	8/4/2015	8/5/2015	8/6/2015	8/7/2015
Chair	Junping Shi	Chris Cosner	Steve Cantrell	Yihong Du
8:40-9:20	Opening	Peter Bates	Philip Maini	Xiaoqiang Zhao
9:20-10:00	Hiroshi Matano	Yasumasa Nishiura	Bei Hu	Hal Smith
10:00-10:20	Tea Break	Tea Break	Tea Break	Tea Break
Chair	Yuan Lou	Julian Lopez-Gomez	Wendi Wang	Yaping Wu
10:20-11:00	Wantong Li	Yi Wang	Yaping Wu	Yanni Xiao
11:00-11:30	King-Yeung Lam	Xiaoqing He	Wenrui Hao	Fang Li
11:30-12:00	Jian Fang	Yu Jin	Harsh Jain	Xiulan Lai
12:00-14:00	Lunch	Lunch	Lunch	Lunch
Chair	Chungen Liu	Bei Hu		Michael Winkler
14:00-14:40	Wendi Wang	Michael Winkler		Xingfu Zou
14:40-15:20	Chris Cosner	Youshan Tao		Steve Cantrell
15:20-15:50	Fengqi Yi	Zhian Wang		Feng-Bin Wang
15:50-16:10	Tea Break	Tea Break		Tea Break
Chair	Xing Liang	Junjie Wei		Xiaoqiang Zhao
16:10-16:50	Rui Peng	Shigui Ruan		Yihong Du
16:50-17:30	Julian Lopez-Gomez	Zhicheng Wang		Bendong Lou
17:30-18:00	Ruijun Zhao	Kun Zhao		Xiangsheng Wang
18:00-19:00	Dinner	Dinner	Dinner	Dinner

Abstract of Talks

1.

Spectral Convergence and Turing Patterns with Nonlocal Diffusion

Peter Bates
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Abstract: Many physical and biological processes occur with long-range interaction, giving rise to equations with nonlocal in space operators in place of the usual Laplacian. These operators are diffusive-like but are bounded rather than unbounded as is the case of the diffusion operator. We study systems that include such nonlocal operators and through a spectral convergence result when a certain scaling parameter becomes small, show that Turing instabilities also occur, producing patterned stable states.

2.

Resident-Invader Dynamics in Infinite Dimensional Dynamical Systems

Robert Stephen Cantrell
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Abstract: We discuss an extension of the Tube Theorem from adaptive dynamics to infinite dimensional contexts, including that of reaction-diffusion equations. This is joint work with Chris Cosner and King-Leung Lam.

3.

The reduction principle, the ideal free distribution, and the evolution of dispersal strategies

Chris Cosner
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Abstract: The problem of understanding the evolution of dispersal has attracted much attention from mathematicians and biologists in recent years. For reaction-diffusion models and their nonlocal and discrete analogues, in environments that vary in space but not in time, the strategy of not dispersing at all is often convergence stable within in many classes of strategies. This is related to a "reduction principle" which states that that in general dispersal reduces population growth rates. However, when the class of feasible strategies includes strategies that generate an ideal free population distribution at equilibrium (all individuals have equal fitness, with no net movement), such strategies are known to be evolutionarily

stable in various cases. Much of the work in this area involves using ideas from dynamical systems theory and partial differential equations to analyze pairwise invasibility problems, which are motivated by ideas from adaptive dynamics and ultimately game theory. The talk will describe some past results and current work on these topics.

4.

Semi-wave and spreading speed for the diffusive competition model with a free boundary

Yihong Du
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Abstract: We determine the asymptotic spreading speed of an invasive species, which invades the territory of a native competitor, governed by a diffusive competition model with a free boundary in a spherically symmetric setting. We show that there exists an asymptotic spreading speed, which is determined by a certain traveling wave type system of one space dimension, called a semi-wave. This appears to be the first result that gives the precise asymptotic spreading speed for a two species system with free boundaries. This talk is based on recent joint work with Zhigui Lin (Yangzhou Univ), Mingxin Wang (Harbin Inst Tech) and Maolin Zhou (Univ of New England).

5.

Monotone wavefronts of the nonlocal Fisher-KPP equation

Jian Fang
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Abstract: For the nonlocal Fisher-KPP equation, we give a sufficient and necessary condition for the existence of monotone traveling waves.

6.

A free boundary problem modeling plaque formation

Wenrui Hao
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Abstract: In this talk, I will describe a recent mathematical model that predicts the formation of a plaque as a function of the combined levels of (LDL, HDL) in the blood. The cholesterol levels in the blood reveal the risk of plaque growth in the artery. The model is given by a system of partial differential equations within the plaque.

7.

Global dynamics of time-periodic Lotka-Volterra competition systems

Xiaoqing He
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Abstract: In this talk, I will first review previous results on global dynamics of both time-periodic Lotka-Volterra competition systems (ODE case) and time-periodic spatially heterogeneous Lotka-Volterra competition-diffusion systems (PDE case). Then I will present some recent progress on both systems.

8.

A Multiscale Cell Model

Bei Hu
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and Institute of Mathematical Science, Renmin University
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Abstract: The reproduction of cells are included in this PDE model. There are two time scales: the cell reproduction cycle, which is usually completed in the magnitude of hours, and the tissue growth time, which is usually measured by days. In this work we shall investigate the relationship between these scales, as well as the response to the environment.

9.

Models of Prostate Cancer Growth and Response to Hormonal Therapy

Harsh Jain
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Abstract: Due to its dependence on androgens, advanced prostate cancer is typically treated with continuous androgen ablation. However, such therapy eventually fails due to the emergence of castration-resistance cells. It has been hypothesized that intermittent androgen ablation can delay the onset of this resistance. In this talk, I will present a biochemically-motivated mathematical model of prostate cancer response to anti-androgen therapy, with the aim of predicting optimal treatment protocols based on individual patient characteristics. The model is derived using ordinary and partial differential equations, and validated versus available clinical data. The model predicts that intermittent scheduling is preferable over continuous therapy only for specific castration-resistant cell phenotypes, namely, androgen-repressed cells, and androgen-independent cells that compete poorly with androgen-dependent

cells for resources. In all other cases, continuous therapy results in longer disease-free survival periods. These results are also proven analytically. Further, simulation and analysis of the model indicates that cancer cell proliferation and mitotic indices and PSA expression levels are important markers of disease significance and useful in predicting patient response to therapy. Finally, a PDE version of the model is developed, and existence and uniqueness results derived for the resulting free boundary problem. These results are illustrated with numerical simulations of a tumor growing in 2-dimensions with radial symmetry.

10.

Persistence metrics and invasion ratchet of stream/river species

Yu Jin
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Abstract: We develop process-oriented advection-diffusion-reaction equations that couple hydraulic flow to population growth, and analyze them to assess the effect of water flow on population persistence. We present a new mathematical framework, based on the net reproductive rate for advection-diffusion-reaction equations and on related measures, and then apply the measures to population persistence in rivers under various flow regimes. Moreover, we derive the water depth and current from a hydrodynamic equation for variable stream bed water flows and feed these quantities into a reaction-diffusion-advection model that governs population dynamics of a river species. We then establish the existence the invasion ratchet phenomenon, using a mixture of mathematical approximations and numerical computations.

11.

Modeling the repulsion effect by infected cells on virius spread

Xiulan Lai
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Abstract: In this talk, we present a mathematical model to describe the repulsion effect by infected cells on spread of virions. The model turns out to be a reaction diffusion system where the diffusion of virions depends not only on its concentration gradient but also on the concentration of infected cells. The basic reproductive ratio, linear stability of steady states, existence of traveling wave solutions for the model are discussed. We show that virus particles spread more rapidly with the repulsion effect by infected cells than with random diffusion only. We observe that for this model, the spreading speed of free virus is not consistent with the minimal traveling wave speed. This is a joint work with Professor Xingfu Zou.

12.

Evolution of Diffusion Rate in a Mutation-selection Model

King-Yeung Lam
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Abstract: We consider a mutation-selection model of a population structured by the spatial variables and a trait variable which is the diffusion rate. Competition for resource is local in spatial variables, but nonlocal in the trait variable. We establish the existence and asymptotic profile of a steady state solution. Our result shows that in the limit of small mutation rate, the solution remains regular in the spatial variables and yet concentrates in the trait variable and forms a Dirac mass supported at the lowest diffusion rate. Our result generalizes the finding of A. Hastings which says that in a two species competition in spatially heterogeneous environment, the slower diffuser always prevails, if all other things are held equal. This is joint work with Yuan Lou (Renmin University and Ohio State University).

13.

On eigenvalue problems arising from nonlocal diffusion models

Fang Li
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Abstract: In this talk, we aim at saying as much as possible about the spectra of three classes of linear diffusion operators involving nonlocal terms. In all but one cases, we characterize the minimum λ_p of the real part of the spectrum in two max-min fashions, and prove that in most cases λ_p is an eigenvalue with a corresponding positive eigenfunction, and is algebraically simple and isolated; we also prove that the maximum principle holds if and only if $\lambda_p > 0$ (in most cases) or ≥ 0 (in one case). We prove these results by an elementary method based on the strong maximum principle, rather than resorting to Krein-Rutman theory as did in the previous papers. In one case when it is impossible to characterize λ_p in the max-min fashion, we supply a complete description of the whole spectrum. This is the joint work with Jerome Coville and Xuefeng Wang.

14.

Invasion Entire Solutions in a Competition System with Nonlocal Dispersal

Wan-Tong Li
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Abstract: This talk is concerned with invasion entire solutions of a Lotka-Volterra competition system with nonlocal dispersal, which formulate a new invasion way of the stronger species to the weaker one. We first give the asymptotic behavior of traveling wave solutions at infinity. Then by the comparison principle and sub-super solutions method, we establish the existence of invasion entire solutions which behave as two monotone waves with different speeds and coming from both sides of x-axis. The main difficulty is that a lack of regularizing effect occurs. This talk is based on the joint work with Li Zhang and Guo-Bao Zhang.

15.

Some Unexpected Results in Reaction Diffusion Equations

Julian Lopez-Gomez
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Abstract: In this talk we will discuss two rather striking results within the theory of Nonlinear Partial Differential Equations. The first one is an old joint result with J. E. Furter on permanence for spatially heterogeneous competing species models. The second one is a very recent joint result with P. H. Rabinowitz which is a substantial refinement of a classic well known result of A. Ambrosetti and P. H. Rabinowitz.

16.

On the Fisher-KPP equation in advective environment with free boundaries

Bendong Lou
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Abstract: We consider the Fisher-KPP equation with advection $u_t = u_{xx} - \beta u_x + f(u)$ in a one dimensional varying domain $[g(t), h(t)]$, where $g(t)$ and $h(t)$ are two free boundaries evolving by one-phase Stefan conditions. This equation is used to describe the population dynamics in advective environment. We find two critical parameters c_0 and β^* with $\beta^* > c_0 > 0$ which play key roles in the dynamics of the solutions. (Joint work with Hong Gu and Maolin Zhou).

17.

Case Studies in Modelling Solid Tumour Progression

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Abstract: In this talk we review a number of recent applications of mathematical modelling of tumour growth. The models range from coupled systems of ordinary differential differential equations, to partial differential equations, to hybrid cellular automata. We consider applications that specifically address metabolic aspects of tumour progression, somatic evolution and tissue heterogeneity.

18.

Front propagation in an anisotropic Allen-Cahn equation

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Abstract: In this talk I will discuss the long time behavior of spreading fronts in anisotropic Allen-Cahn type nonlinear diffusion equations on $\mathbf{R}^N$. Here, the term spreading fronts roughly means expanding level surfaces of solutions with compactly supported initial data. Among other things I show that the shape of the spreading front converges to the Wulff shape associated with the anisotropic term of the equation. This is joint work with Yoichiro Mori and Mitsunori Nara.

19.

How single-celled organisms respond to environmental changes? - From a dynamical system view point -

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Abstract: It has recently been reported that even single-celled organisms appear to be 'indecisive' or 'contemplative' when confronted with an obstacle. When the amoeboid organism Physarum plasmodium encounters the chemical repellent quinine during migration along a narrow agar lane, it stops for a period of time and then suddenly begins to move again. When movement resumes, three distinct types of behavior are observed: The plasmodium continues forward, turns back, or migrates in both directions simultaneously. Here, we develop a continuum mathematical model of the cell dynamics of contemplative amoeboid movement.

Our model incorporates the dynamics of the mass flow of the protoplasmic sol, in relation to the generation of pressure based on the autocatalytic kinetics of pseudopod formation and retraction (mainly, sol-gel conversion accompanying actin-myosin dynamics). The biological justification of the model is tested by comparing with experimentally measured spatiotemporal profiles of the cell thickness. The experimentally observed types of behavior are reproduced in simulations based on our model, and the core logic of the modeled behavior is clarified by means of nonlinear dynamics. An on-off transition between the refractory and activated states of the chemical reactivity that takes place at the leading edge of the plasmodium plays a key role in the emergence of contemplative behavior. This is a joint work with K.-I. Ueda, S. Seiji, and T. Nakagaki.

20.

The Principal Eigenvalue of A Periodic Parabolic Problem with Applications

Rui Peng
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Abstract: The principal eigenvalue is a basic concept in the field of parabolic partial differential equations. In recent decades, a large amount of research works have been devoted to the study of qualitative properties of the principal eigenvalue and its eigenfunction for second-order linear elliptic operators. As far as the nonautonomous periodic-parabolic operator is concerned, however, much less has been known for the associated principal eigenvalue, especially when the advection term appears. The principal eigenvalue for linear periodic-parabolic operators becomes important when a time periodic environment is involved. In this talk, I will report our recent research on a one-dimensional periodic-parabolic eigenvalue problem. The dependence of the principal eigenvalue on the diffusion and advection coefficients is investigated. I will also mention an application of the theoretical results to a nonlocal reaction-diffusion-advection model of a single phytoplankton species with periodic incident light intensity. This is a joint work with Prof. Xiaoqiang Zhao, Memorial University of Newfoundland, Canada.

21.

Spread of Phage Infection of Bacteria in a Petri Dish

Hal Smith
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Abstract: We extend our previous work on the spatial spread of phage infection of immobile bacteria on an agar coated plate by explicitly including loss of viruses by both adsorption to bacteria and by decay of free viruses and by including a distributed virus latent period and distributed burst size rather than fixed values of these key parameters. We extend earlier results on the spread of virus and on the existence of traveling wave solutions when the

basic reproductive number for virus, R_0, exceeds one and we compare the results with those obtained in earlier work. Finally, we formulate and analyze a model of multiple virus strains competing to infect a common bacterial host in a petri dish.

22.

On a chemotaxis-haptotaxis system

Youshan Tao
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Abstract: This talk addresses a chemotaxis-haptotaxis model for cancer invasion, which describes the mutual interactions between cancer cells, enzymes and extracellular matrix. The system consists of two parabolic PDEs, one of which possesses two cross-diffusion terms reflecting the biased movements of cells due to chemotaxis and haptotaxis, coupled with an ODE. Inspired by some new observations or approaches toward this system, we could discuss the boundedness and asymptotic behavior of the solutions. This is a joint work with Michael Winkler (Paderborn).

23.

A reaction-diffusion-advection model of harmful algae growth with toxin degradation

Feng-Bin Wang
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Abstract: This talk is devoted to the study of a reaction-diffusion-advection system modeling the dynamics of a single nutrient, harmful algae and algal toxin in a flowing water habitat with a hydraulic storage zone. We introduce the basic reproduction ratio R_0 for algae and show that R_0 serves as a threshold value for persistence and extinction of the algae. More precisely, we prove that the washout steady state is globally attractive if $R_0 < 1$, while there exists a positive steady state and the algae is uniformly persistent if $R_0 > 1$. With an additional assumption, we obtain the uniqueness and global attractivity of the positive steady state in the case where $R_0 > 1$. This is a joint work with Drs. Sze-Bi Hsu and Xiao-Qiang Zhao.

24.

Spatial invasion threshold of Lyme disease

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Abstract: A mathematical model of Lyme disease is formulated to incorporate a spatially heterogenous structure. The basic reproduction number R_0 of the disease and its computational formulae are established. It is shown that R_0 serves as a threshold value between extinction and persistence in the evolution of Lyme disease. Numerical simulations indicate that spatial heterogeneity of the disease transmission coefficient increases the basic reproduction number, but spatial heterogeneity of the carrying capacity of mice alleviates the value of R_0. Moreover, the influence of host population in size, destruction of tick habitats and deployment of vaccinations is studied to give insights into optimal control of the disease. The talk is based upon the joint research with Xiaoqiang Zhao.

25.

Traveling waves of a diffusive Kermack-McKendrick SIR model

Xiang-Sheng Wang
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Abstract: We study the existence and nonexistence of traveling waves of a diffusive Kermack-McKendrick SIR model with standard incidence where the total population is not constant. We show that the minimum wave speed of traveling waves for the three-dimensional nonmonotonic system can be derived from its linearization at the disease-free equilibrium. The proof is based on Schauder fixed point theorem and Laplace transform. This is a joint work with Haiyan Wang of Arizona State University.

26.

Dynamics of Almost Periodic Scalar Parabolic Equations on the Circle

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Abstract: In this talk, we focus on an almost periodic scalar reaction-diffusion equation on the circle. The structure of the minimal set M is thoroughly investigated under the assumption that its associated center space is no more than 2-dimensional. Such situation naturally occurs while, for instance, M is hyperbolic or uniquely ergodic. We show that M is

a 1-cover provided that M is hyperbolic. If $\dim V^c(M)=1$, then either M is an almost 1-cover; or can be embedded into an almost periodically forced circle-flow. This new phenomena we discovered here reinforces the possible appearance of the almost periodically forced circle flow in infinite-dimensional dynamical systems. This is a joint work with Wenxian Shen and Dun Zhou.

27.

Chemotactic waves and their applications

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Abstract: Compared to the classical chemotaxis models with linear chemotactic sensitivity, logarithmic sensitivity has more specific applications in modeling biological processes such as the bacterial movement and onset of tumor angiogenesis. The typical patterns generated by the logarithmic sensitivity are traveling waves which were explicitly observed in the experiment. However the logarithmic sensitivity induces a singularity and hence brings a great challenge for mathematical analysis. In this talk, the recent progress of existence and stability of traveling waves of chemotaxis model with logarithmic sensitivity will be reported and some new insights and open questions will be discussed.

28.

Nonplanar traveling fronts in Reaction-Diffusion equations with combustion and degenerate Fisher-KPP nonlinearities

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Abstract: In this talk we concern with nonplanar traveling fronts in reaction-diffusion equations with combustion nonlinearity and degenerate Fisher-KPP nonlinearity. Our study contains two parts: in the first part we establish the existence of traveling fronts of pyramidal shape in $\mathbb{R}^3$, and in the second part we establish the existence and stability of V-shaped traveling fronts in $\mathbb{R}^2$.

29.

Transient growth phenomenon in a parabolic-elliptic chemotaxis system

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Abstract: We consider variants of the Keller-Segel system of chemotaxis which contain logistic-type source terms and thereby account for proliferation and death of cells. We briefly review results and open problems with regard to the fundamental question whether solutions exist globally in time or blow up. The primary focus will then be on the prototypical parabolic-elliptic system

$$\begin{cases} u_t = \varepsilon u_{xx} - (uv_x)_x + ru - \mu u^2, \\ 0 = v_{xx} - v + u, \end{cases}$$

in bounded real intervals. The corresponding Neumann initial-boundary value problem, though known to possess global bounded solutions for any reasonably smooth initial data, is shown to have the property that the so-called carrying capacity $\frac{r}{\mu}$ can be exceeded dynamically to an arbitrary extent during evolution in an appropriate sense, provided that $\mu < 1$ and that $\varepsilon > 0$ is sufficiently small. To achieve this, an analysis of the hyperbolic-elliptic problem obtained on taking $\varepsilon \to 0$ is carried out; indeed, it turns out that the latter limit problem possesses some solutions which blow up in finite time with respect to their spatial L^∞ norm.

This result is in stark contrast to the case of the corresponding Fisher-type equation obtained upon dropping the term $-(uv_x)_x$, and hence reflects a drastic peculiarity of destabilizing action due to chemotactic cross-diffusion, observable even in the simple spatially one-dimensional setting. Numerical simulations underline the challenge in the analytical derivation of this result by indicating that the phenomenon in question occurs at intermediate time scales only, and disappears in the large time asymptotics.

30.

Spectral Stability of Bacteria Pulses for the Keller-Segel Chemotactic Model

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Abstract: Consider the following Keller-Segel chemotactic model, which was first proposed by Keller and Segel in 1971 to model the bacteria population chemotaxis in a capillary tube

$$\begin{cases} \dfrac{\partial b}{\partial t} = \dfrac{\partial}{\partial x}\Big(\dfrac{\partial b}{\partial x} - \gamma \dfrac{s_x}{s} b\Big), & x \in \mathbf{R},\ t > 0 \\ \dfrac{\partial s}{\partial t} = \epsilon s_{xx} - b, & x \in \mathbf{R},\ t > 0, \end{cases}$$

where $b(x,t)$ is the density of bacteria and $s(x,t)$ is the concentration of chemoattractant.

For the case $\gamma > 1$ and $\epsilon = 0$, and for any $c > 0$ and $s_\infty > 0$, Keller and Segel found explicit presentation of positive wave solutions $(B(x-ct), S(x-ct))$ of the system satisfying

$$S(-\infty) = 0, S(\infty) = s_\infty > 0, B(-\infty) = B(+\infty) = 0,$$

which can interpret the wave phenomena of the bacteria pulses observed in a famous experiment.

In this talk we shall talk about our recent work on the spectral stability/spectral instability of the whole family of explicit traveling waves $(B(x-ct), S(x-ct))$ for the system when $\epsilon = 0$ and $\gamma > 1$ in some appropriate weighted spaces, we shall also talk about our work on the local well-posedness of solution for the original Keller-Segel model. This is a joint work with Yi Li and Yong Li.

31.

A multiscale model to investigate comprehensive effect of antiretroviral therapy on HIV infection

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Abstract: The antiretroviral therapy (ART) has been shown to be effective in slowing down the progression to AIDS. Estimating the impact of ART plays an important role in guiding treatment regime both at the individual level and at the population level. Few models coupling the within-host and between-host dynamics have been developed. In this talk, I shall briefly view the current situation of HIV infection in China. Then we propose an infection-age structured epidemic model, which explicitly links the individual and the host population scale. The basic reproduction number R_0 was obtained for the coupled system, and it provided a threshold value determining whether or not the disease dies out. Two Lyapunov functionals are constructed to prove the global asymptotical stability of the disease-free and endemic equilibria. Main results suggest that increasing the effectiveness of inhibitors can decrease the basic reproduction number, but can also increase the overall infected population because of a lower disease-induced morality rate and a longer lifespan of HIV infected individuals. To further investigate the impact of various treatment regimes on HIV infection at the population level, an individual based simulation model was proposed. In particular, we will focus on the contribution of different HIV progression stages to HIV new infection, and the effects of different timings to start ART or drug efficacy on HIV new infection among men who have sex with men (MSM). Some key control strategies will then be proposed.

32.

Dynamics and patterns formations of a substrate-enzyme Sporn-Seelig chemical reaction model: linear diffusion vs nonlinear diffusion

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Abstract: We discuss a reaction-diffusion substrate-enzyme Sporn-Seelig system that was used to model the genetic regulatory mechanism of enzyme induction. To study the influences of diffusions on the emergence of spatiotemporal patterns, we consider the problem in two cases: classical linear diffusion and nonlinear density-dependent diffusion. Dynamics and pattern formations of both classical linear diffusion problem and the nonlinear diffusion problem are considered in details. In particular, we observe that, in certain parameter ranges, if classical linear diffusion system does not exhibit Turing patterns, then even in the same parameter ranges, the nonlinear diffusion can still exhibit Turing patterns if the power of the nonlinear diffusions of the enzyme is larger enough for any fixed power of nonlinear diffusions of the substrate. This suggests that nonlinear diffusion can induce Turing patterns which can not be driven by classical linear diffusions, and thus nonlinear diffusions are more than willing to favor the emergence of Turing patterns.

33.

Uniform Distribution in Negative Chemotaxis

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Abstract: In contrast to random diffusion without orientation, chemotaxis is the biased movement of organisms toward the region that contains higher concentration of beneficial or lower concentration of unfavorable chemicals. The former often refers to the attractive chemotaxis and latter to the repulsive chemotaxis. Chemotaxis has been advocated as a leading mechanism to account for the morphogenesis and self-organization of a variety of biological coherent structures such as aggregates, fruiting bodies, clusters, spirals, spots, rings, labyrinthine patterns and stripes, which have been observed in experiments. In this talk, I will present some recent results regarding the rigorous analysis of a nonlinear PDE model arising from the study of repulsive chemotaxis. In particular, local/global well-posedness, long-time asymptotic behavior and diffusion limits of classical solutions will be discussed. The long-time behavior results show that constant equilibrium states are stable, which indicates that chemo-repulsion problem with logarithmic chemotactic sensitivity exhibits a strong tendency against pattern formation. The diffusion limit results demonstrate that the chemically diffusive model is consistent with the non-diffusive model under certain boundary conditions, which may help reduce the computational cost for numerical simulation of the model.

34.

An age-structured mathematical model studying the imperfect vaccine of malaria, RTS, S

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Abstract: Malaria is a mosquito-borne disease. Vector control measures such as Indoor residual spraying (IRS) and long-lasting insecticidal nets (LLINs) have been major control methods implemented in the endemic areas. In 2015, it is expected that the first malaria vaccine, RTS,S developed by GlaxoSmithKline, will be an important addition to the disease control. However, the clinical trials suggest that the vaccine has only partial protection and its protection varies among different age group of individuals.

In this talk, we will investigate an age-structured mathematical model consisting of a system of first order partial differential equations to study the effectiveness of this imperfect vaccine. In addition, the optimal control theory is also applied to the model. This is a joint work with Dr. Jemal Mohammed-Awel, Dr. Calistus Ngonghala, Dr. Eric Numfor and Dr. Suzanne Lenhart.

35.

Traveling Waves and Spreading Speeds for Time-Space Periodic Monotone Systems

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Abstract: The theory of traveling waves and spreading speeds is developed for time-space periodic monotone semiflows with monostable structure. By using traveling waves of the associated Poincare maps in a strong sense, we establish the existence of time-space periodic traveling waves and spreading speeds. We then apply these abstract results to a two species competition reaction-advection-diffusion model. It turns out that the minimal wave speed exists and coincides with the single spreading speed for such a system no matter whether the spreading speed is linearly determinate. We also obtain a set of sufficient conditions for the spreading speed to be linearly determinate. This is a joint work with Jian Fang and Xiao Yu.

36.

Dirichlet problem of a delayed reaction-diffusion equation on a semi-infinite interval

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Abstract: We consider a nonlocal delayed reaction-diffusion equation in a semi-infinite interval that describes mature population of a single species with two age stages (immature and mature) and a fixed maturation period living in a spatially semi-infinite environment. Homogeneous Dirichlet condition is imposed at the finite end, accounting for a scenario that that boundary is hostile to the species. Due to the lack of compactness and symmetry of the spatial domain, the global dynamics of the equation turns out to be a very challenging problem. We first establish *a priori* estimate for nontrivial solutions after exploring the delicate asymptotic properties of the nonlocal delayed effect and the diffusion operator. Using the estimate, we are able to show the repellency of the trivial equilibrium and the existence of a positive heterogeneous steady state under the Dirichlet boundary condition. We then employ the dynamical system arguments to establish the global attractivity of the heterogeneous steady state. As a byproduct, we also obtain the existence and global attractivity of the heterogeneous steady state for the bistable evolution equation in the whole space. This is a joint work with Taishan Yi.