodic potentials by using a new topological fixed points theorem, a KAM invariant tori theorem for higher-dimensional twist Symplectic mappings and some averaging methods for systems with singularities, respectively.

37.

## The number of zeros of Abelian integral of symmetric system of degree 5 under some perturbations of degree $n$

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**Abstract:** In this paper, we will give the upper bound of the number of isolated zeros of  $I(h)$  for symmetric polynomial system of degree 5 under some polynomial perturbations of degree  $n$ .

38.

## Ghost circles in the periodically forced Frenkel-Kontorova model

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**Abstract:** Assume that the Frenkel-Kontorova model is driven by a  $T$ -periodic force. Then we show that the Poincare map has an invariant ghost circle provided the interaction potential is convex. Meanwhile, via the existence of ghost circle we show for each mean spacing, rational or irrational, that the average velocity exists independently of initial values. Furthermore, we discuss the depinning force under which the system admits periodic solutions and above which, the system has sliding states.

## Invariants and cyclicity of polynomial systems of ODE

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**Abstract:** Consider a two-dimensional system of ODE's

$$(3) \quad \frac{dx}{dt} = P(x, y), \quad \frac{dy}{dt} = Q(x, y),$$

and suppose that the coefficients of the polynomials are parameters. In the case when the origin of the system is a non-degenerate center or focus, a limit cycle bifurcates from the origin, when the linearized system changes its stability. This is the well-known Andronov-Hopf bifurcation. The limit cycle bifurcations which depend on nonlinear terms of such system (sometimes such bifurcations are called degenerate Andronov-Hopf bifurcations) are much less investigated, but there is an approach to their study suggested by N.N. Bautin. Bautin also introduced the notion of cyclicity, which nowadays plays an important role in the theory of bifurcations. By the definition, the cyclicity of an elementary focus or center of a polynomial system of ODEs is the maximum number of limit cycles that can be made to bifurcate from the singularity under small perturbation of parameters of the system (the problem of cyclicity of polynomial systems is often called the local 16th Hilbert problem).

We present an algorithmic approach to investigate the cyclicity problem for polynomial systems. The main steps of the approach are as follows. We complexify the system and let  $B$  denote the Bautin ideal of the system, that is, the ideal generated by the focus quantities (polynomials whose vanishing characterizes a center at the origin). Suppose  $B_K$  is the ideal generated by the first  $K$  focus quantities and generates the same variety as  $B$ . If the ideal  $B_K$  is radical then the cyclicity is bounded above by  $K$ .

If it is not radical we show that sometimes it is possible to map the focus quantities to a polynomial subalgebra in which a non-radical  $B_K$  can become radical. Namely, since the coefficients of  $P$  and  $Q$  are parameters, the action of the group  $SL(2, \mathbb{C})$  (or  $SL(2, \mathbb{R})$ ) on  $(x, y)$  induces a transformation of the coefficients of (3). These transformations also form a group which we denote by  $U$ . In the talk we describe an efficient algorithm to compute a generating set of these invariants. We then show that for some systems the Bautin ideal is a radical ideal in the subalgebra and use this observation to obtain an upper bound for cyclicity of a center or focus of these systems. Most of calculations are performing using algorithms of computational commutative algebra based on the Groebner basis theory.

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40.

## Solutions to integro-differential parabolic problems arising in the Lévy Market

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**Abstract:** We study an integro-differential parabolic problem modeling a process with jumps arising in financial mathematics. Under suitable conditions, we prove the existence of strong solutions to a more general integro-differential equation by using the Schaefer's fixed point theorem and generalize the result to unbounded domains. We also introduce a few models for financial option pricing, including stochastic volatility and the case in which the asset price is modeled by an exponential Lévy model. We then extend these models to more general parabolic problems, and then we obtain existence and uniqueness results by applying various iterative methods.

41.

## Optimal control problem for the nonlinear parabolic equation without convexity of the admissible control set

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**Abstract:** An abstract optimization problem is considered. The corresponding admissible control set is not convex. The convex regularization method is proposed for the resolution of the given problem. The corresponding admissible control set is convex. The convergence of the regularization method is proved. The approximate solution of the initial optimization problem can be chosen as a solution of the regularization problem with a small enough regularization parameter. The approximate optimization problem is solved with using of standard methods. Particularly the necessary conditions of optimality in the form of variational inequality are obtained.

The optimal control problem for a nonlinear parabolic equation with an integral cost functional is considered as an example. The control includes to the right side of the equation. The admissible control set is not convex. The approximate value of the optimal control can be found with using of the variational inequality for the approximate optimization problem.

42.

## The solution of coefficient inverse problem of atmospheric optics

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**Abstract:** Coefficient (parametric) inverse problem of full section determining is considered. By means of well-known theory of solution of coefficient inverse problem we have an inconsistent system in order to determine full section in the atmospheric layer. Different integral characteristics of transport process can be expressed as linear functionals of the transport equation's solutions. The derivative of solution functionals (radiation intensity) in the atmospheric layer is estimated by method of dependent tests of the Monte Carlo methods. In the same way other parameters of the atmospheric optics could be estimated: an optical depth, an absorption section, a section of aerosol scattering, a section of molecular scattering and albedo.

43.

## Harmonic and Sub-harmonic Solutions to Impulsive Duffing Equations via Poincaré-Birkhoff Theorem

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**Abstract:** Impulsive perturbation behaviors exist widely in many dynamical systems in which their states are changed abruptly at certain instants during the evolution process. The mathematical description of these phenomena leads to impulsive differential equations. In this paper, by using a generalized form of the well-known Poincaré-Birkhoff fixed point theorem, we demonstrate that the impulsive Duffing equation with forced nonlinear term has an infinity of  $2\pi$ -periodic solutions under Lipschitzian condition even in a contact resonance case.

Key words and phrases. Poincaré-Birkhoff theorem; impulsive Duffing equation; periodic solutions; Lipschitzian condition; contact resonance

44.

## Global stability of equilibrium in reaction-diffusion models with delay

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**Abstract:** For a time-evolution system, an equilibrium is a solution which does not depend on the time. The local stability of an equilibrium can be determined from linearization analysis, but the global stability is usually hard to determine. We will analyze the global stability of constant equilibrium in several well-known reaction-diffusion models with delay in the studies of spatial-temporal pattern formation: Rosenzweig-MacArthur predator-prey model, Leslie-Gower predator-prey model and Gierer-Meinhardt morphogenesis model. We show that global stability can be achieved in some cases despite the delay effect, but in other cases, a large delay will destabilize the equilibrium. Joint work with Shanshan Chen, Ying Su and Junjie Wei of Harbin Institute of Technology will be reported.

45.

## Structural stability of maps with coupled-expansion and snap-back repellers

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**Abstract:**

The chaos theory for discrete dynamical systems has been greatly developed since Li and Yorke introduced the concept “chaos” and showed that period 3 implies chaos in 1975. In particular, many good results for continuous interval maps have been obtained. Some important progresses were made for higher-dimensional systems in recent years. In 1978, Morotto introduced the concept of snap-back repeller and showed that a snap-back repeller implies Li-Yorke chaos for a continuously differentiable map in  $\mathbf{R}^n$ . This result has been extensively applied to determination of chaos in higher-dimensional discrete systems. Another important type of chaotic maps was observed. It is called a turbulent or horseshoe map or coupled-expanding map. By properties of coupled-expanding maps, it has been shown that a snap-back repeller defined in the Morotto paper implies Li-Yorke chaos as well as Devaney chaos.

In the real world, a system is often influenced by various factors. Is a chaotic system still chaotic under small perturbation? Further, one should ask whether it is structurally stable? In this talk, we will discuss these two problems for coupled-expanding maps. Similar results about maps with snap-back repellers are derived as a consequence.

46.

## Periodicity and synchronization in blood-stage malaria infection

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**Abstract:** Malaria fever is highly periodic and is associated with the parasite replication cycles in red blood cells. The existence of periodicity in malaria infection demonstrates that parasite replication in different red blood cells is synchronized. In our research, we provided a rigorous mathematical analysis for an age-structured human malaria model of infected red blood cells, and obtained the existence of Hopf bifurcations, which indicate synchronization with regular periodic oscillations (of period 48 hours) occurs when the replication rate increases. The talk is based on a joint work with Drs. Shigui Ruan and Junjie Wei.

47.

## Modulation of gene transcription noise by signal transduction pathways

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**Abstract:** Each of us is made of 50 to 75 trillion cells. The cells in our hearts are apparently different from the cells in our eyes, but yet they contain the same set of approximately 23,000 protein-coding genes. Gene transcription is a central cellular process that determines if, when, and to what extent, genes will be expressed, and ultimately defines the cell's identity. Given the magnificent precision of our body plan, it is intriguing to know that gene transcription is a stochastic process. It remains largely unknown how cells balance their functional fidelity and the transcription noise. We approach this question through mathematical modeling that combines differential equations and methods in renewal theory. Our analysis predicted several mechanisms by which genes could stay away from abnormally noisy transcription while living with multiple cross-talking signal transduction pathways. The most efficient mechanism is to maintain a relatively long elongation duration by transcription pausing, interrupting, or backtracking. Alternatively, high noise strength is prevented if all the signaling pathways activate transcription strongly. If one pathway activates transcription much weakly than others, then low noise is ensured if the cells shut down this noise-making pathway, or, to our big surprise, use it even more frequently.

48.

## On the linearization problem for neutral equations with state-dependent delays

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**Abstract:** Neutral functional differential equations of the form

$$x'(t) = g(\partial x_t, x_t)$$

define continuous semiflows  $G$  on closed subsets in manifolds of  $C^2$ -functions, under hypotheses designed for the application to equations with state-dependent delay. Differentiability of the solution operators  $G(t, \cdot)$  in the usual sense is not available, but for a certain variational equation along flowlines the initial value is well-posed. Using this variational equation we prove a principle of linearized stability which covers the prototype

$$x'(t) = A(x'(t + d(x(t)))) + f(x(t + r(x(t))))$$

with nonlinear real functions  $A$ ,  $d < 0$ ,  $f$ ,  $r \leq 0$ . Special cases of the latter describe the interaction of two kinds of behaviour, namely, following a trend versus negative feedback with respect to a stationary state.

**Key words:** Functional differential equation, neutral, state-dependent delay, stability

49.

## A mutualist system: birds and mistletoes

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**Abstract:** In this work, a mutualist model with chemotaxis which describes the spatial spread of mistletoes and birds is studied. The dynamical behaviors of the system with or without spatial structure are investigated. The results reveal the nonhomogeneous distributions of mistletoes and birds in practice. Numerical simulations are also carried out to support theoretical analysis in the case of one and two dimensional spatial variables. This is joint work with professor Junping Shi and professor Rongsong Liu.

50.

## Dynamics and pattern formation in a diffusive predator-prey system with strong Allee effect in prey

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and

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**Abstract:** The dynamics of a reaction-diffusion predator-prey system with strong Allee effect in the prey population is considered. Nonexistence of non-constant positive steady state solutions are shown to identify the ranges of parameters of spatial pattern formation. Bifurcations of spatially homogeneous and nonhomogeneous periodic solutions as well as non-constant steady state solutions are studied. These results show that the impact of the Allee effect essentially increases the system spatiotemporal complexity. This is joint work with professor Junping Shi and professor Junjie Wei.

51.

## Oscillations in Heterogeneous Disease Models

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**Abstract:** To study the impact of heterogeneity on the spread of infectious diseases, two models (one considers movements between two patches and the other considers mixing among different groups) are proposed and studied. Oscillations are shown to be possible in both models. Specifically, for the two-patch SIRS model with travel, it is shown that 1) travel can reduce oscillations in both patches; 2) travel may enhance oscillations in both patches; 3) travel can also switch oscillations from one patch to another. For the group mixing model, the basic reproduction number  $R_0$  is identified. It is shown that if  $R_0 < 1$ , then the disease dies out in the sense that the disease free equilibrium is globally asymptotically stable; whereas if  $R_0 > 1$ , this equilibrium becomes unstable. In this latter case, depending on the distribution functions and the group mixing strengths, the disease either persists at a constant endemic level or exhibits sustained oscillatory behavior.

52.

## Existence of nonoscillatory solutions to second-order nonlinear neutral dynamic equations on time scales

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**Abstract:** In this talk, we present a classification scheme of the eventually positive solutions to certain second-order nonlinear neutral dynamic equations on time scales and establish the existence criteria for each type of eventually positive solutions by employing Kratoselskii's fixed point theorem.

53.

## Complex dynamics of a diffusive epidemic model

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**Abstract:** In this talk, we investigate the complex dynamics of a reaction-diffusion  $SI$  model incorporating demographic and epidemiological processes with zero-flux boundary conditions. The value of this study lies in three aspects. First, it presents global stability of the equilibria and the analysis of Turing bifurcation, which determines the Turing space in the spatial domain. Second, it illustrates five categories of Turing patterns (e.g., holes, holes-stripes, stripes, spots-stripes and spots) close to the onset Turing bifurcation via numerical simulations, from which one can be sure of the parametric range for epidemic outbreak or safety in the spatial domain. Third, it shows the relations between the Turing patterns and diffusion with diseases spreading, which may be a new answer to the question "Which is better, isolation from the infectious or not?" That is, isolation is better.

54.

## Asymptotic Behavior of Comparable Nonmonotone Skew-Product Semiflows with Applications

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**Abstract:** The (almost) 1-cover lifting property of omega-limit sets is established for nonmonotone skew-product semiflows, which are comparable to uniformly stable eventually strongly monotone skew-product semiflows. These results are then applied to study the asymptotic behavior of solutions to the nonmonotone comparable systems of ODEs, reaction-diffusion systems, differential systems with time delays and semilinear parabolic equations. This is a joint work with F. Cao and M. Gyllenberg.

## Survey on Progress for Spreading Speed and Traveling Wave Solutions of Lattice Differential Systems

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**Abstract:** The asymptotic patterns including the asymptotic speed of propagation (spreading speed) and the existence of traveling solutions is a very important topic in the study of nonlinear lattice differential systems. Because of their strong backgrounds in applicable sciences such as physics, Cellular Neural Networks and epidemics etc, and the interesting and challenging mathematical problems appearing in the study, they have been paid more and more attentions by the mathematicians and physicists. During the past thirty years, especially in the recent ten years, there are a great deal of excellent research results have been published on these two topics, and the theory has got developed. In this article, we present a short survey on the recent progress and development towards modeling, new results on the analysis of long-term behaviors about asymptotic speed of propagation, minimal wave speed and traveling wave solutions of some types of nonlinear lattice differential systems. We try to reveal the relative background, the idea, the developing clue and the researching techniques in order to motive the future research.

## Fronts propagation in monostable discrete reaction-diffusion equations with delay on higher-dimensional lattices

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**Abstract:** This talk is concerned with the traveling wave fronts for a class of spatially discrete delayed reaction-diffusion equations on higher-dimensional lattices. Under the monostable assumptions, we show that, for any fixed direction of propagation  $\sigma$ , there exists a unique minimal wave speed  $c_*(\sigma) > 0$  such that a traveling wave front exists if and only if its speed is above this minimal speed. The exact asymptotic behavior of the wave profiles as  $\xi \rightarrow \pm\infty$  is then established. Furthermore, we show that (i) for  $c \geq c_*(\sigma)$  any traveling wave front with direction  $\sigma$  and speed  $c$  is strictly monotone and unique up to a translation, and (ii) for  $c > c_*(\sigma)$ , the traveling wave front is globally asymptotically stable with phase shift and circumnutation. Of particular interest is the effects of the delay, spatial dimension and direction of wave on the minimal wave speed, and we obtain some interesting phenomenon for the delayed lattice dynamical system which are different from the case when the spatial variable is continuous.

57.

## Boundary Value Problem of Vector Integro-differential Equations

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**Abstract:** We develop a method to study the existence result for BVP of Vector Integro-differential Equations. With this method we discuss the periodic boundary value problem and the anti-periodic boundary value problem.

58.

## Limit cycles in small perturbations of some hyperelliptic Hamiltonian systems

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**Abstract:** In this talk, we will introduce some studies on small perturbations of Hamiltonian vector field with three hyper-elliptic Hamiltonian of degree five, which are Liénard systems of the form  $x' = y$ ,  $y' = Q_1(x) + \varepsilon y Q_2(x)$  with  $Q_1$  and  $Q_2$  polynomials. It is shown that the maximum number of isolated zeros (multiplicity taken into account) for the related Abelian integrals are the same to the degree of  $Q_2(x)$  for a few classes of systems. And the number of limit cycles of the systems is discussed in the plane for sufficiently small parameter  $\varepsilon$ .

**Keywords:** Hyper-elliptic Hamiltonian systems, Abelian integrals, limit cycles

59.

## Further results on Existence-uniqueness and continuation theorems for stochastic functional differential equations

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**Abstract:** The aim of this talk is to develop some basic theories of stochastic functional differential equations (SFDEs) under the local Lipschitz condition in continuous functions space  $C$ . Firstly, we establish a global existence-uniqueness theorem for the SFDEs under the global Lipschitz condition in  $C$  without the linear growth condition. Then, the non-continuable solution of SFDEs is given under the local Lipschitz condition in  $C$  by establishing the local existence-uniqueness and continuation theorem. Finally, we shows that all global existence-uniqueness results obtained by Xu, Yang and Huang [D. Xu, Z. Yang, Y. Huang, Existence-uniqueness and continuation theorems for stochastic functional differential

equations, J. Differential Equations 45(2008) 1681-1703] still hold under the local Lipschitz condition in  $C$ . Our new theorems give better results while conditions imposed are much weaker than some exiting results. For example, we need only the local Lipschitz condition in  $C$  but neither the linear growth condition nor the continuous condition on the time  $t$ .

60.

## Hyperbolicity and controllability of smooth dynamical systems

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**Abstract:** Hyperbolicity is a fundamental property that makes a dynamical system display complex dynamics such as chaos. Controllability is also another fundamental property that means a control system can exhibit a desired behavior as long as an external input is properly designed. It appears that hyperbolicity would make controllability difficult or even impossible. In this talk I will show that, the controllability can take advantage of hyperbolicity, thus revealing a connection between hyperbolicity and controllability.

61.

## Global Dynamics of the Oregonator System

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**Abstract:** In this work the existence and properties of a global attractor for the solution semiflow of the Oregonator system are proved. The Oregonator system is the mathematical model of the famous Belousov-Zhabotinskii reaction. A rescaling and grouping estimation method is developed to show the absorbing property and the asymptotic compactness of the solution trajectories of this three-variable reaction-diffusion system with quadratic non-linearity from the autocatalytic kinetics. The existence of an exponential attractor for this Oregonator semiflow is also shown. Applications and extensions of the results to biological dynamical systems will be commented.

62.

### A note on periodic solutions for the delay differential equation

$$x'(t) = -f(x(t-1))$$

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**Abstract:** Consider the delay differential equation  $x'(t) = -f(x(t-1))$ , where  $f \in C(\mathbb{R}; \mathbb{R})$  is odd and satisfies  $xf(x) > 0$  for  $x \neq 0$ . When  $\alpha = \lim_{x \rightarrow 0} f(x)/x$  and  $\beta = \lim_{x \rightarrow \infty} f(x)/x$  exist, there is at least one Kaplan-Yorke periodic solution with period 4 if  $\min\{\alpha, \beta\} < \pi/2 < \max\{\alpha, \beta\}$ . When this condition is not satisfied, we present several sufficient conditions on the existence/nonexistence of such periodic solutions. It is worthy to mention that some results are on the existence of at least two Kaplan-Yorke periodic solutions with period 4 and in some cases we don't require the limits  $\alpha$  and/or  $\beta$  exist. Hence our results not only greatly improve but also complement existing ones. Moreover, some of the theoretical results are illustrated with examples.

63.

### Bifurcation Analysis on an HIV-1 Model with Constant Injection of Recombinants

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**Abstract:** This work is a continuation of our previous work on an HIV-1 therapy model of fighting a virus with another virus. We propose a modification of the model by adding a constant  $\eta$  to the recombinant virus equation, which accounts for the treatment of constant injection of recombinants. We study the dynamics of the new model and find that  $\eta$  plays an important role in the therapy. It is shown that a series of bifurcations leads to Hopf bifurcation. Our results indicate that appropriate injection rate can help eliminate the HIV virus by choosing  $\eta > 0$  sufficiently large. This is in contrast to the conclusion for the case with  $\eta = 0$  in which, the recombinants do not help eliminate the HIV virus but only help reduce the HIV load in the long term sense. (Collaborator: Xingfu Zou)

64.

### Recent results on embedding diffeomorphisms in flows

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**Abstract:** This is a survey talk in which we will introduce our recent results on embedding diffeomorphisms in flows with some smoothness in the higherdimensional spaces. These results can be found in [1]–[5], where we obtained the existence of embedding flows for  $C^\infty$  hyperbolic diffeomorphisms [1,2], for finite resonant diffeomorphisms [3], and for integrable diffeomorphisms in the finite dimensional spaces [4], and also the existence of embedding flows for smooth diffeomorphisms in the Banach spaces [5]. We will also pose some problems on this subject which still remain open now.

- [1 ] W Li, J Llibre and X Zhang, American J. Math. 124 (2002), 107–127.
- [2 ] X Zhang, J. Differential Equations 250 (2011) 2283-2298.
- [3 ] X Zhang, J. Differential Equations 248 (2010) 1603-1616.
- [4 ] X Zhang, J. Differential Equations 244 (2008) 1080-1092].
- [5 ] X Zhang, Ergodic Theory and Dynamical Systems 29 (2009) 1349-1367.

65.

## Homoclinic orbits of a class of discrete Hamiltonian systems

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**Abstract:** The research of homoclinic orbits plays an important role in the development of chaotic dynamics. The well-known Smale-Birkhoff Theorem asserts that the existence of transversal homoclinic orbits could imply that the system has very complicated dynamical behaviors. However, it is very hard to confirm whether a system has a transversal homoclinic orbit. The variational method has gradually become very powerful in the study of existence of homoclinic orbits. In this talk, we will present several results about the existence of homoclinic orbits of a class of discrete Hamiltonian systems via the variational method.

This talk is based on joint works with Yuming Shi.

66.

## Stably Dissipative Matrix, Graphical Classifications and Dynamics of Lotka-Volterra Systems

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**Abstract:** Related to the study of  $n$ -dimensional Lotka-Volterra(LV) systems, in this talk, the notations of stably dissipative matrix (also called admissible matrix) and stably dissipative graph, and the close relation between studying the dynamical properties of a LV system and the properties of its interaction matrix are introduced firstly. Then based on The concept of Maximum Stably Dissipative Graph, a complete characterization of stably dissipative matrices are proposed. Finally, for the case of 5-order matrix, an algebraic necessary and sufficient conditions for a matrix to be stably dissipative are proved.

67.

## Recent advances on the cyclicity of quadratic integrable systems of genus one

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**Abstract:** This talk is concerned with the cyclicity of quadratic integrable systems of genus one under quadratic perturbations. We will recall the history of this problem, and then introduce some recent results this direction. The results are contained in several papers, published or unpublished, collaborated with Haihuang Liang and Yi Shao.

68.

## Bifurcation of Canard Cycles in Predator-Prey Competition Systems

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**Abstract:** There have been extensive stability and bifurcation studies of predator-prey type of systems, yet the study of canard cycles of such type of systems is rather limited due to the degenerate singularities and technical difficulties in dealing with the singularities. In this talk, by using the theory of center manifolds and geometric singular perturbation, I will present the bifurcation studies of canard cycles in a general singular perturbed predator-prey systems, and apply the results to obtain canard cycles in the model with different Holling types of functional responses. This is a joint work with Chengzhi Li.

69.

## Pullback trajectory attractors for evolution equations and application to 3D incompressible non-Newtonian fluid

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**Abstract:** This paper studies the pullback asymptotic behavior of trajectories for evolution equations. We first combine the idea of trajectory attractor and pullback attractor to formulate a new type of attractor, called pullback trajectory attractor. Then we prove a sufficient condition for the existence of a pullback trajectory attractor for the translation cocycle defined on the united trajectory space of the evolution equations. Finally, we take a three-dimensional incompressible non-Newtonian fluid as the applied example and prove its pullback trajectory asymptotic smoothing effect.

## Global dynamics of a delay differential equation with spatial non-locality in an unbounded domain

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**Abstract:** In this talk, I will report some results on the global dynamics of a class of differential equations with temporal delay and spatial non-locality in an unbounded domain, obtained in a recent joint work with Dr. Taishan Yi. Such an equation can be used to model the population dynamics for those species whose immature individuals diffuse but mature individuals do not (e.g. barnacles and mussels). In order to overcome the difficulty due to non-compactness of the spatial domain, we introduce the compact open topology and describe the delicate asymptotic properties of the nonlocal delayed effect. Then, we establish some *a priori* estimate for nontrivial solutions which enables us to show the permanence of the equation. Combining these results with a dynamical systems approach, we are able to determine the global dynamics of the equation under appropriate conditions. Applying the main results to particular models with the Ricker's birth function and Mackey-Glass's hematopoiesis function, we obtain threshold results for the global dynamics of these two models. We explain why our results on the global attractivity of the positive equilibrium in  $C_+ \setminus \{0\}$  under the *compact open topology* will become invalid in  $C_+ \setminus \{0\}$  with respect to the *usual supremum norm*, but the positive equilibrium can remain attractive in a *subset* of  $C_+ \setminus \{0\}$  with respect to the supremum norm.