The XI Americas Conference on Differential Equations and Nonlinear Analysis

August 15-19, 2017
Edmonton, Alberta, Canada

Welcome

We welcome you to the 11th Americas Conference on Differential Equations and Nonlinear Analysis (Americas XI) at the University of Alberta in Edmonton, from August 12-19, 2017. The XI Americas Conference is dedicated to the memory of Professor George R. Sell. A special George R. Sell Lecture series is established for the Americas Conference series, sponsored by Springer. The inaugural George R. Sell Lecture will be given at the Americas XI by Professor John Mallet-Paret of Brown University.

The first three days of the conference, August 12-14, 2017, are for the **Summer School on New Trends and Applications of Differential Equations and Dynamical Systems** for graduate students and postdoctoral fellows. The XI Americas Conference will run from **August 15-19, 2017.** We would also like to bring to your attention the concurrent PIMS Workshop on Nonlinear Stochastic Dynamics at the University of Alberta, August 12-14, 2017.

The Americas Conference on Differential Equations and Nonlinear Analysis (Americas Conference) series started in 1994 with the goal of promoting collaboration among researchers from Latin America, the USA and Canada in this broadly defined area of Mathematics. This conference series has become a well-established forum for mathematics motivated by applications ranging from disciplines in natural and social sciences to engineering. From its inception, the conference has strived to achieve several goals: to foster and enhance collaborations among scientists; to ensure high standards of the research, and to promote the incorporation of young mathematicians from the Americas into these fields. Recognizing the variability in training with regard to breadth, depth, and concurrency, and motivated by the desire to maximize the experience of the junior participants, both with regard to assimilation of the different aspects of the subjects covered during the conference period and to foster their motivation towards high level research in nonlinear and applied mathematics, intensive tutorial lectures have been included since the VI Americas Conference (January 10-21, 2005). The first meeting took place in Taxco, Mexico, in 1994 with the participation of 25 lecturers from the USA, Brazil, Mexico and Venezuela. Since then, meetings have taken place on a regular basis: Sao Paulo, Brazil, in 1996; Atlanta, USA, in 1998; Merida, Venezuela, in 2000; Edmonton, Canada in 2002, Santiago, Chile, in 2005; Cartagena, Colombia in 2007; Veracruz, Mexico, in 2009; Trujillo, Peru, in 2012; and Buenos Aires, Argentina in 2015.

The XI Americas Conference brings together mathematicians from throughout the Americas to share their recent research findings, to assess recent research developments, to identify new research directions, and to strengthen existing and foster new collaborations in the broad field of differential equations and nonlinear analysis.

We wish all the participants of the Americas XI a fruitful and enjoyable experience.

Americas XI Local Organizing Committee
Jim Muldowney (Chair, Alberta), Michael Li (Co-Chair, Alberta), Yingfei Yi (Co-Chair, Alberta), Arno Berger (Alberta), Hao Wang (Alberta), Sue-Ann Campbell (Waterloo), Jacques Belair (Montreal), Xiaoqiang Zhao (Memorial)

We thank the generous support of the major sponsors of the Americas XI:

- **National Science Foundation (NSF)**
- **Natural Science and Engineering Research Council of Canada (NSERC)**
- **Pacific Institute for Mathematical Sciences**
- **The Fields Institute**
- **AARMS**
- **University of Alberta**
- **Applied Math Institute**
- **Springer**

Americas XI Schedule Overview

Time/First Day	Aug. 15 (Tue)		Time/Remaining Days	Aug. 16 (Wed)		Aug. 17 (Thur)	Aug. 18 (Fri)		Aug. 19 (Sat)	
8:00-8:30	Registration		8:00-8:30	Registration		Registration				
8:30-9:00	Opening		8:30-9:30	Lu		Raugel	Damanik		Carvalho	
9:00-10:00	Young		9:30-10:30	McCann		Santier	Lessard		Arino	
10:00-11:00	Miller		10:30-11:00	**Coffee**		**Coffee**	**Coffee**		**Coffee**	
11:00-11:30	**Coffee**			**Functional**	**Infinite dimension**	**George R. Sell Lecture**	**Functional**	**Elliptic**	**Computation**	**Contributed**
	Bifurcation	**Infinite dimension**	11:00-11:30	Chen	Manasevich	**Mallet-Paret**	L. Wang	Wei	Gameiro	Arshad
11:30-12:00	Campbell	Silva	11:30-12:00	Humphries	Quintero		Magpantay	Bonder	Bowman	Singh
12:00-12:30	Seo	Pereira	12:00-12:30	X. Wang	Panayotaros		Mahaffy	E. Pimentel	Pineau	X. Zhang
12:30-2:00	**Lunch**			**Lunch**		**Lunch**	**Lunch**		**Lunch**	
	Plenary			**Plenary**		Sightseeing/Networking	**Plenary**		**Computation**	**Contributed**
2:00-3:00	Shen			Pego			Porter		Goyal	Song
3:00-4:00	Liu			Lopez			Iturriaga		Torres	Y. Wang
4:00-4:30	**Coffee**			**Coffee**			**Coffee**			
	Functional	**Channel**		**Bifurcation**	**Infinite dimension**		**Computation**	**Elliptic**	Closing	
4:30-5:00	Braverman	Xu		Belair	Rodrigues		Jolly	Hillen		
5:00-5:30	Zhu	Chen		Hsu	Manaka		Jaquette	Terra		
5:30-6:00	Buono	Ji		Zou	J. Pimentel		Aguirre	Ou		
6:00-6:30	Ncube	Zhang		Shan	Narita		Haddad	Fang		
6:30-7:00	Rebaza	X. Liu		Pal	Villamizar-Roa		Emami	Ramazi		
7:30-9:00				**Reception/BBQ**		**Banquet (The Faculty Club, cash bar at 6:30, dinner at 7:00)**	**Exec. Comm. Dinner (8:00 pm)**			

Notes: Plenary sessions are in **Education North 2-115**, Sessions A are in Education **North 2-115**, Sessions B are in **Education 254**, Reception/BBQ is in the Heritage Lounge on the ground floor of **Athabasca Hall**, Banquet is in the Jasper Room of the **Faculty Club**. Please note the time change for morning talks starting from the second day.

TABLE 1. **The week at a glance**

	Tuesday		Wednesday	Thursday	Friday	Saturday
8:00	Registration	8:00	Registration	Registration		
8:30	Opening Ceremony					
9:00	Plenary Session Room: Education North 2-115 Chair: R. de la Llave	8:30	Plenary Session Room: Education North 2-115 Chair: X. Zhou	Plenary Session Room: Education North 2-115 Chair: S. A. Campbell	Plenary Session Room: Education North 2-115 Chair: W. Craig	Plenary Session Room: Education North 2-115 Chair: R. Manasevich
11:00	Coffee Break	10:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:30	Parallel Session: BT Room: Education North 2-115 Org.: G. Wolkowicz and H. Zhu Parallel Session: IDDS Room: Education North 254 Org.: G. Flores and A. Carvalho	11:00	Parallel Session: FDZ Room: Education North 2-115 Org.: J. Belair, S. A. Campbell, and X. Zhou Parallel Session: IDDS Room: Education North 254 Org.: G. Flores and A. Carvalho	Plenary Session Room: Education North 2-115 Chair: G. Raugel	Parallel Session: FDZ Room: Education North 2-115 Org.: J. Belair, S. A. Campbell, and X. Zhou Parallel Session: PDE Room: Education North 254 Org.: J. F. Bonder and X. Zhao	Parallel Session: CDS Room: Education North 2-115 Org.: K. Mischaikow and M. Gameiro Parallel Session: C Room: Education North 254 Chair: M. Li
12:30	Lunch Break	12:30	Lunch Break	Lunch Break	Lunch Break	Lunch Break
2:00	Plenary Session Room: Education North 2-115 Chair: K. Mischaikow	2:00	Plenary Session Room: Education North 2-115 Chair: X. Zhao		Plenary Session Room: Education North 2-115 Chair: N. Wolanski	Parallel Session: CDS Room: Education North 2-115 Org.: K. Mischaikow and M. Gameiro Parallel Session: C Room: Education North 254 Chair: M. Li
4:00	Coffee Break	4:00	Coffee Break	Sightseeing/Networking	Coffee Break	Conference Ends
4:30	Parallel Session: FDZ Room: Education North 2-115 Org.: J. Belair, S. A. Campbell, and X. Zhou Parallel Session: EICP Room: Education North 254 Org.: C. Liu and W. Liu	4:30	Parallel Session: BT Room: Education North 2-115 Org.: G. Wolkowicz and H. Zhu Parallel Session: IDDS Room: Education North 254 Org.: G. Flores and A. Carvalho		Parallel Session: CDS Room: Education North 2-115 Org.: K. Mischaikow and M. Gameiro Parallel Session: PDE Room: Education North 254 Org.: J. F. Bonder and X. Zhao	
Even.		Even.	Reception/BBQ 7:30 Ground Floor, Athabasca Hall	Conference Banquet Cash Bar at 6:30 Jasper Room, Faculty Club	Exec. Comm. Dinner 8:00	

August 15, 2017, Tuesday

		8:00 - 8:30	Registration	
		8:30 - 9:00	Opening	Chair: M. Li

Page	Session P1: Room Education North 2-115			Chair: R. de la Llave
10	P1.1	9:00 - 10:00	**Lai-Sang Young**, *"Smooth Ergodic Theory of Finite and Infinite Dimensional Dynamical Systems"*	
10	P1.2	10:00 - 11:00	**Peter Miller**, *"Singular Limits for Integrable Nonlinear Wave Equations"*	

		11:00 - 11:30	COFFEE BREAK	

Page	Session BT1: Room Education North 2-115			Org: G. Wolkowicz and H. Zhu
10	BT1.1	11:30 - 12:00	**Sue Ann Campbell** , *"Bifurcations in Piecewise Smooth Continuous Mean-Field Models "*	
11	BT1.2	12:00 - 12:30	**Gunog Seo**, *"Pest Control by generalist parasitoids: a bifurcation theory approach"*	

Page	Session IDDS1: Room Education 254			Org: G. Flores and A. Carvalho
11	IDDS1.1	11:30 - 12:00	**Ricardo Silva**, *"The 2D nonautonomous Navier-Stokes equations with impulses at variable times"*	
11	IDDS1.2	12:00 - 12:30	**Antonio Lui Pereiraz**, *"Dissipative property for neural fields in an unbounded domain"*	

		12:30 - 2:00	LUNCH BREAK	

Page	Session P2: Room Education North 2-115			Chair: K. Mischaikow
12	P2.1	2:00 - 3:00	**Wenxian Shen** , *"Front Propagation Dynamics in Chemotaxis Models with Logistics Source on* R^N *"*	
12	P2.2	3:00 - 4:00	**Weishi Liu**, *"Dynamics of Poisson-Nernst-Planck Systems and Ion Channel Problems"*	

		4:00 - 4:30	COFFEE BREAK	

Page	Session FDE1: Room Education North 2-115			Org: J. Belair, S. Campbell and X. Zou
13	FDE1.1	4:30 - 5:00	**Elena Braverman**, *"On Mackey-Glass equations with variable delays"*	
13	FDE1.2	5:00 - 5:30	**Huaiping Zhu**, *" Bifurcations and Transmission Dynamics of Compartmental Models for Mosquito-Borne Diseases with Delay"*	

13	FDE1.3	5:30 - 6:00	**Pietro-Luciano Buono** , *"Bifurcations in symmetric networks of coupled Lang-Kobayashi laser models"*
14	FDE1.4	6:00 - 6:30	**Israel Ncube** , *"Effects of distributed time delays on some neuronal network micro-circuits "*
14	FDE1.5	6:30 - 7:00	**Jorge Rebaza**, *"Global stability in networked connectivity and ZIKA virus models "*

page	Session EICP1: Room Education 254		Org: C. Liu and W. Liu
14	EICP1.1	4:30 - 5:00	**Zhenli Xu** , *"Asymptotic analysis for polarization effect on ionic distribution and dynamics from modified Poisson-Nernst-Planck equations"*
14	EICP1.2	5:00 - 5:30	**Duan Chen**, *"A New Poisson-Nernst-Planck Model with Ion-Water Interactions for Charge Transport in Ion Channels"*
15	EICP1.3	5:30 - 6:00	**Shuguan Ji**, *"Flux ratios and channel structures via Poisson-Nernst-Planck systems"*
15	EICP1.4	6:00 - 6:30	**Mingji Zhang**, *"Ion size effects on ionic flows via Poisson-Nernst-Planck systems "*
16	EICP1.4	6:30 - 7:00	**Xuejiao Liu** , *"Mean Field Free Energy Functional of Electrolyte Solution with Non-homogenous BCs and the Generalized PB/PNP Equations "*

August 16, 2017, Wednesday

		8:00 - 8:30	Registration
Page	Session P3: Room Education North 2-115		Chair: X. Zou
16	P3.1	8:30 - 9:30	**Kening Lu**, *"SRB Measures, Entropy, and Horseshoe for Infinite Dimensional Dynamical Systems"*
17	P3.2	9:30 - 10:30	**Robert McCann**, *"Optimal Transportation between Unequal Dimensions"*
		10:30 - 11:00	COFFEE BREAK
Page	Session FDE2: Room Education North 2-115		Org: J. Belair, S. Campbell and X. Zou
17	FDE2.1	11:00 - 11:30	**Yuming Chen**, *"Impacts of the cell-free and cell-to-cell infection modes on viral dynamics"*
17	FDE2.2	11:30 - 12:00	**Tony Humphries**, *"Delay Differential Equations in Hematopoiesis"*
18	FDE2.3	12:00 - 12:30	**Xiunan Wang**, *"A malaria transmission model with temperature-dependent incubation period"*
Page	Session IDDS2: Room Education 254		Org: G. Flores and A. Carvalho
18	IDDS2.1	11:00 - 11:30	**Rául Manásevich**, *"Systems of Quasilinear Elliptic Equations With Weights"*
18	IDDS2.2	11:30 - 12:00	**Jose Quintero**, *"Well-posedness for the initial-boundary-value problem for the Benney-Luke equation in a quarter planes"*
20	IDDS2.3	12:00 - 12:30	**Panayotis Panayotaros**, *"Optical solitons in nematic liquid crystals: nonlocal and saturation effects "*
		12:30 - 2:00	LUNCH BREAK
Page	Session P4: Room Education North 2-115		Chair: X. Zhao
20	P4.1	2:00 - 3:00	**Robert Pego**, *"Least Action, Incompressible Flow, and Optimal Transportation"*
20	P4.2	3:00 - 4:00	**Mayra Nunez Lopez**, *"Transmission Dynamics of Two Dengue Serotypes with vaccination scenarios"*
		4:00 - 4:30	COFFEE BREAK
	Session BT2: Room Education North 2-115		Org: G. Wolkowicz and H. Zhu
21	BT2.1	4:30 - 5:00	**Jacques Bélair**, *"Oscillations in a model of platelet regulations"*

21	BT2.2	5:00 - 5:30	**Sze-Bi Hsu**, *"On the global stability of a patch-occupancy barnacle-algae-mussel model"*
21	BT2.3	5:30 - 6:00	**Xingfu Zou**, *"Bifurcation analysis of a diffusive population model for pioneer-climax species"*
22	BT2.4	6:00 - 6:30	**Chunhua Shan**, *"Dynamics and Bifurcations in Some Models of Infectious Diseases"*
22	BT2.5	6:30 - 7:00	**Samares Pal**, *"Mathematical modeling of macroalgal allelopathy in the emergence of coral diseases"*

Session IDDS3: Room Education 254 — Org: G. Flores and A. Carvalho

23	IDDS3.1	4:30 - 5:00	**Hildebrando Munhoz Rodrigues**, *"Regularity with respect to parameters of the Banach Fixed Point Theorem. Applications to Linearization in Infinite Dimensions"*
23	IDDS3.2	5:00 - 5:30	**Hiroko Manaka**, *"An Elastic Nonlinear Mapping in Banach Spaces and Fixed Point Theory"*
24	IDDS3.3	5:30 - 6:00	**Juliana Pimentel**, *"Unbounded Attractors Under Perturbations"*
24	BT2.4	6:00 - 6:30	**Makoto Narita**, *"On Global Properties of Gowdy Spacetimes in Brans-Dicke Theory"*
24	BT2.5	6:30 - 7:00	**Élder J. Villamizar-Roa**, *"On the Keller-Segel-Navier-Stokes Equations with Initial Data in Lp-Spaces"*

August 17, 2017, Thursday

Page	Session P5: Room Education North 2-115		Chair: S. A. Campbell
25	P5.1	8:30 - 9:30	**Genevieve Raugel**, *"Dynamics of the Weakly Damped Focusing Sub-critical Klein-Gordon Equation"*
25	P5.2	9:30 - 10:30	**Nicolas Santier**, *"Opinión formation model in the presence of stubborn people"*
		10:30 - 11:00	COFFEE BREAK
Page	George R. Sell Lecture: Room Education North 2-115		Chair: G. Raugel
25	P6.1	11:30 - 12:30	**John Mallet-Paret**, *"Some Generic Properties of Delay-Differential Equations"*
		12:30 - 2:00	LUNCH BREAK
		2:00 - 7:00	**Sightseeing/Networking**
		7:30 - 9:00	Banquet (The Faculty Club. cash bar at 6:30. dinner at 7:00)

August 18, 2017, Friday

Page	Session P7: Room Education North 2-115		Chair: W. Craig
26	P7.1	8:30 - 9:30	**David Damanik**, *"The KdV Equation with Almost Periodic Initial Data"*
26	P7.2	9:30 - 10:30	**Jean-Philippe Lessard**, *"Rigorously Verified Computing for Infinite Dimensional Nonlinear Dynamics: a Functional Analytic Approach"*
		10:30 - 11:00	COFFEE BREAK

Page	Session FDE3: Room Education North 2-115		Org: J. Belair, S. Campbell and X. Zou
26	FDE3.1	11:00 - 11:30	**Lin Wang**, *"Formation, bifurcations and switches of flocking in a two-agent flock with processing delay"*
27	FDE3.2	11:30 - 12:00	**Felicia Magpantay**, *"Lyapunov-Razumikhin techniques for state-dependent delay differential equations"*
27	FDE3.3	12:00 - 12:30	**Joseph Mahaffy**, *"Bifurcation Analysis of an Age-Structured Model for Thrombopoiesis"*

Page	Session PDE1: Room Education 254		Org: J. F. Bonder and X. Zhao
28	PDE1.1	11:00 - 11:30	**Juncheng Wei**, *"Finite Morse Index Implies Finite Ends"*
28	PDE1.2	11:30 - 12:00	**Julian Fernandez Bonder**, *"Uniqueness of minimal energy solutions for a semilinear problem involving the fractional laplacian"*
28	PDE1.3	12:00 - 12:30	**Edgard Pimentel**, *"Regularity theory for the Isaacs equation: a geometric approach"*
		12:30 - 2:00	LUNCH BREAK

Page	Session P8: Room Education North 2-115		Chair: N. Wolanski
29	P8.1	2:00 - 3:00	**Mason Porter**, *"Spreading Processes on Networks"*
29	P8.2	3:00 - 4:00	**Renato Iturriaga**, *"Random Lagrangian Systems: Old and New Results"*
		4:00 - 4:30	COFFEE BREAK

Page	Session CDS1: Room Education North 2-115		Org: K. Mischaikow and M. Gameiro
29	CDS1.1	4:30 - 5:00	**Michael Jolly**, *"Computations of vertically averaged 3D Rayleigh-Benard convection"*
29	CDS1.2	5:00 - 5:30	**Jonathan Jaquette**, *"A proof of Wright's conjecture: counting and discounting periodic orbits in a DDE"*
30	CDS1.3	5:30 - 6:00	**Pablo Aguirre**, *"Invariant manifolds and global bifurcations"*
30	CDS1.4	5:30 - 6:00	**Julián Haddad**, *"Global bifurcation-like Theorems in presence of non-vanishing Spectral Flow"*
30	CDS1.5	6:30 - 7:00	**Pedram Emami**, *"On the Global Attractor of 2D Incompressible Turbulence with Random Forcing"*

Page	Session PDE2: Room Education 254		Org: J. F. Bonder and X. Zhao
31	PDE2.1	4:30 - 5:00	**Thomas Hillen**, *"TBA"*
31	PDE2.2	5:00 - 5:30	**Joana Terra**, *"TBA"*
31	PDE2.3	5:30 - 6:00	**Chunhua Ou**, *"Challenge and Breakthrough on Speed Selection for Mono-stable Wave Propagation"*
32	PDE2.4	6:00 - 6:30	**Jian Fang**, *"Forced Waves of the Fisher-KPP Equation in a Shifting Environment"*
32	PDE2.5	6:30 - 7:00	**Ramazi**, *"TBA"*

August 19, 2017, Saturday

Page	Session P9: Room Education North 2-115		Chair: R. Manasevich
32	P9.1	8:30 - 9:30	**Alexandre de Carvalho**, *"Non-Autonomous Morse-Smale Dynamical Systems: Structural Stability under Non-Autonomous Perturbations"*
32	P9.2	9:30 - 10:30	**Julien Arino**, *"Meta-Population Models of Spread of Infectious Diseases in Discrete Space"*
		10:30 - 11:00	COFFEE BREAK
	Session CDS2: Room Education North 2-115		Org: K. Mischairkow and M. Gameiro
33	CDS2.1	11:00 - 11:30	**Marcio Gameiro**, *"Rigorous Computations on Differential Equations"*
33	CDS2.2	11:30 - 12:00	**John Bowman**, *"Pseudospectral methods for investigating the global attractor of 2D turbulence."*
33	CDS2.3	12:00 - 12:30	**Benjamin Pineau**, *"Exponential Integrators"*
	Session C1: Room Education 254		Org: M. Li
34	C1.1	11:00 - 11:30	**Sadia Arshad**, *"Modeling the effect of depression in control of chronic diseases"*
34	C1.2	11:30 - 12:00	**Anuraj Singh**, *"Complex Dynamics in a fractional-ordered prey predator model"*
34	C1.3	12:00 - 12:30	**Xianghong Zhang**, *"The dynamical analysis of different sex-ratio of Wolbachia-carrying mosquito augmentations on the control of dengue fever"*
		12:30 - 2:00	LUNCH BREAK
	Session CDS3: Room Education North 2-115		Org: K. Mischairkow and M. Gameiro
35	CDS3.1	2:00 - 3:00	**Kavita Goyal**, *"Curvelet Optimized Finite Difference Method for Partial Differential Equations."*
35	CDS3.2	3:00 - 4:00	**Ledesma Torres**, *"Solutions for a class of fractional Hamiltonian systems with a parameter"*

	Session C2: Room Education 254		Org: M. Li
36	C2.1	2:00 - 3:00	**Haitao Song**, *"Virus dynamics model with intracellular delays and immune response"*
36	C2.2	3:00 - 4:00	**Yiyuan Wang**, *"The impact of weather and stormwater management ponds on the transmission of West Nile virus"*

CLOSING

Session P1

P1.1

Smooth ergodic theory of finite and infinite dimensional dynamical systems

Lai-Sang Young
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I will report on progress in smooth ergodic theory in contexts that include systems generated by ODEs and semiflows defined by some dissipative nonlinear PDEs and differential delay equations. The focus will be on natural invariant measures and a possible meaning of "typical" solutions. An example of shear-induced chaos arising from the periodic forcing of limit cycles will be used to illustrate the ideas.

P1.2

Singular Limits for Integrable Nonlinear Wave Equations

Peter Miller
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Various singular limits (long-time behavior, small-dispersion or semiclassical limits) for linear constant-coefficient equations can be analyzed with great precision through the combination of Fourier or Green's function integral representations of solutions with classical methods of asymptotic expansions for integrals. For nonlinear integrable equations, the role of an explicit integral representation of solutions is instead played by a Riemann-Hilbert problem of analytic function theory. There is an analogue of the steepest descent method for the asymptotic expansion of integrals that applies to Riemann-Hilbert problems, originally invented by Percy Deift and Xin Zhou. The Deift-Zhou method allows nonlinear integrable problems to be analyzed in similar limits as classical methods allow for linear problems, with similar precision. Naturally new phenomena appear in the nonlinear setting.

This talk will review some of these ideas and then present some details in the context of recent work joint with R. Buckingham on critical phenomena that appear in solutions of the sine-Gordon equation in the semiclassical limit.

Session BT1

BT1.1

Bifurcations in Piecewise Smooth Continuous Mean-Field Models

Sue Ann Campbell
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Using a population density approach, we derive the mean-field model for a network of integrate and fire neurons with spike frequency adaptation. The resulting model is a two dimensional system of piecewise smooth differential equations, representing the network mean synaptic activity and adaptation. We analyze the smooth and nonsmooth bifurcation structure of these equations and show that the system is organized around a pair of co-dimension-two bifurcations that involve, respectively, the collision between a Hopf equilibrium point and a switching manifold, and a saddle-node equilibrium point and a switching manifold. We show how this bifurcation structure is reflected in the dynamics of the original network.

BT1.2

Pest Control by Generalist Parasitoids: a Bifurcation Theory Approach

Gunog Seo
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Megal et al. (Math. Med. Biol. 25, 1-20; 2008) studied a spatial and non-spatial host-parasitoid model motivated by biological control of horse-chestnut leafminers, microlepidoptera (micro moths) which have spread through Europe. Here we focus on the non-spatial model. They considered predation of leafminers by a generalist parasitoid with a Holling type II functional response. They showed that there can be at most six equilibrium points and discussed local stability. In my talk, I revisit their model identifying cases missed in their investigation and discuss the possible consequences with respect to pest control strategies. I study both the local stability of equilibria and global properties. I use a bifurcation theoretical approach and provide analytical expressions for fold and Hopf bifurcations. My numerical results show very interesting dynamics, which include multiple limit cycles, homoclinic orbits, and codimension one bifurcations including: Hopf, fold, transcritical, cyclic-fold, and homoclinic bifurcations as well as codimension two bifurcations including: Bautin and Bogdanov-Takens bifurcations.

Session IDDS1

IDDS1.1

The 2D nonautonomous Navier-Stokes equations with impulses at variable times

Ricardo Silva
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In this talk we will concern with existence and uniqueness of global mild solutions for a new model of Navier-Stokes equations on two-dimensional domains subjected to impulses effects at variable times. By using the framework of impulsive/nonautonomous dynamical systems we are able to consider impulse effects in the system as well relax conditions on the external forcing term, which in our case, is non-linear and explicitly time-dependent. Moreover, we also introduce sufficient conditions on the structure of the impulse set which ensure dissipativity for the system, i.e., uniform boundedness of global solutions starting in bounded sets, which is an indicative to the existence of objects as attractors.

IDDS1.2

Dissipative property for neural fields in an unbounded domain

ANTONIO LUIZ PEREIRA
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We consider a non local evolution equation modelling a neural field in the space Cb(RN) of bounded continuous functions. We prove the existence of a global compactor attractor for the fow generated by this equation, exhibit a continuous Lyapunov function well defined in the whole phase space and conclude that this flow has the gradient property, allowing the characterization of the attractor as the unstable set of the equilibrium point set. We also illustrate our result with a concrete example.

Session P2

P2.1

Front Propagation Dynamics in Chemotaxis Models with Logistics Source on R^N

Wenxian Shen
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Chemotaxis models are used to describe the movements of mobile species or living organisms influenced by certain chemical substances. At the beginning of the 1970s, Keller and Segel introduced some chemotaxis model to describe the aggregation of certain types of bacteria. Since then, a variety of chemotaxis models have been proposed, and a large amount of research has been carried out toward various central problems in chemotaxis models on bounded domains, including global existence of classical/weak solutions with given initial data; finite-time blow-up; pattern formation; etc. In contrast, there is much less study of chemotaxis models on unbounded domains. In the current talk, I will present some recent progress on front propagation dynamics in chemotaxis models with logistic source on R^N . I will first identify the circumstances under which positive classical solutions of such chemotaxis models exist globally, which is fundamental for the study of front propagation dynamics as well as many other dynamical features. It should be pointed out that, in general, it is open whether a positive solution of such a chemotaxis model exists globally. Next, I will discuss the asymptotic stability of nonzero constant equilibria of such chemotaxis models, which also plays a role in the study of front propagation dynamics. I will then consider the spreading properties of positive solutions with compactly supported or front-like initial functions. Throughout the talk, special attention will be given to the combined effect of the chemotaxis sensitivity and the logistic damping on the above dynamical issues. This talk is based on my joint works with Rachidi Salako.

P2.2

Dynamics of Poisson-Nernst-Planck Systems and Ion Channel Problems

Weishi Liu
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Electrodiffusion-diffusion and migration of charged particles- plays a critical role in understanding of natures and in inventions of modern electronic devices. Ionic flow through ion channels is an important particular process of electrodiffusion that depends on many physical parameters such as channel structures (channel shape and spatial distribution of permanent charges), boundary concentrations, electric potential differences, diffusion coefficients, dielectric properties,ionic sizes, etc. It is no surprising that ionic flow exhibits extremely rich dynamics and its study is of great challenge. Poisson-Nernst-Planck (PNP) type systems serve as basic primitive models for ionic flow through ion channels. Mathematical analysis of PNP models plays crucial roles in understanding of ionic flow properties. In fact, the classical Debye-Huckel theory of electrolytes relies on the Poisson-Boltzmann approximation-the equilibrium theory of PNP models. In this talk, we will present a dynamical system framework for analysis of PNP systems. The framework provides an opportunity for one to handle relevant physical quantities all together. A number of results that have direct implications to ionic flow properties will be reported. Most of these results are obtained with collaborators who will be acknowledged in the talk.

Session FDE1

FDE1.1

On Mackey-Glass Equations with Variable Delays

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The celebrated Mackey-Glass equation with a unimodal (hump) feedback function describes blood cells production and gives a classical example how introduction of delays can lead to oscillatory and chaotic behavior. We review known results and investigate generalizations of this equation, especially equations with variable delays. We focus on permanence, oscillation and stability of the positive equilibrium, as well as on stabilization.

Further, we proceed to Mackey-Glass equations where both delays can be incorporated in one nonlinear term. Introduction of two variable delays can change its properties: there may exist non-oscillatory about the positive equilibrium unstable solutions, the effect of possible absolute stability disappears. We obtain sufficient conditions for local and global stability of the positive equilibrium and illustrate the stability tests, as well as new effects of two different delays, with examples.

FDE1.2

Bifurcations and Transmission Dynamics of Compartmental Models for Mosquito-Borne Diseases with Delay

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For emerging and reemerging mosquito-borne diseases, it is important to study the conditions and mechanisms triggering an outbreak and recurrence of an endemic. In this talk, I will present bifurcations and dynamics for compartmental models with delays to address the threshold conditions for an outbreak and recurrence of some general mosquito-borne diseases. The bifurcations include backward bifurcations, Hopf bifurcations and Bogdanov-Takens bifurcations of codimension two and three. I will then associate these bifurcations to the outbreak and recurrence of an endemic of mosquito-borne diseases, in particular, to explain the oscillations of the models with some examples.

FDE1.3

Bifurcations in symmetric networks of coupled Lang-Kobayashi laser models

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The Lang-Kobayashi (LK) equations are rate equations describing the dynamics of semiconductor lasers. We explore ring networks of LK equations with cyclic and dihedral symmetry groups and determine the existence of the basic states called Compound Laser Modes (CLMs). We look at steady-state and Hopf bifurcations from CLMs and use DDE-Biftool to illustrate the symmetry-breaking bifurcations and determine the stability of CLMs. Bifurcations from periodic orbits in the system will be briefly discussed.

FDE1.4

Effects of distributed time delays on some neuronal network micro-circuits

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Adopting general delay distributions, we consider the effects of distributed time delays on some common mathematical models of artificial neuronal micro-circuits. In particular, we study the linear stability of equilibria, and investigate how this is impacted by some model parameters. This is joint work with S.A. Campbell at the University of Waterloo.

FDE1.5

Global Stability in Networked Connectivity and Zika Virus Models

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The dynamics of a networked connectivity model of disease epidemics on a site of n communities, and a recent model of Zika virus dynamics are studied. The main part of the presentation is a detailed global stability analysis of the endemic equilibria. Appropriate Lyapunov functions are constructed using a graph-theoretic method and combinatorial identities introduced by M. Li and Z. Shuai.

Session EICP1

EICP1.1

Asymptotic Analysis for Polarization Effect on Ionic Distribution and Dynamics from Modified Poisson-Nernst-Planck Equations

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Dielectric polarization effect plays important role in many soft matter and electrochemical energy systems at the nano/micro scale. We develop a modified Poisson-Nernst-Planck model to include the dielectric boundary effect for ions in electrolytes. We present the asymptotic analysis for the electric double layer structure of the model and investigate the ionic distribution and dynamics due to the influence of the dielectric boundary. The physical relevance of the analysis is also discussed.

EICP1.2

A New Poisson-Nernst-Planck Model with Ion-Water Interactions for Charge Transport in Ion Channels

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In this work we propose a new Poisson-Nernst-Planck (PNP) model with ion-water interactions for biological charge transport in ion channels. Due to narrow geometries of these membrane proteins, ion-water interaction is critical for both dielectric property of water molecules in channel pore and transport dynamics of mobile ions. We model the ion-water interaction energy based on realistic experimental observations in an efficient mean-field approach. Variation of a total energy functional of the biological system yields a new PNP type continuum model. Numerical simulations show that the proposed model with ion-water interaction energy has the new features that quantitatively de- scribe dielectric properties of water molecules in narrow pores and are possible to model the selectivity of some ion channels.

EICP1.3

Flux ratios and channel structures via Poisson-Nernst-Planck systems

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This is a joint work with Bob Eisenberg (Rush Medical Center) and Weishi Liu (University of Kansas). In this work, we investigate Ussing?s unidirectional fluxes and flux ratios of charged tracers motivated particularly by the insightful proposal of Hodgkin and Keynes on a relation between flux ratios and channel structure. Our study is based on analysis of quasi-one-dimensional Poisson-Nernst-Planck type models for ionic flows through membrane channels. We focus on two treatments of tracer flux measurements that serve as estimators of important properties of ion channels. The first estimator determines the flux of the main ion species from measurements of the flux of its tracer. The second treatment of tracer fluxes concerns ratios of fluxes and experimental setups that try to determine some properties of channel structure. This work is a first step showing how measurements of fluxes and flux ratios can give important insights into channel structure and function.

EICP1.4

Ion size effects on ionic flows via Poisson-Nernst-Planck systems

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We analyze a one-dimensional steady-state Poisson-Nernst-Planck type model for ionic flow through a membrane channel with oppositely charged ion species. A local hard-sphere potential is included in the model to account for ion size effects on ionic flows. The model problem is treated as a boundary value problem of a singularly perturbed differential system. Our analysis is based on the geometric singular perturbation theory but, most importantly, on specific structures of this concrete model. The existence of solutions to the boundary value problem for small ion sizes is established and, treating the ion sizes as small parameters, we also derive approximations of the individual fluxes, the I-V (current-voltage) relation and identify eight critical potentials or voltages for ion size effects. Under electroneutrality boundary conditions, each of these eight critical potentials separates the potential into two regions over which the ion size effects are qualitatively opposite to each other. On the other hand, without electroneutrality boundary conditions, the qualitative effects of ion sizes will depend not only on the critical potentials but also on boundary concentrations and relative ion valences. Important scaling laws of I-V relations and critical potentials in boundary concentrations are obtained. The flow properties of interest depend on multiple physical parameters such as boundary conditions (boundary concentrations and boundary potentials) and diffusion coefficients, in addition to ion sizes and ion valences. For the relatively simple setting and assumptions of the model in this paper, we are able to characterize, almost completely, the distinct effects of the nonlinear interplay between these physical parameters. We believe our results will provide useful insights for numerical and even experimental studies of ionic flows through membrane channels.

EICP1.5

Mean Field Free Energy Functional of Electrolyte Solution with Non-homogenous BCs and the Generalized PB/PNP Equations

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In electrolyte solution study, people usually use a free energy form of an infinite domain system (with vanishing potential boundary condition) and the derived PDE(s) for analysis and computing. However, in many real systems and/or numerical computing, the objective domain is bounded, and people still use the similar energy form, PDE(s) but with different boundary conditions, which may cause inconsistency. In this report, (1) we present a mean field free energy functional for electrolyte solution within a bounded domain with either physical or numerically required artificial boundary. Apart from the conventional energy components, new boundary interaction terms are added for both Neumann and Dirichlet boundary conditions. (2) The traditional physical-based Poisson-Boltzmann (PB) equation and Poisson-Nernst-Planck (PNP) equations are proved to be consistent with the new free energy form, and different boundary conditions can be applied. (3) In particular, for inhomogeneous electrolyte with ionic concentration-dependent dielectric permittivity, we derive the generalized Boltzmann distribution (thereby the generalized PB equation) for equilibrium case, and the generalized PNP equations (VDPNP) for non-equilibrium case, under different boundary conditions. (4) Furthermore, the energy laws are calculated and compared to study the energy properties of different energy functionals and the resulted PNP systems.

Session P3

P3.1

SRB measures, Entropy, and Horseshoe for infinite dimensional dynamical systems

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This talk contains three parts: (1) Lyapunov exponents for infinite dimensional dynamical systems; (2) the existence of SRB measures and their properties for infinite dimensional dynamical systems and SRB measures for parabolic PDEs undergoing Hopf bifurcations driven by a periodic forcing with applications to the Brusselator; (3) Positive entropy implying the existence of horseshoes for infinite dimensional dynamical systems. This is based on the joint works with Zeng Lian, Peidong Liu, Qiudong Wang, and Lai-Sang Young.

P3.2

Optimal transportation between unequal dimensions

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Over the last few decades, the theory of optimal transportation has blossomed into a powerful tool for exploring applications both within and outside mathematics Its impact is felt in such far flung areas as geometry, analysis, dynamics, partial differential equations, economics, machine learning, weather prediction, and computer vision. The basic problem is to transport one probability density onto other, while minimizing a given cost $c(x, y)$ per unit transported. In the vast majority of applications, the probability densities live on spaces with the same (finite) dimension. After briefly surveying a few highlights from this theory, we focus our attention on what can be said when the densities instead live on spaces with two different (yet finite) dimensions. Although the answer can still be characterized as the solution to a fully nonlinear differential equation, it now becomes badly nonlocal in general. Remarkably however, one can identify conditions under which the equation becomes local, elliptic, and amenable to further analysis.

Session FDE2

FDE2.1

Impacts of the cell-free and cell-to-cell infection modes on viral dynamics

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Virus can disseminate among uninfected target cells via two modes, namely, the diffusion- limited cell-free viral spread and the direct cell-to-cell transfer using virological synapses. In this talk, we propose and analyze a general viral infection model to investigate the impact of these two modes on the viral dynamics. The model also includes nonlinear target-cell dynamics, infinitely distributed intracellular delays, nonlinear incidences, and concentration-dependent clearance rates. Under some reasonable assumptions, the model exhibits a global threshold dynamics. Two specific examples are provided to illustrate that our theoretical results cover and improve some existing ones. When the underlying assumptions are not satisfied, oscillation via global Hopf bifurcation can be observed. Two-parameter bifurcation analyses are carried out to explore the joint impacts on viral dynamics for the interplay between nonlinear target-cell dynamics and intracellular delays and between the two infection modes. This a joint work with Prof. Hongying Shu and Prof. Lin Wang.

FDE2.2

Delay Differential Equations in Hematopoiesis

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We present a model for the production of white blood cells from hematopoietic stem cells which incorporates both the kinetics and dynamics of the principal cytokine that regulates this process. The resulting model has discrete, distributed and state-dependent delays in 5 differential equations and over 20 parameters. The stem cell component of the model consists of a single constant delay equation whose dynamics we explore in depth, revealing invariant tori, chaotic dynamics and an apparent canard explosion.

FDE2.3

A Malaria Transmission Model with Temperature-Dependent Incubation Period

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Malaria is an infectious disease caused by Plasmodium parasites and is transmitted among humans by female Anopheles mosquitoes. Climate factors have significant impact on both mosquito life cycle and parasite development. To consider the temperature sensitivity of the extrinsic incubation period (EIP) of malaria parasites, we formulate a delay differential equations model with a periodic time delay. We derive the basic reproduction ratio R_0 and establish a threshold type result on the global dynamics in terms of R_0, that is, the unique disease-free periodic solution is globally asymptotically stable if $R_0 < 1$; and the model system admits a unique positive periodic solution which is globally asymptotically stable if $R_0 > 1$. Numerically, we parameterize the model with data from Maputo Province, Mozambique and simulate the long term behavior of solutions. The simulation result is consistent with the obtained analytic result. In addition, we find that using the time-averaged EIP may underestimate the basic reproduction ratio.

This talk is based on a joint work with Prof. Xiao-Qiang Zhao.

Session IDDS2

IDDS2.1

SYSTEMS OF QUASILINEAR ELLIPTIC EQUATIONS WITH WEIGHTS

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We consider system of quasilinear elliptic equations with weight of the form

$$(Qs)\begin{cases} \operatorname{div}(|x|^{\varsigma}\nabla u) + |x|^{\nu} v^{\delta}(x) = 0 & \text{in } \Omega, \\ \operatorname{div}(|x|^{\bar{\varsigma}}\nabla v) + |x|^{\bar{\nu}} u^{\mu}(x) = 0 & \text{in } \Omega. \end{cases}$$

We will show some results of Liouville type, i.e, nonexistence of positive radial solutions that decay to zero at infinity in $\Omega = \mathbb{R}^n$, solutions that we call ground states, and some results for the existence and nonexistence of positive radial solutions when Ω is a ball in $\mathbb{R}^N$.

This talk is based on a cooperation with Marta Garcia Huidobro.

IDDS2.2

Well-posedness for the initial-boundary-value problem for the Benney-Luke equation in a quarter plane

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In this paper we consider the initial-boundary-value problem associated with the Benney-Luke equation on the half line

$$\begin{cases} u_{tt} - u_{xx} + a u_{xxxx} - b u_{xxtt} + p u_t u_x^{p-1} u_{xx} + 2u_x^p u_{xt} &= 0, \\ u_x(0,t) = h_1(t), \quad u_t(0,t) &= h_2(t) \\ u_x(x,0) = f_1(x), \quad u_t(x,0) &= f_2(x), \end{cases} \tag{1}$$

where functions f_i and h_i belong to suitable Sobolev type spaces. For $p = 1$, this equation is a formally valid approximation for describing small-amplitude, long water waves in water of finite depth. This equation is the one dimensional version of the model derived by J. Quintero and R. Pego in [1] as an isotropic model for three-dimensional water waves, where the parameters $a > b > 0$ are such that $a - b = \sigma - \frac{1}{3}$, with σ being associated with the surface tension. In contrast to one-way equations such as the KdV, or BBM equations, we point out that the model (1) is an approximation formally valid for describing *two-way* water wave propagation in the case $p = 1$.

It is important to mention that the study of the initial-boundary-value problems (**IBVP**) for dispersive water wave models has recently brought the attention to some researcher due to the need for looking those models in a finite domains or in the half line, and also due to its importance in the theory of controllability of those models (see [2], [3], [4], [5], [6], [7], [8]). For instance, in the **IBVP** for the KdV equation, using the boundary forcing methods for initial data $(\varphi, h) \in H^s(\mathbb{R}^+) \times H^{\frac{s+1}{3}}(\mathbb{R}^+)$, J. Colliander and C. Kenig in ([3]) with $s \geq 0$, and J. Holmer in [4] for $s \geq -\frac{3}{4}$ established a local well-posedness result for the (**IBVP**) for the KdV model. J. Bona, S. Sun, and B. Zhang in [2] using a Laplace transform technique studied the local well-posedness $(\varphi, h) \in H^s(\mathbb{R}^+) \times H_{loc}^{\frac{s+1}{3}}(\mathbb{R}^+)$ with $s \geq \frac{3}{4}$.

Now, in the case of the "good Boussinesq equation", the local well-posedness for (**IBVP**) was established by R. Xue in [6] using the contraction principle and a Laplace transform technique, as the one used by J. Bona, S. Sun, and B. Zhang in [2] in the case of the (**IBVP**) for the KdV equation, for initial data $(f, h) \in H^s(\mathbb{R}^+) \times H^{s-1}(\mathbb{R}^+)$ and boundary condition $(h_1, h_2) \in H^{\frac{s}{2}+\frac{1}{4}}(\mathbb{R}^+) \times H^{\frac{s}{2}-\frac{3}{4}+\epsilon}(\mathbb{R}^+)$, under some compatibility conditions, for $s > \frac{1}{2}$ and $\epsilon > 0$ small. Moreover, the global well-posedness was established in the case of zero boundary data and initial conditions $(f, h) \in H_0^s(\mathbb{R}^+) \times H_0^{s-1}(\mathbb{R}^+)$ for $s \geq 1$ with $\|f\|_{H_0^1(\mathbb{R}^+)} + \|h\|_{L^2(\mathbb{R}^+)}$ small.

The aim of this work is to establish a well-posedness result for (**IBVP**) associated with the Benney-Luke equation on the half line, on suitable Sobolev type spaces, imposing some compatibility conditions on the initial-boundary-data. The solution mapping associated to the appropriate initial-boundary-data is Lipschitz between appropriate Banach spaces. We follow the approach used by R. Xue for the "good Boussinesq equation" and J. Bona, S. Sun, and B. Zhang in [2] in the case of the KdV equation. In other words, we will use the contraction mapping principle and a Laplace transform technique to study the (**IBVP**) for the Benney-Luke equation (1).

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IDDS2.3

Optical solitons in nematic liquid crystals: nonlocal and saturation effects

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We consider a system of an NLS equation coupled to a nonlinear elliptic equation that models the interaction of laser light with the director field of a nematic liquid crystal. The model is derived from the Oseen-Frank-Maxwell equations and has been used to describe experimentally observed optical solitons. Considering the elliptic equation, we show the existence of a unique solution that satisfies a pointwise bound for arbitrary laser field intensity. This analysis is used to show local and global well-posedness for the initial value problem. We also show the existence of energy minimizing soliton solutions for sufficiently large L^2 norm.

Session P4

P4.1

Least action, incompressible flow, and optimal transportation

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We describe a striking connection between Arnold’s least-action principle for incompressible Euler flows and geodesic paths for Wasserstein distance. The least-action problem for geodesic distance on the ‘manifold’ of fluid-blob shapes exhibits instability due to microdroplet formation. A connection with fluid mixture models via a variant of Brenier’s relaxed least-action principle for generalized Euler flows will be outlined also. This is joint work with Jian-Guo Liu and Dejan Slepcev.

P4.2

Transmission Dynamics of Two Dengue Serotypes with vaccination scenarios

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In this talk we present a mathematical model that incorporates two Dengue serotypes. The model has been constructed to study both the epidemiological trends of the disease and conditions that allow coexistence in competing strains. We consider two viral strains and temporary cross-immunity with one vector mosquito population. Results suggest that vaccination scenarios will not only reduce disease incidence but will also modify the transmission dynamics. Indeed, vaccination and cross immunity period were seen to decrease the frequency and magnitude of outbreaks.

Session BT2

BT2.1

TBA

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BT2.2

On the Global Stability of a Patch-Occupancy Barnacle-Algae-Mussel Model

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In the paper of PNAS (2015) the authors Huisman et reported on a pristine rocky intertidal community located in one of the world's oldest marine reserves that displayed a complex cyclic succession for more than 20 years. Bare rock was colonized by barnacles and crustose algae, they were overgrown by mussels and the subsequent detachment of the mussels return the bare rock again. In this talk we study a patch-occupancy barnacle-algae-mussel model. First we consider the autonomous system of 4D equations without periodic perturbations. When the mussel is absent, we prove the global stability of an interior local stable equilibrium by showing a periodic solution whenever exists is orbitally asymptotically stable. We first transform the system to a 3D K-type competitive system. Then we consider the corresponding second compound system and construct a Lyapunov function to prove the orbital asymptotic stability of the periodic solution. Then we consider the case that the mussel is present. We prove the extinction case by comparison method and Butler-McGhee Lemma and then the uniform persistence of positive equilibrium. For the case of periodic perturbations, we show the possibility of chaos by numerical simulation results.

BT2.3

Bifurcation analysis of a diffusive population model for pioneer-climax species

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I will report some bifurcation results of a general diffusive population model for interactions of pioneer and climax species subject to the no-flux boundary condition, including steady state bifurcations and Hopf bifurcations. In particular, we identify a condition for Turing instability not to occur, and we also obtain some conditions for occurrences of Turing bifurcations and Hopf bifurcations. I will also present some numerical simulation results to demonstrate and extend the obtained analytic results which suggest that the spatial diffusion may make the climax species more dominant. The results indicate that the model, with spatial diffusion incorporated, can have very rich spatial-temporal dynamics.

BT2.4

Dynamics and Bifurcations in Some Models of Infectious Diseases

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In this talk, I will introduce some compartmental models to study the complex dynamics of infectious diseases. By considering the nonlinear recovery rate, the impact of limited health resources on recurrence of diseases is investigated. Our study shows that the nilpotent singularity of high codimension will be the organizing center for the complex dynamics. Oscillations during the transmission of mosquito-borne diseases will be discussed.

BT2.5

Mathematical Modeling of Macroalgal Allelopathy in the Emergence of Coral Diseases

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Competition between macroalgae and corals for occupying the available space in sea bed is an important ecological process underlying coral-reef dynamics. Several benthic macroalgae species produce allelopathic chemical compounds that hinder the settlement and survival of coral larvae. Toxic macroalgae species damage coral tissues when in contact by transferring hydrophobic allelochemicals present on macroalgal surfaces. This leads to the reduction in fecundity of corals and even coral mortality. Also, the release of allelochemicals by toxicmacroalgae influences the microbes associated with corals by transmitting pathogens. Proliferation of benthic macroalgae in coral reefs results in increased physical contacts between corals and macroalgae, triggering the susceptibility of coral disease. The abundance of macroalgae changes the community structure towards macroalgae dominated reef ecosystem. We investigate coral-macroalgal phase shift in presence of macroalgal allelopathy and microbial infection on corals by means of an eco-epidemiological model under the assumption that the transmission of infection occurs through both contagious and noncontagious pathways. We first perform equilibrium and stability analysis on our non-linear ODE model and found that the system is capable of exhibiting the existence of two stable configurations of the community under the same environmental conditions by allowing saddle-node bifurcations that involves in creation and destruction of fixed points and associated hysteresis effect. It is observed that in presence of low coral recruitment rate on algal turf and reduction in herbivory, the system exhibits hysteresis through a saddle-node bifurcation and a transcritical bifurcation. Also, the system undergoes a supercritical Hopf bifurcation if disease-transmission rate crosses certain critical value. Further, we examine the effects of incubation time lag of infectious agents develop in susceptible corals after coming in contact with infected corals and a time lag in the recovery of algal turf in response to grazing of herbivores by performing equilibrium and stability analyses of delay-differential forms of the ODE model and found that when macroalgal recovery time lag and incubation time lag cross some critical thresholds, the interior equilibrium loses its stability and a Hopf bifurcation occurs.

Session IDDS3

IDDS3.1

Regularity with respect to parameters of the Banach Fixed Point Theorem. Applications to Linearization in Infinite Dimensions.

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This talk will be mostly based in the following papers: H. M. Rodrigues and J. Solà-Morales, ”On the Hartman-Grobman theorem with parameters”, J. Dynam. Differential Equations 22 (2010) 473-489. Hildebrando M. Rodrigues and J. Solà-Morales, ”Differentialbility with respect to parameters in global smooth linearizarion”, J. Differential Equations 262 (2017) 3583-3596. Some historic results. Some Elementary Motivations. On the relationship between norms of bounded linear operators and their spectral radius. A Hartman-Grobman Theorem with parameters. Continuity of the Conjugation with respect to parameters. The Continuity of the Fixed Point with respect to parameters. The Differentiability of the Fixed Point with respect to parameters. A Hartman-Grobman Theorem with parameters. Differentiability of the Conjugation with respect to parameters.

IDDS3.2

An Elastic Nonlinear Mapping in Banach Spaces and Fixed Point Theory

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Let E be a smooth Banach space with a norm $\|\cdot\|$. Let $V(x,y)=\|x\|^2+\|y\|^2-2(x,Jy)$ for any $x,y\in E$, where $(\cdot,\cdot)$ stands for the duality pair and J is the normalized duality mapping. There are many mappings which are characterized by this bifunction $V(\cdot,\cdot)$ (cf.[1]). A nonlinear mapping named V-strongly nonexpansive mapping is also one of them. We have named it a V-strongly nonexpansive mapping because of a behavior of nonexpansive mappings in a Hilbert space. However, we have just discovered a fact that this mapping is not always nonexpansive in Banach spaces (see [2]-[4]). Moreover,we remark that it is not guaranteed that a V-strongly nonexpansive mapping is always continue in all Banach spaces (see [3],[4]).

In this talk, we introduce the results which are already obtained with respect to relations with a V-strongly nonexpansive mapping and other nonlinear mappings in a Hilbert space, and properties of this elastic nonlinear mapping in Banach spaces. Finally, we show some fixed point theorems with respect to this nonlinear mappings.

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IDDS3.3

Unbounded Attractors Under Perturbations

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We put forward the recently introduced notion of unbounded attractors. These objects will be addressed in the context of a class of 1-D semilinear parabolic equations. The nonlinearities are assumed to be non-dissipative and, in addition, defined in such a way that the equa- tion possesses unbounded solutions as time goes to infinity. Small autonomous and non-autonomous perturbations of these equations will be treated. This is based on joint work with A. Carvalho and S. Bruschi.

IDDS3.4

On Global Properties of Gowdy Spacetimes in Brans-Dicke Theory

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Recent results show that standard singularity theorem that holds when an energy condition is applied in general relativity also holds when that energy condition is applied to the Bakry-Emery-Ricci tensor which naturally arises in the scalar-tensor theory of gravity. The theory is one of the generalized theories of gravitation and is a low energy effective superstring theory. Thus it is important to investigate global behavior of solutions to the gravitational field equations in the theory. We study the global properties of the Gowdy spacetime generated by Cauchy data on T^3 in the Brans-Dicke theory which is one of the scalar-tensor theory of gravity. We show that the past boundaries of the maximal Cauchy developments of Gowdy initial data sets are asymptotically velocity-terms dominated singularities. The Kretschmann scalar blows up on the boundary. Thus the maximal Cauchy development cannot extend beyond the boundary and our result shows that the validity of the strong cosmic censorship conjecture.

IDDS3.5

On the Keller-Segel-Navier-Stokes Equations with Initial Data in Lp-Spaces

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We consider an attraction-repulsion chemotaxis model coupled with the Navier-Stokes system. This model describes the interaction between a type of cells (e.g., bacteria), which proliferate following a logistic law, and two chemical signals produced by the cells themselves that degraded at a constant rate. Also, it is considered that the chemoattractant is consumed with a rate proportional to the amount of organisms. The cells and chemical substances are transported by a viscous incompressible fluid under the influence of a force due to the aggregation of cells. We prove the existence of global mild solutions in bounded domains of $\mathbb{R}^N$, $N = 2, 3$, for small initial data in L^p-spaces.

Session P5

P5.1

Dynamics of the Weakly Damped Focusing Subcritical Klein-Gordon Equation

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We consider the focusing subcritical Klein-Gordon equation with positive damping and radial data. We show that either the solutions blow up in finite time or they converge to an equilibrium point (Joint work with N. Burq and W. Schlag)

P5.2

Opinión formation model in the presence of stubborn people

Nicolas Saintier
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In this talk I will present a detailed study of a model of formation of opinion that takes into account the power of conviction and the volatility of each agent in the population. It turns out that the stubborn agents, those who never change their opinion, impose their view to the rest of the population: the distribution of opinions of the non-stubborn agents converges to a Dirac mass centered at some opinion explicitly given in term of the opinion of the stubborn agents. We give an explicit rate of convergence using a Monge-Kantorovich distance. This derivation relies on the study of some nonlocal transport equation describing the asymptotic behavior of the density of opinion which is rigorously obtained as the grazing-limit of some Boltzmann-like equation.

This is a joint work with J.P.Pinasco (Univ. Buenos Aires - Argentina), M: Perez-Llanos (Univ. Buenos Aires - Argentina) and A. Silva (Univ. San Luis - Argentina)

George R. Sell Lecture

P6.1

Some Generic Properties of Delay-Differential Equations

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We discuss some generic properties of delay-differential equations, in the spirit of the Kupka-Smale Theorem. Results are very dependent on the class of equations considered; for example generic hyperbolicity of periodic solutions holds for equations of the form $\dot{x}(t) = f(x(t), x(t-1))$, but is unknown for equations of the form $\dot{x}(t) = f(x(t-1))$. This study is motivated in part by efforts to understand global continuation and global bifurcation of periodic orbits for such equations.

Session P7

P7.1

The KdV equation with almost periodic initial data

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Percy Deift conjectured that solutions to the KdV equation with almost periodic initial data exist globally and are almost periodic in time. Recent work by Ilia Binder, Michael Goldstein, Milivoje Lukic, and the speaker has established this conjecture under suitable assumptions on the spectral properties of the Schrödinger operator with potential given by the almost periodic initial condition in question. Specifically, it is assumed that the spectrum as a set is not too thin and the spectral measures are absolutely continuous. These properties have been verified for small analytic quasi-periodic functions with Diophantine frequency vector. This talk will present the history and context of the problem, and explain the BDGL approach to the Deift conjecture.

P7.2

Rigorously verified computing for infinite dimensional nonlinear dynamics: a functional analytic approach

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Studying and proving existence of solutions of nonlinear dynamical systems using standard analytic techniques is a challenging problem. In particular, this problem is even more challenging for partial differential equations, variational problems or functional delay equations which are naturally defined on infinite dimensional function spaces. The goal of this talk is to present rigorous numerical technique relying on basic functional analytic tools to prove existence of steady states, time periodic solutions, traveling waves and connecting orbits for the above mentioned dynamical systems. We will spend some time identifying difficulties of the proposed approach as well as time to identify future directions of research.

Session FDE3

FDE3.1

Formation, bifurcations and switches of flocking in a two-agent flock with processing delay

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In this joint work with Xiao Wang and Jianhong Wu, we present necessary and sufficient conditions for a two-agent flock model to admit a time-asymptotic flocking provided the processing delay is relatively small. The results provide a relation based on which proper initial positions and velocities can be

selected to form a flocking with predetermined position displacement distance. The concepts of flocking-transcritical bifurcation and flocking-Hopf bifurcation are introduced. These bifurcations show that the processing delay can terminate or induce a flocking, and can also induce a periodic flocking. It is also shown that the processing delay can induce flocking switches in the sense that as the processing delay varies, the flock may undergo a sequence of bifurcations leading to the switch from one flocking state to another.

FDE3.2

Lyapunov-Razumikhin techniques for state-dependent delay differential equations

Felicia Magpantay
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We present theorems for the Lyapunov and asymptotic stability of the steady state solutions to general state-dependent delay differential equations (DDEs) using Lyapunov-Razumikhin methods. These theorems build upon the previous work of Hale and Verduyn Lunel (1993) and Barnea (1969) which were mainly aimed at equations with simpler delay terms (e.g. constant and time-dependent delays), and are less applicable to state-dependent DDEs such as the following model equation,

$$\dot{u}(t) = \mu u(t) + \sigma u(t - a - cu(t)).$$

For fixed a and c, the stability region Σ_* of the zero solution to this model problem is known, and it is the same for both the constant delay ($c = 0$) and state-dependent delay ($c \neq 0$) cases. Using our results we can prove the asymptotic stability of the zero solution to this model problem in parts of Σ_*, considerably expanding upon the work of Barnea who proved Lyapunov stability for the simpler $\mu = c = 0$ constant delay case. Similar techniques are used to derive a condition for global asymptotic stability of the zero solution to the model problem, and bounds on periodic solutions when the zero solution is unstable.

This is joint work with A.R. Humphries.

FDE3.3

Bifurcation Analysis of an Age-Structured Model for Thrombopoiesis

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An age-structured model for thrombopoiesis was developed to better understand periodic diseases associated with platelet production in some individuals. The model was fitted successfully to clinical data for subjects with normal and pathological platelet production by varying four parameters. A single stationary solution was shown to undergo a Hopf bifurcation. The study explored sensitivity to the various parameters and examined the most significant changes in behavior of the system with respect to these parameters. It was observed that near the Hopf bifurcation there was a very rapid transition of the stationary solution along with the change in the real part of the leading pair of eigenvalues. The creation and analysis of the characteristic equation from this model provides some interesting new ideas. We examine the most significant factors in the model and discuss the physiological significance leading to the pathological state, where levels of platelets and thrombopoietin vary periodically. Alternate modeling ideas are presented to reduce this complex system and gain a better understanding of the source of the Hopf bifurcation, which might improve insight into the primary problems underlying the diseased state.

Session PDE1

PDE1.1

Finite Morse Index Implies Finite Ends

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We prove that finite Morse index solutions to the Allen-Cahn equation in R^2 have finitely many ends and linear energy growth. The main tool is a curvature decay estimate on level sets of these finite Morse index solutions, which in turn is reduced to a problem on the uniform second order regularity of clustering interfaces for the singularly perturbed Allen-Cahn equation in R^n. Using an indirect blow-up technique, in the spirit of the classical Colding-Minicozzi theory in minimal surfaces, we show that the obstruction to the uniform second order regularity of clustering interfaces in Rn is associated to the existence of nontrivial entire solutions to a (finite or infinite) Toda system in $R^{n?1}$. For finite Morse index solutions in R^2, we show that this obstruction does not exist by using information on stable solutions of the Toda system.

PDE1.2

Uniqueness of Minimal Energy Solutions for a Semilinear Problem Involving the Fractional Laplacian

Julian Fernandez Bonder
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In this paper we study a semilinear problem for the fractional laplacian that are the counterpart of the Neumann problems in the classical setting. We show uniqueness of minimal energy solutions for small domains.

PDE1.3

Regularity theory for the Isaacs equation: a geometric approach

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In this talk, we consider an Isaacs equation and study the regularity of solutions in Sobolev and Hölder spaces. This class of equations arises in the study of two-players, zero-sum, stochastic differential games. In addition, it is a toy-model for non-convex/non-concave operators. In the framework of viscosity solutions, fundamental developments regarding the Isaacs equation have been produced; for example, the existence and uniqueness of solutions. We propose an approximation method, relating the Isaacs operator with a Bellman one. From a heuristic viewpoint, we import regularity from the latter to our problem of interest, by imposing a *proximity regime*. Distinct regimes yield different classes of estimates, covering the cases of Sobolev and Hölder spaces. We close the talk with some consequences and applications of our results.

Session P8

P8.1

Spreading Processes on Networks

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Diseases, rumors, memes, "alternative facts", and many other things spread on networks, whose structure has a significant effect on spreading processes. In this talk, I will give an introduction to spreading processes on networks. I will discuss several generalizations of "threshold" contagion models, in which spreading occurs when some kind of peer pressure matches or exceeds some kind of internal resistance of nodes. Generalizations that I will discuss include multi-stage contagions, synergy from nodes other than nearest neighbors, incorporation of timers to augment stubbornness thresholds, and the modeling of hipsters. I will also briefly discuss current challenges, such as studying spreading processes on multilayer networks and developing signal-based models of spreading dynamics.

P8.2

Random Lagrangian Systems: old and new results

Renato Iturriaga
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In this talk we will address the existence uniqueness and hyperbolic behaviour of some special orbits of the an stochastic Lagrangian system in the d-dimensional Torus. We will discuss the relation with Hamilton Jacobi equation and the Burgers equation.

Session CDS1

CDS1.1

Computations of vertically averaged 3D Rayleigh-Benard convection

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We look for features of 2D turbulence in the vertical average of momentum in the 3D Rayleigh-Benard system. The resulting 2D system has a body force which involves various integrals of the 3D flow. This force is time-dependent and potentially excites all modes. We recall rigorous results for 2D turbulence under this scenario and compare computed values with rigorous upper bounds for the Grashof number of the vertically averaged flow.

CDS1.2

A Proof of Wright's Conjecture: Counting and Discounting Periodic Orbits in a DDE

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In Wright's equation, $y'(t) = -\alpha y(t-1)[1 + y(t)]$, a Hopf bifurcation at $\alpha = \pi/2$ divides the global dynamics. Wright?s conjecture claims that the zero solution is globally attractive for $0 < \alpha < \pi/2$, and Jones? conjecture claims that there is a unique slowly oscillating periodic solutions (SOPS) for $\pi/2 < \alpha$. In this talk I will discuss how computer assisted proofs have made substantial progress on these conjectures.

CDS1.3

Invariant manifolds and global bifurcations

Pablo Aguirre
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Global bifurcations of maps and vector fields such as homoclinic and heteroclinic phenomena are characterized by the re-arrangement of stable and unstable manifolds of invariant objects under parameter variation. This may result in drastic changes of the dynamics, including transitions to chaotic regimes, transforming or creating basins of attraction and, ultimately, reorganizing the overall structure of the phase space. The aim of this talk is to discuss how the study of global invariant manifolds by analytical and computational methods allows one to obtain deeper insight into the nature of global bifurcations. We will illustrate this topic with examples coming from laser dynamics, population dynamics, and mathematical epidemiology.

CDS1.4

Global bifurcation-like Theorems in presence of non-vanishing Spectral Flow

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Given a one-parameter family of functions $f_t : H \to \mathbb{R}$ where $f_t(0) = 0, \nabla f_t(0) = 0$ and H is a real Hilbert space, the Spectral Flow of the Hessian of f was related recently to local bifurcation results by Fitzpatrick, Pejsachowicz and Waterstraat. While this invariant is finer than the topological index, the existent results are of local nature, in contrast to the global bifurcation theorem of Krasnoselski and Rabinowitz. We prove a global bifurcation theorem for "target values" of f under Spectral Flow hypothesis.

CDS1.5

On the Global Attractor of 2D Incompressible Turbulence with Random Forcing

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This study revisits bounds on the projection of the global attractor in the energy-enstrophy plane for 2D incompressible turbulence [Dascaliuc, Foias, and Jolly 2005, 2010]. In addition to providing more elegant proofs of some of the required nonlinear identities, the treatment is extended from the case of constant forcing to the more realistic case of random forcing. Numerical simulations in particular often use a stochastic white-noise forcing to achieve a prescribed mean energy injection rate. The analytical bounds are illustrated numerically for the case of white-noise forcing.

Session PDE2

PDE2.1

TBA

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PDE2.2

TBA

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PDE2.3

Challenge and Breakthrough on Speed Selection for Mono-stable Wave Propagation

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Since the pioneer work of KPP or Fisher on the study of wave propagation for equation $u_t = u_{xx} + f(u), f(0) = f(1) = 0, f(u) > 0$ for $u \in (0,1)$, traveling wave phenomena in various systems have attracted considerable attention of researchers due to their significant applications in science and engineering. However, the determination of the minimal speed has become a challenging problem and there have been very limited contributions on the so-called non-linear (linear) selection of the minimal speed, including two papers by Lucia, Muratov and Novaga (CPAM, 2004) and Weinberger (DCDSB,2012). As we know, both of them only apply to the scalar KPP equation and cannot be developed to handle the general monotone system $u_{n+1} = Q(u_n)$ that has been studied by Weinberger's group and Liang and Zhao(CPAM,2007). Even for the simple diffusive Lotka-Volterra competition model, Hosono raised a conjecture in 1998. This conjecture has been outstanding for almost 20 years, while there are some part-results by Weinberger's group, and by Wenzhang Huang and his collaborators. I will mainly present our new result on the selection of wave speed for this model and will work on this conjecture. It is expected that our method can be applied to Difference-integral models, delayed reaction diffusion systems, monotone systems with periodic habitat, time-periodic monotone systems.

PDE2.4

Forced Waves of the Fisher-KPP Equation in a Shifting Environment

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We consider the Fisher-KPP equation in a wavelike shifting environment. The questions of interest are whether such an environment can give rise to any forced wave solutions and how they (if exist) attract other solutions. A complete characterization for the solution set and a sharp convergence result are obtained. This talk is based on joint works with Yijun Lou and Jianhong Wu, and with Henri Berestycki.

PDE2.5

TBA

Ramazi
TBA
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Session P9

P9.1

Non-autonomous Morse-Smale Dynamical Systems: Structural Stability under Non-autonomous perturbations.

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In this lecture we present our recent results on structural stability of gradient Morse-Smale Dynamical Systems under non-autonomous perturbations. To that end we introduce the notion of lifted invariant sets and give a characterization of the uniform attractor in terms of dynamical structures of a family of pullback attractors. This is a joint work with G. Raugel (Paris XI), J. Langa (U. Sevilla) and M. Bortolan (UFSC-Brazil) .

P9.2

Meta-Population Models of Spread of Infectious Diseases in Discrete Space.

Julien Arino
University of Manitoba

Session CDS2

CDS2.1

Rigorous Computations on Differential Equations

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We present a rigorous computational method to compute solutions of differential equations. The method combines classical numerical methods, analytic estimates and the uniform contraction principle to prove existence of solutions of nonlinear differential equations. The method is applied to compute periodic solutions and of the Kuramoto-Sivashinsky equations and to study their stability.

CDS2.2

Pseudospectral methods for investigating the global attractor of 2D turbulence.

John Bowman
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A recent study extended the bounds of Dascaliuc, Foias, and Jolly [2005, 2010] on the projection of the global attractor in the energy-enstrophy plane for 2D incompressible turbulence from the case of constant to stochastic forcing. Numerical simulations often use a stochastic white-noise forcing to achieve a prescribed mean energy injection rate.

In this talk, we use new numerical techniques for simulating 2D turbulence to illustrate these bounds on the pullback (random) attractor. We show how white-noise forcing can be robustly implemented numerically, emphasizing the underlying assumption of ergodicity.

To obey the convolution theorem, the pseudospectral simulation method requires dealiasing unwanted harmonics arising from the periodicity of the discrete Fourier transform. Conventionally, dealiasing has been accomplished by zero padding the data in an extended buffer, wasting memory and computer time. We show how the more efficient method of implicit dealiasing can be applied to the formulation of Basdevant [1983] that reduces the number of FFTs for 2D incompressible turbulence from five to four.

Another advance is the technique of dynamic moment averaging, in which the time integrals of moments of the vorticity field are integrated with the same discretization used to advance the vorticity field. These integrals can be used to extract accurate statistical averages over an arbitrary time window specified by the user during the post-processing phase, once the saturation time has been determined a posteriori. We also describe an excellent energy transfer diagnostic for determining when a pseudospectral simulation has reached a steady state.

CDS2.3

Exponential Integrators

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A new method is proposed for deriving exponential integrators for stiff ordinary differential equations. Exponential integrators are explicit discretizations that solve the linear part of the problem exactly. An important property of exponential integrators is that they reduce to classical discretizations in the limit of vanishing linearity. We review the history and current status of exponential integrators, which have been rediscovered many times since Certaine used a first-order exponential method in 1960. Stiff order conditions for exponential integrators were developed in a Banach space framework by Hochbruck and Ostermann [2005].

While first- and second-order exponential integrators are well understood, higher-order methods obeying the stiff order equations are difficult to construct and compute. We demonstrate a technique that can be used to circumvent this problem, by converting any classical integration method into a corresponding exponential discretization.

In particular, we are interested in embedded Runge-Kutta pairs that efficiently generate both a high-order and low-order estimate, to allow dynamic adjustment of the time step to achieve a specified numerical accuracy. An exponential version of the efficient (3,2) embedded Bogacki-Shampine Runge-Kutta pair was previously proposed by Bowman [2006]. To date, no efficient adaptive exponential integrator beyond third order have been presented in the literature. We show how the new technique can be used to derive robust adaptive exponential integrators of any order. We present exponential versions of standard Runge-Kutta (5,4) embedded pairs, which have application to problems with a dominant linearity, such as well-resolved simulations of turbulence.

Session C1

C1.1

Modeling the Effect of Depression in Control of Chronic Diseases

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Aim of this article is to examine the impact of depression on the spread and control of chronic diseases. The higher levels of depression influence chronic disease risk via physiological mechanisms. Acute and chronic depression activates the hypothalamo-pituitary-adrenal (HPA) axis, which activates a flow of neuroendocrine alterations that have adverse effects on physical health and functioning. We introduce an epidemic model that incorporates the influence of depression on physical health. Our computational modeling suggests predictions about disease control. We study the stability of the disease-free and endemic equilibrium points. Numerical simulations of the model are presented to show the effect of various parameter values.

C1.2

Complex Dynamics in a Fractional-Oordered Prey Predator Model

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The dynamical behavior of a fractional ordered prey-predator model is discussed. The stability conditions for local and global behavior are discussed. The numerical simulation substantiate the analytical findings and show complex dynamical behavior for the system. The fractional ordered discrete time prey-predator model exhibit chaotic dynamics.

C1.3

The dynamical analysis of different sex-ratio of Wolbachia-carrying mosquito augmentations on the control of dengue fever

Xianghong Zhang
York University

Wolbachia as an innovative new technology are introduced into mosquito populations to prevent the vectors from reproduction and then break the cycle of dengue transmission. A dynamical model is proposed to investigate the effect of nonidentical sex ration releases of Wolbachia-carrying mosquitoes on the control of dengue transmission. Firstly, we analyze the existence and stability of equilibria of the system, prove the existence of backward bifurcation and the basin of attraction of the equilibria with respect to initial values and the mosquito augmentation. Secondly, three possible results for mosquito augmentation are summarized under different parameter regions. Thirdly, we explore an uncertainty and sensitivity analysis of solutions to estimate the effects of different parameter values on the success or failure of population replacement. Based on the above analysis, we consider a series of relevant issues such as (a) whether mosquito augmentation can guarantee the success of population replacement? (b) If not, what are the parameter regions for the success or possible success of population replacement? (c) How the initial density of natural mosquitoes and the quantity of mosquito augmentation affect the success of population replacement? The results of this study could be helpful for public health authorities in designing proper plan of mosquito augmentation for the control of dengue transmission. This is a joint work with Qiyong Liu, Sanyi Tang and Huaiping Zhu.

Session CDS3

CDS3.1

Curvelet Optimized Finite Difference Method for Partial Differential Equations

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This paper proposes curvelet optimized finite difference method to solve partial differential equations (PDEs). The method uses finite difference approximations for differential operators involved in the PDEs. After the approximation, it uses curvelets for generation of the adaptive grid. The grid which is used for obtaining the numerical solutions of PDEs is obtained with the help of curvelets. Before generation of the adaptive grid using curvelets, compression and reconstruction errors have been tested with respect to different parameters. The developed method has been applied on five test problems of different nature. For each test problem the convergence of the method is verified. Moreover, to measure the efficiency of the proposed method the CPU time taken by the method is compared with the CPU time taken by finite difference method. It is observed that the proposed method is computationally very efficient.

CDS3.2

Solutions for a Class of Fractional Hamiltonian Systems with a Parameter

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In this paper we are concerned with the existence of solutions for the following fractional Hamiltonian systems with a parameter

$$\begin{cases} -{}_tD^{\alpha}_{\infty}({}_{-\infty}D^{\alpha}_t u(t)) - \lambda L(t)u(t) + \nabla W(t,u(t)) = 0, \\ u \in H^{\alpha}(\mathbb{R},\mathbb{R}^n), \end{cases} \qquad \text{(FHS)}_\lambda$$

where $\alpha \in (1/2, 1)$, $t \in \mathbb{R}$, $u \in \mathbb{R}^n$, $\lambda > 0$ is a parameter, $L \in C(\mathbb{R}, \mathbb{R}^{n^2})$ is a symmetric matrix for all $t \in \mathbb{R}$, $W \in C^1(\mathbb{R} \times \mathbb{R}^n, \mathbb{R})$ and $\nabla W(t, u)$ is the gradient of $W(t, u)$ at u. The novelty of this paper is that, assuming $L(t)$ is a positive semi-definite symmetric matrix for all $t \in \mathbb{R}$, that is, $L(t) \equiv 0$ is allowed to occur in some finite interval T of $\mathbb{R}$, $W(t, u)$ satisfies Ambrosetti-Rabinowitz condition and some other reasonable hypotheses, we show the existence of nontrivial solution of $(\mathrm{FHS})_\lambda$, which vanishes on $\mathbb{R}\backslash T$ as $\lambda \to \infty$, and converges to $\tilde{u} \in H^\alpha(\mathbb{R})$; here $\tilde{u} \in E_0^\alpha$ is a nontrivial solution of the Dirichlet BVP for fractional systems on the finite interval T. Recent results are generalized and significantly improved.

Session C2

C2.1

Virus dynamics model with intracellular delays and immune response

Haitao Song
York University

In this paper, we incorporate an extra logistic growth term for uninfected CD4+ T-cells into an HIV-1 infection model with both intracellular delay and immune response delay which was studied by Pawelek et al. in [26]. First, we proved that if the basic reproduction number R0 < 1, then the infection-free steady state is globally asymptotically stable. Second, when R0 > 1, then the system is uniformly persistent, suggesting that the clearance or the uniform persistence of the virus is completely determined by R0. Furthermore, given both the two delays are zero, then the infected steady state is asymptotically stable when the intrinsic growth rate of the extra logistic term is sufficiently small. When the two delays are not zero, we showed that both the immune response delay and the intracellular delay may destabilize the infected steady state by leading to Hopf bifurcation and stable periodic oscillations, in which we analyzed the direction of the Hopf bifurcation as well as the stability of the bifurcating periodic orbits by normal form and center manifold theory introduced by Hassard et al [15]. Third, we engaged numerical simulations to explore the rich dynamics like chaotic oscillations, complicated bifurcation diagram of viral load due to the logistic term of target cells and the two-time delays.

C2.2

The impact of weather and stormwater management ponds on the transmission of West Nile virus

Yiyuan Wang
York University

By investigating the data from larvae surveillance program launched by Toronto and Region Conservation Authority (TRCA), Canada, we establish a basic dynamical model to study the impact of Stormwater Management Ponds (SWMP) as well as weather factors on the mosquito abundance and transmission of West Nile virus (WNV). Our analysis and numerical results show that moderate temperature and precipitation, and weak aquatic intraspecific competition among mosquitoes in the SWMP will increase the basic reproduction number, consequently the risk of WNV. Furthermore, an excess of precipitation and fiercer intraspecific competition will reduce vector population and the peak value of infectious vectors and birds. This is a joint work with Wendy Pons, Jessica Fang and Huaiping Zhu.

List of Abstracts by Author

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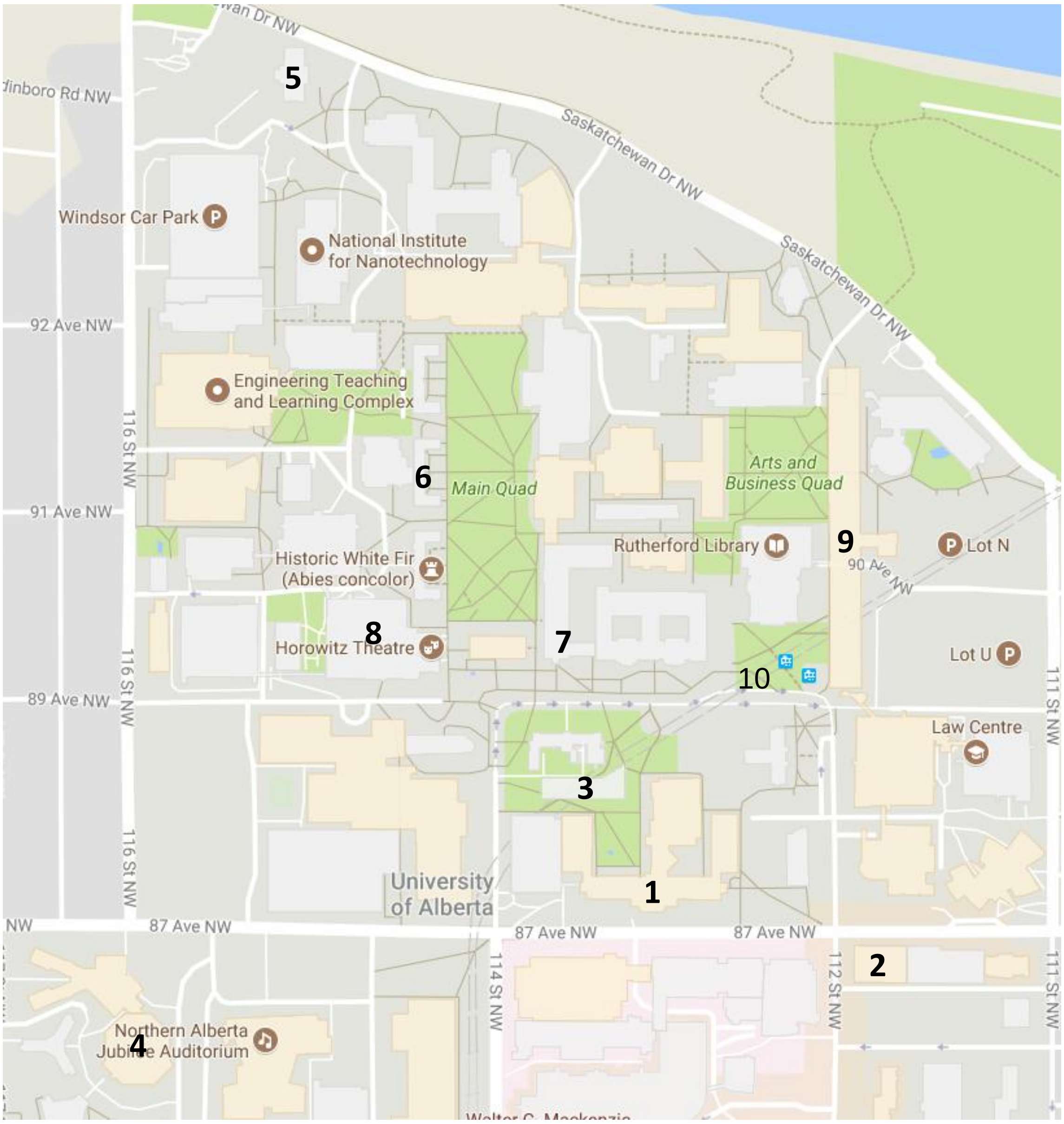

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