Post-Tenure 5-Year Review

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Summary of Accomplishments from 01/2012 through 12/2016

Scholarly activity

- Published 17 peer-reviewed papers, 7 referred book chapters and 6 referred proceedings.
- Citation index is 2838 (Google Scholar), including 1432 citations since 2012.
- h-index is 28 (Google Scholar) - very high for a mathematician.
- Most cited author in the GSU Department of Mathematics and Statistics.
- 3rd highest annual citation rate in GSU Neuroscience Institute (Google Scholar).

Funding

- PI on the $234K NSF grant (2010-2014).
- PI on the $880K NSF grant (2015-19) - ranked #1 by the NSF panel.
- Submitted 2 NSF and 1 RSF grants totaling $1.7M (UCD) in 2016.
- PI of $100K (2012-14) and a Co-PI on $980K (2015-17) international grants.

Teaching

- Supervised 8 GSU PhD students (3 to completion), 2 visiting PhD and 2 international students
- 4 postdocs came to study and work in my lab.
- My PhD students received best presentation awards at major meetings in the field.
- Mentored 9 GSU undergrads, and 1 visiting undergrad.

Service

- Founded and helped a computational group grow at GSU; attracted: Drs. I. Belykh, M. Dhamala, R. Osan, V. Bondorenko, R. Clewley, Y. Jiang, G. Cymbalyuk, and V. Molkov. All generated about $4M in external support.
- Invited Dr. Forger (Michigan U), who is now considered for a GSU Eminent Scholar position.
- Member of multiple departmental committees, including (P&T, Executive) college and university-wide (2CI search) committees.
- Launched a GSU-Genoa University (Italy) partnership and student exchange program
- PI and co-PI of 3 conference grants (total $39K from the Office of Naval Research (2014-16)

Recognition at GSU

- Nominated for the College Outstanding Research Award, 2016.

Recognition Outside of GSU

- Findings are included in many textbooks used by many US colleges and worldwide.
- Shilnikov lab research highlighted in a SIAM Applied Dynamical Systems quarterly bulletin.
- Founding member and current faculty of GaTech Center for Nonlinear Dynamics.
- Held visiting Professor positions at Imperial College London (UK; funded by the Royal Society), University of Zaragoza (Spain), and Potsdam University (Germany).
- Editor of J. Mathematical Neuroscience, Frontier J. Applied Mathematics, and J. Discontinuity, Nonlinearity and Complexity, J. Bifurcations and Chaos (guest editor).
- Grant reviewer for NSF and national funding agencies in the Netherlands, Poland, India, and Russia.
- Reviewer on MIT-SkolTech expert panel for the $850M “5 in 100 Best Universities” strategic plan by the Ministry of Higher Education of Russia (2013-2015).
- 21 keynote and invited addresses at conferences in Australia, Brazil, USA, The Netherland, Germany, Canada, Russia, the UK, Belgium, Portugal and Spain.
- Served on the program committees and organizing committees of over 10 national and international conferences and chaired many workshops and sessions at meeting, including the 2015 Mathematical Biology meeting held at GSU with 500 participants.
- Included in the panel of experts of mathematical sciences in Russia based on Web of Science 1000 citation threshold.
- Invited to the panel of experts of Skolkovo Institute of Science and Technology and the Skoltech/MIT Initiative.

Statement of Research Interests, and Professional Development

I hold a joint position of tenured Professor of Mathematics and Mathematical Neuroscience in the cross-disciplinary Neuroscience Institute (founded and joined in 2008) and the Department of Mathematics and Statistics at Georgia State University (joined in 2000). Since 2014 I am Professor of Applied and Computational Mathematics at my alma mater - Nizhny Novgorod University in Russia.

My original area of expertise is the theory of dynamical systems and global bifurcations. Deterministic chaotic dynamics, Lorenz and any strange attractors with underlying homoclinic and heteroclinic puzzles have been always on my mind. I study complex dynamics, its origin and universal underlying principles and properties in a variety of diverse systems. They include phenomenological and mathematical systems, as well as biologically plausible models from life sciences and highly detailed models from physical sciences.

Of special interest, nowadays to me is a new emergent cross-disciplinary field known as mathematical neuroscience. Its scopes include high-order nonlinear models of individual neurons and cellular networks. Thoroughly understanding the generic bifurcation mechanisms for the transitions between distinct patterns of the activity in realistic models of individual and networked neurons is a fundamental challenge for the theory of applied dynamical systems. In-depth examination of such models requires the further development of advanced theoretical tools paired with sophisticated and efficient computational simulations. I derive mathematical models, detailed and reduced, and create bifurcation toolkits for studying a stunning array of complex activities such as multistability in individual neurons and polyrhythmic bursting patterns discovered in multifunctional central pattern generators governing vital locomotor behaviors of animals and humans. Understanding generic mechanisms of the evolution of neuronal connectivity and transitions between different patterns of neural activity and modeling these processes are fundamental challenges for applied mathematics and mathematical neuroscience.

My research has become inherently interdisciplinary, integrating experimental data and intense computations with sophisticated mathematical analysis. I am committed to collaboration with other research labs in academia and industry. My past and current research projects and external support have provided interdisciplinary training and educational opportunities for graduate students and summer research experiences for undergraduate students. I consider the mentoring of students (as well as postdocs) be one of the most important and rewarding aspects of my job.

Future goals

In the future, I will try to challenge and systematically address the fundamental question of how circuit architecture contributes to the dynamics of neural activity. Our fundamental hypothesis is that neural circuit function is emergent and rises from complex nonlinear interactions among constituent elements - coupled cells or neural motifs. This research trend, a genuine cross-disciplinary research pairing applied mathematics with neuroscience, will develop a new mathematical framework of dynamic principles in life sciences. It aims to extend and generalize our understanding of key bifurcation mechanisms of stability of self-oscillatory patterns, principles of rhythmogenesis and multi-functionality in neural networks. I plan to enhance the applicability of the developed algorithms for systematic studies of rhythmogenesis and formation of bursting patterns and their bifurcations in neural networks, including central pattern generators. This research aims to develop a dynamical system framework of the neural circuit dynamics supporting locomotion functions, as well as to understand how dysfunction in these processes may underlie mobility impairments. Its prime objective is to elucidate how neural circuits can learn, reliably store, and stably produce multiphase coordinated rhythmic activities that determine diverse locomotion behaviors. It aims to further extend our understanding of and next to explain key mechanisms of robustness of synchronized oscillatory patterns in nature, and reveal universal principles of rhythmogenesis and multifunctionality of neural systems. Answering the following questions concerning emergent functional properties shall likely become pivotal contributions of the mathematics of dynamical systems to neuroscience: are there circuit attractors? and what is the functional, not anatomical, connectivity diagram of a circuit? The generality of our modeling approaches developed for swim central pattern generators in the sea mollusks will ensure the applicability of our results and tools for other neural systems.

I will also further intensify my research in the theory of advanced dynamical systems and bifurcations, with scopes focused on ordered and hierarchical complexity of homoclinic bifurcations of saddle structures that can give rise to hyper-chaotic attractors only occurring in high-dimensional systems. I will further continue to foster trans-disciplinary research bridging sophisticated mathematics, computation and applications from the life sciences and engineering. It will deepen our understanding of the origins of deterministic chaos and its universality in modern science, as well as amend the role of nonlocal homoclinic and heteroclinic bifurcations for pattern formations and provide foundations for theoretical predictions in real-world applications. The computational tools developed in my lab will benefit a wide audience of interdisciplinary researchers for studies of diverse nonlinear applications.

Extramural and Departmental Research Funding

I have been very active in grant development and submissions through these years. Since 2012, as PI and co-Pi I have secured and helped secure nearly more than $2M in external funds from various extramural sources.

I would like to indicate that as PI I led several joint grant initiatives that did not get funded after 1st attempts including collaborative research projects on mathematical modeling of neural circuits with Dr. P. Katz (NSF CRCNS), and with Dr. Mayer (UFL) on grid cell pattern formations through NIH in 2016. In 2015 was nominated by the Provost of Monash University (Australia, 72nd position in the University World Ranking) for the $3,100,000 ARC Laureate Fellowship.

The list of the current and past projects includes:

1. Neural Mechanisms underlying evolvability of behavior. NSF. **$880,000**, 06/2015-05/2019, **PI**. The proposal was ranked #1 by the Panel because of the mathematics component.
2. Bifurcations and dynamics in dissipative and Hamiltonian systems. **$980,000** (27,000,000 rubles) from Russian Scientific Foundation (RSF), 09/2014-12/2016, **Co-PI**
3. Multistability and bifurcations for polyrhythmic Central Pattern Generators. DMS-1009591 NSF Applied Mathematics Division and Mathematical Biology, **$219,738.** 08/2010-08/2014, **PI**
4. Studies of formation mechanisms of rhythms for motor activities in biological neuronal networks in application to adaptive bio-robotics, **$91,000** (2,400,000 rubles), #14.740.11.0919 grant "Attracting leading scientists to Russian universities" by Ministry of Education and Science of Russian Federation, 09/2011-12/12, **PI**
5. Summer Research Experience for Undergraduates (REU) Supplement to DMS #1009591, **$14,931.** 5/2011-9/12, **PI**
6. B&B summer assistantship for undergrads, **$3,000**, 05/2016
7. Bridge grant **$8,500**, 2014-2015, **PI**
8. B&B summer assistantships for undergrads, **$4,000**, 05/2014
9. Comparative analysis of neural circuit dynamics. B&B seed grant, **$30,000**, 2012-2013, **Co-PI**
10. Modeling of active amplification and tuning in inner hair cells. B&B seed grant **$21,300**, 2011-2012, **PI**

Three international trips of my former and current students and postdocs, J. Wojcik, A. Kelly and J. Schwabedal to attend the meetings in Russia that I co-chaired and co-organized were supported by the RSF grant (above) and the grants of the Office of Naval Research (Service section).

Pending review

1. Analytical-computational toolkit for bifurcation analysis of complex homoclinic dynamics, NSF, **$310,890**, 2017-2020, pending, **PI**
2. Rhythmogenesis in Multifunctional and Dedicated Neural Networks, NSF, **$310,883**, 2017-2020, pending, **PI**
3. Mathematical Methods of Theory of Living Systems and Dynamical Chaos. Russian Science Foundation. 6,000,000 rubles ($1M), 2017-2020, **PI**

During the reported period, as a visiting Professor, I was invited to visit (fully coved) the Imperial College London (UK; funded by the Royal Society) and University of Zaragoza (Spain), and Potsdam University (Germany).

Academic Awards, Recognition and Marketability

- In 2016 I was nominated for the Outstanding Senior Faculty Research Award at GSU.

During 2014-15, while being on a job market due to family reasons, I was invited for interviews at the following institutions:

- I was invited to an on-campus job interview at Monash University (Australia) in 2015.
- I was nominated by the Provost of Monash University (Australia, 72nd position in the University World Ranking) for the $3.5M ARC Laureate Fellowship for 5 years. http://www.arc.gov.au/australian-laureate-fellowships
- I was selected for an interview for a Professor position at University of North Texas in 2015.
- I was invited to an on-campus job interview at Indiana University (IUPUI) in 2015.
- I was shortlisted for a Professor position at Basque Center for Applied Mathematics (BCAM) in 2015. http://www.bcamath.org/en/
- University of Potsdam and Humboldt University plan to nominate Dr. Shilnikov for the Alexander von Humboldt Professorship in Applied Mathematics in 2018-19. https://www.humboldt-foundation.de/web/alexander-von-humboldt-professorship.html

Publications

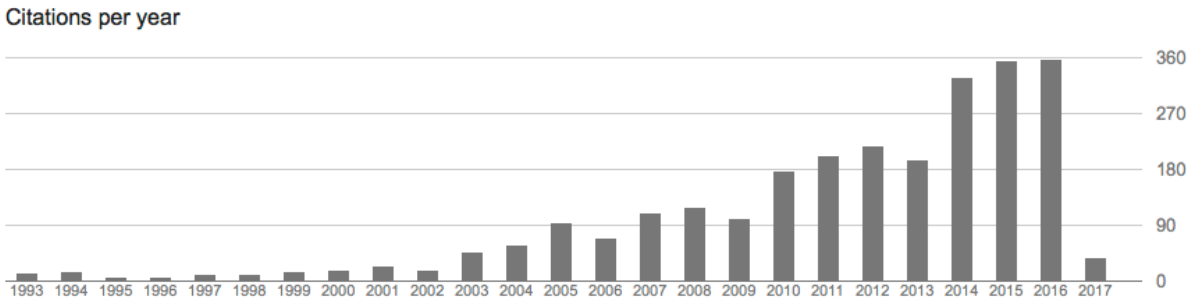
My research has become inherently interdisciplinary, integrating experimental data and intense computations with sophisticated mathematical analysis. My recent papers have generated much interest evidenced by growing citations and keynote speaker invitations for conferences in Australia, Brazil, USA, Holland, Canada and Spain since 2012. The citations of the recent papers come from nine different discipline groups including, first, mathematics, neuroscience, and physics. The impact of my research is therefore felt across disciplines, and across the world, with my research cited in publications across 29 countries.

Since 2012, I have published 17 journal articles in the premier mathematical and trans-disciplinary journals with impact factors (IF) quite high for computational fields. The list of the journals includes Frontier Neural Circuits (IF 3.9), PloS ONE (IF 3.2), J. Nonlinear Dynamics (IF 3.0), Communications in Nonlinear Science and Numerical Simulation (IF 2.8), J Neurophysiology (IF 2.9), Chaos (IF 2.0), Physics Review E (IF 2.3), European Physics Letters (IF 2.0), J. Bifurcations and Chaos (IF 1.4), Nonlinearity (IF 1.3). In addition, I have co-authored 7 referred book chapters and 6 conference proceedings, as well as an uncountable number of conference abstracts.

Most publications list Ph.D. and undergraduate students from my lab as co-authors, and me as the senior author (except, perhaps, for a joint paper [5], which required the combined expertise of both labs). Currently, there are 2 papers under review and at least 10 papers in final phases of completion.

Through many years, I have been the most cited author at Department of Mathematics and Statistics, and the 3rd cited author at NI during the last 3 years. My current citation index is 2588, and h-index is 27 (Google Scholar), whereas my ISI index is 1271 and h-index is 19 (Thomson-Reuter Web of Science, WoS). My publications have been cited 1449 times since 2012 (Google Scholar).

https://scholar.google.com/citations?user=Pi7dBeMAAAAJ&hl=en



These numbers are considered very high for applied mathematician of my age, 54, at any leading research university in the world.

Based of Thomson-Reuter Web of Science, I was included in the panel of the Russian experts to review and evaluate projects in mathematical sciences (the table below lists GSU-affiliated experts) http://expertcorps.ru/science/whoiswho/info/56908

Name	Acad	CI_{tot}	$\sum CI_i/N_i$	CI_7	$\sum_7 CI_i/N_i$	h	CI_{max}	M_{ref},M_{all}	Field	Other Affiliations	Residence	First pub.	Updated
Larkin IA		1262	322.9	10	3.2	14	391	79, 107	cond-mat	Microel Techn Minho U	Braga	1982	2016-03-29
Shilnikov AL		1271	557.1	237	89.6	19	71	46, 183	math		Atlanta, GA	1986	2016-04-11
Stockman MI		9809	4644.7	2477	1280.9	48	900	196, 462	cond-mat mater-sci quant-opt	✈	Atlanta, GA	1972	2017-01-10

Many of my original results are included in the following textbooks on dynamical systems and bifurcations, as well as in two recent textbooks on mathematical neuroscience used for teaching relevant courses at universities worldwide:

- Y. Kuznetsov, *Elements of Applied Bifurcation Theory*, Springer
- J.D. Meiss, *Differential Dynamical Systems*, SIAM
- T. Kapitaniak, *Chaos for Engineers: Theory, Applications, and Control*, Springer
- C. Kuehn, *Multiple Time Scale Dynamics*, Springer, its references list includes 15 may papers;
- E. Izhikevich, *Dynamical Systems in Neuroscience: Geometry of Excitability and Bursting*, MIT
- B. Ermentrout B. and D. Terman, *Mathematical Foundations of Neuroscience*, Springer

Journal articles since 2012
(indicates students and postdocs)*

1. Shilnikov AL and Maurer P. The art of grid fields: geometry of neuronal time. Frontiers in Neural Circuits, 2016
2. Schwabedal JTC.*, Knapper DE*, and Shilnikov AL. Qualitative and quantitative stability analysis of penta-rhythmic circuits. Nonlinearity, 29, 3647–367, 2016

3. Nagornov R.*, Osipov G., Komarov M., Pikovsky A. and Shilnikov AL. Mixed mode synchronization and network bursting of neurons with post-inhibitory rebound. Communications in Nonlinear Science and Numerical Simulation, 36, 175-191, 2016
4. Barrio, R., Rodriguez, M. and Shilnikov, AL. Mechanism of quasi-periodic lag jitter in bursting rhythms by a neuronal network, European Physics Letters, 12(3), 38002, 2015
5. Krishnan G.P*., Filatov, G., Shilnikov A.L. and Bazhenov M. Electrogenic properties of Na+/K+ ATPase controls seizure onset and termination. Journal of Neurophysiology, 113:3356-3374, 2015
6. Alacam, D.* and Shilnikov, AL. Making a swim central pattern generator out of latent parabolic bursters. Bifurcations and Chaos, 25(7), 1540003, 2015
7. Shilnikov A.L. and Turaev D.V. Leonid Shilnikov. Editorial. Bifurcations and Chaos, 4(8), 2014
8. Afraimovich V.S., Gonchenko S.V., Lerman L.M., Shilnikov A.L. and Turaev D.V. Scientific heritage of L.P. Shilnikov. Part 1. Regular and Chaotic Dynamics 19(4), 435-460. 2014
9. Wojcik J.*, Clewley R., Schwabedal J. and Shilnikov A.L. Key bifurcations of bursting polyrhythms in 3-cell central pattern generators. PLoS ONE 9(4): e92918, 2014
10. Xing T.*, Barrio R. and Shilnikov A.L. Symbolic quest into homoclinic chaos. Bifurcations and Chaos, 4(8), 2014
11. Schwabedal J.T.C.*, Neiman A.B. and Shilnikov A.L. Robust design of polyrhythmic neural circuits. Physics Review E, 002700, 2014
12. Shilnikov L.P. Shilnikov A.L. and Turaev D.V., Showcase of Blue Sky Catastrophes, Bifurcations and Chaos, 4(8), 2014
13. Barrio, R. Martinez MA*, Serrano S. and Shilnikov AL. Micro-chaotic and macro-chaotic structures in the Hindmarsh-Rose model of bursting neurons. Chaos 24(2):023128, 2014
14. Jalil S.*, Allen D*, Youker J* and Shilnikov A. Toward robust phase-locking in Melibe swim central pattern generator model. J Chaos 23(4) Rhythms and Dynamic Transitions in Neurological Disease, 2013
15. Barrio R, Shilnikov A, Shilnikov L. Kneadings, symbolic dynamics, and painting Lorenz chaos. Tutorial. J. Bifurcations and Chaos, Vol. 22, No. 4, 123016, 2012
16. Jalil S.*, Belykh I. and Shilnikov A.L. Multiple phase locked states in half-center oscillators, Physics Review E 85(3), 036214, 2012
17. Shilnikov A. Complete dynamical analysis of an interneuron model. Dynamics in Biology and Medicine. J. Nonlinear Dynamics, 68(3), 305-328, 2012.

Book chapters

1. Pusuluri K.*, Pikovsky A., and Shilnikov AL. Unraveling the Chaos-land and its organization in the Rabinovich system, in Challenges in Complexity: Dynamics, Patterns, and Cognition, Springer series “Nonlinear Systems and Complexity” 2017
2. Wojcik J.* and Shilnikov A.L. Voltage interval mappings for an elliptic burster, a referred chapter in "Nonlinear Dynamics: New Directions," Springer. 2015 ISBN 978-3-319-09866-1
3. Xing T.*, Wojcik J.*, Zaks M. and Shilnikov A.L. Fractal Parameter Space of Lorenz-like Attractors: A Hierarchical Approach. in "Chaos, Information Processing and Paradoxical Games: The legacy of J.S. Nicolis.” World Scientific Publishing, 2015
4. Xing T.*, Wojcik J.*, Barrio R. and Shilnikov A.L. Symbolic toolkit for chaos exploration, book chapter in "International Conference on Theory and Application in Nonlinear Dynamics" (ICAND 2012). Springer series Understanding complex systems, 2014
5. Wojcik J.*, Clewley R., and Shilnikov A.L. The role of duty cycle in three-cell central pattern generator. "International Conference on Theory and Application in Nonlinear Dynamics" (ICAND 2012). Springer series Understanding complex systems, 2014.

6. R. Barrio, F. Blesa, S. Serrano, T. Xing* and A. Shilnikov, Homoclinic spirals: theory and numeric. “Progress and Challenges in Dynamical Systems,” Springer Proceedings in Mathematics & Statistics, v. 54. 2013
7. Shilnikov A., Shilnikov L. and Barrio R, Symbolic dynamics and spiral structures due to the saddle-focus bifurcations, in “Chaos, CNN, Memristors and Beyond”, 2012

Conference proceedings

1. Lodi M.*, Shilnikov AL, and, Storace M. CEPAGE: a toolbox for Central Pattern Generator analysis. 2017 IEEE International Symposium on Circuits and Systems, 2017
2. A Kelley* and Shilnikov, AL. Two-Theta Neuron Model: Novel Phase Reduced Model Explored in Central Pattern Generators. Opera Medica et Physiologica, vol. 2(S1) page 99, 2016
3. A Shilnikov, D Alacam*, J Collens*, A Kelley* and J, Schwabedal. Towards Bifurcation Theory for Rhythmogenesis in Neural Networks. Opera Medica et Physiologica, vol. 2(S1), page 48, 2016
4. J Wojcik*, R Clewley, A Shilnikov. Phase-lag return mappings for a 3-cell multifunctional central pattern generator, BMC Neuroscience 13 (Suppl 1), P188, 2012
5. S Jalil*, D Allen*, A Shilnikov. Modeling study of a Central Pattern Generator in the Melibe sea slug BMC Neuroscience 13, 1-2, 2012
6. AB Neiman, K Dierkes*, B Lindner, AL Shilnikov. Voltage oscillations and response dynamics in a model of sensory hair cells, BMC Neuroscience 13 (Suppl 1), P186, 2012

Presentations at Scientific Conferences

My research program over the last 5 years has been highly visible: my students (labeled by * in the list below) and I have delivered 99 presentations at various international, national and local meetings. The list includes my 22 invited and keynote addresses at international conferences. Three of my students received the best poster awards at the key meetings in our field. In addition, I was invited to present 24 seminar and colloquium talks at universities in USA and overseas.

1. Pulusuri, K.*, T. Xing* and AL. Shilnikov. Homoclinic chaos painted. Dynamics Days Latin America and the Caribbean, Puebla, Mexico, October 24 - November 01, 2016. **Invited speaker**
2. Shilnikov, A.L. Analysis and Dynamics of Multifunctional and Dedicated Neural Circuits. IEEE International Workshop on Complex Systems and Networks, GSU, Atlanta, November 14-15, 2016. **Invited speaker**
3. Ju, H.*, and Shilnikov, A.L. Torus bifurcations in neural systems. IEEE International Workshop on Complex Systems and Networks, GSU, Atlanta, November 14-15, 2016. Poster
4. Alacam, D.*, and Shilnikov, A.L. Modeling the Melibe swim CPG. IEEE International Workshop on Complex Systems and Networks, GSU, Atlanta, November 14-15, 2016. Poster
5. Pulusuri, K.*, Pikovsky, A., and Shilnikov, A.L. Unraveling the Chaos-land and its organization in the Rabinovich System. IEEE International Workshop on Complex Systems and Networks, GSU, Atlanta, November 14-15, 2016. Poster
6. Basodi, S.*, Pulusuri, K.*, and Shilnikov, A.L. Return maps in oscillatory networks. IEEE International Workshop on Complex Systems and Networks, GSU, Atlanta, November 14-15, 2016. Poster
7. Ju, H.*, and Shilnikov, A.L. Torus bifurcation in Purkinje cell. Scientific Computing Day 2016, GSU, Atlanta, September 29, 2016. Poster

8. Pulusuri, K.*, Pikovsky, A., and Shilnikov, A.L. Unraveling the Chaos-land and its organization in the Rabinovich System. Scientific Computing Day 2016, GSU, Atlanta, September 29, 2016. Poster
9. 2016 CNS Workshop Dynamical Principles in Neural Circuits. July 6, 2016. **Co-Organizer.**
10. J. Collens*, D. Alacam*, A. Kelley*, K. Pusuluri*, D. Knapper*, J. Schawabedal and AL. Shilnikov. Polyrhythmic Pattern Generation in Networks with Three-Node CPG Kernels., 2016 SIAM Conference on the Life Sciences, Boston, MA, USA, July 11014, 2016. Poster
11. Pulusuri, K.* and Shilnikov, A.L. Deconstructing the stunning complexity of global bifurcations in a far-infrared Raman laser model. Special Session 120: Global bifurcations and complex dynamics. AIMS 2016 Meeting, Orlando, Florida, USA, July 1-5, 2012. **Invited**
12. D. Alacam*, J. Collens*, A. Kelley*, K. Pusuluri*, D. Knapper*, J. Schawabedal and AL. Shilnikov Stability and bifurcations of rhythms in neuronal circuits. Special Session 85: Differential Equation Modeling and Analysis for Brain and other complex bio-systems. AIMS 2016 Meeting, Orlando, Florida, USA, July 1-5, 2012. **Invited**.
13. Shilnikov, A.L. Rhythmogenesis and stability of neural networks. Volga Neuroscience meeting, Saint Petersburg- Nizhny Novgorod, Russia, July 24-30, 2016. **Co-organizer** and **Chair**
14. Kelley, A.* and Shilnikov, A.L. 2-theta models of oscillatory CPG networks. Volga Neuroscience meeting, Saint Petersburg- Nizhny Novgorod, Russia, July 24-30, 2016. **Best Poster award.**
15. Kelley, A.* and Shilnikov, A.L. Reduced model of 3-cell motifs. Volga Neuroscience meeting, Saint Petersburg- Nizhny Novgorod, Russia, July 24-30, 2016. Contributed.
16. Pulusuri, K.*, T. Xing* and AL. Shilnikov. Homoclinic bifurcations and symbolic dynamics in action. 2016 Shilnikov meeting, University of Nizhniy Novgorod, Russia, July, 2016. **Keynote Speaker**
17. Collens, J.*, Alaçam, D.*, Knapper, D.E.*, Shilnikov, A. Phase-lag variance and bifurcation theory in neural networks. Brains & Behavior Annual Retreat, April 2016, Atlanta, Poster
18. Collens, J.*, Knapper, D.E*., Alaçam, D.*, Kelley, A.*, Pusuluri, K.*, Schwabedal, J., Shilnikov, A. Towards bifurcation theory for rhythmogenesis in neural networks. Computational and Systems Neuroscience (COSYNE) Conference, February, 2016. Poster
19. Collens, J.*, Knapper, D.E.*, Alaçam, A.*, Xing, T.*, Kelley, A.*, Schwabedal, J.T., Shilnikov, A.L. Polyrhythmic and recurrent pattern generation in three-node CPG networks." Dynamics in Networks with Special Properties, MBI at OSU, 2016 – Columbus, OH. Poster
20. AL. Shilnikov. Bifurcation Theory for neural networks, MBI at OSU, January 2016, Columbus, OH. **Invited**
21. AL. Shilnikov and T. Xing*. Ordered Intricacy of Shilnikov saddle-focus homoclinics. International Conference-School: 50 years of the Shilnikov saddle-focus, University of Nizhniy Novgorod, Russia, 17-19 December, 2015. **Keynote Speaker**
22. AL. Shilnikov. Bifurcation Theory for Networks. Workshop at Brain Modes, GSU, Atlanta, 2015 December 8-11, 2015. **Invited Speaker**
23. D. Alacam* and AL. Shilnikov, Parabolic Bursting in Inhibitory Neural Circuits. Brain Modes, GSU, Atlanta, 2015 December 10-11. Poster.
24. AL. Shilnikov. Bifurcation Theory for Networks. Network Frontier Workshop 2015, Northwestern University, Evanston, IL, December 6-7, 2015. Contributed
25. AL. Shilnikov. Rhythmogenesis in central pattern generators. Dynamics of Coupled Oscillators: 40 years of the Kuramoto Model. Max Plant Institute, Dresden, Germany, July 27-31, 2015. **Invited**
26. AL. Shilnikov. Symbolic Quest into Homoclinic Chaos. International Conference-School: Dynamics, Bifurcations and Chaos 2015, University of Nizhniy Novgorod, Russia, 20–24 July, 2015.
27. AL. Shilnikov. Plausible and phenomenological models of multifunctional central pattern generators. 2015 Society of Mathematical Biology meeting, GSU. Atlanta, June 30-August 3, 2015. **Co-Organizer**

28. J. Collens*, JT. Schwabedal, D. Alacam*, D. Knapper* and AL. Shilnikov, Polyrhythmic Synchronization in Modular Networks. 2015 Society of Mathematical Biology meeting, GSU. Atlanta, June 30-August 3, 2015. Poster
29. D. Knapper*, JT. Schwabedal, and AL. Shilnikov, Understanding Patterns in Neural Networks. 2015 Society of Mathematical Biology meeting, GSU. Atlanta, June 30-August 3, 2015. Poster
30. D. Alacam* and AL. Shilnikov, Parabolic Bursting in Inhibitory Neural Circuits. 2015 Society of Mathematical Biology meeting, GSU. Atlanta, June 30-August 3, 2015. Poster
31. A. Kelley* and AL. Shilnikov. Two-Theta Neuron: Phase Models for Bursting Networks. 2015 Society of Mathematical Biology meeting, GSU. Atlanta, June 30-August 3, 2015. Poster
32. AL. Shilnikov. Quest into homoclinic chaos. 2015 AMS international meeting. Porto, June 10-13, 2015.
33. AL. Shilnikov. Plausible and phenomenological models of multifunctional central pattern generators. 1st International Conference on Mathematical Neuroscience. Antibes Juan les Pins, June 8-10, 2015. Contributed talk.
34. R. Barrio, M. Lefranc, M. A. Martínez, M. Rodríguez, S. Serrano and A. Shilnikov. Roadmaps for neuronal models: individual and networked. 1st International Conference on Mathematical NeuroScience. Antibes Juan les Pins June 8-10, 2015. Poster
35. J. Collens*, JT. Schwabedal, D. Alacam*, D. Knapper*, A. Kelley*, D. Alacam*, T Xing* and AL. Shilnikov, Polyrhythmic Synchronization in Modular Networks. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015, Contributed talk
36. J. Wojcik*, R. Clewley, JT. Schwabedal and AL. Shilnikov. Key Bifurcations of Bursting Polyrhythms in 3-Cell Central Pattern Generator. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015. Contributed talk
37. AL. Shilnikov and A. Neiman. Torus Canard Breakdown. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015. Contributed talk
38. M. Rodriguez, R. Barrio, S. Serrano and AL. Shilnikov. From Andronov-Hopf to Z3 Heteroclinic Bifurcations in CPGs. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015. Contributed talk
39. J. Collens*, JT. Schwabedal, D. Alacam*, D. Knapper* and AL. Shilnikov, Polyrhythmic Synchronization in Modular Networks. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015. Poster
40. D. Alacam* and AL. Shilnikov, Parabolic Bursting in Inhibitory Neural Circuits. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015. Poster
41. T. Xing* and AL. Shilnikov, A Symbolic Method in Chua's Circuit. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015. Poster
42. A. Kelley* and AL. Shilnikov. Two-Theta Neuron: Phase Models for Bursting Networks. 2015 SIAM Meeting on Applied Dynamical Systems, May 16-21, 2015. Poster
43. J. Collens* and AL. Shilnikov, Polyrhythmic generation and key bifurcations in three-node CPG networks. Brains and Behavior Annual Spring Retreat, Georgia State University, April 24, 2015
44. D. Knapper*, JT. Schwabedal, and AL. Shilnikov. Quantitative and qualitative stability analysis of polyrhythmic circuits. Brains and Behavior Annual Spring Retreat, Georgia State University, April 24, 2015. Poster
45. T. Xing*, J. Wojcik, R. Barrio, and A. Shilnikov. Chaos stirred not shaken. Brains and Behavior Annual Spring Retreat, Georgia State University, April 24, 2015. Poster
46. A.L. Noriega*, A.M. Kelley*, A. Shilnikov. Post inhibitory rebound in a reduced 3-cell network. Brains and Behavior Annual Spring Retreat, Georgia State University, April 24, 2015
47. D. Alacam* and A. Shilnikov. Half-center oscillators of parabolic non-burster. Brains and Behavior Annual Spring Retreat, Georgia State University, April 24, 2015

48. T. Xing* and A. Shilnikov. Homoclinic quest. Shilnikov workshop. Nizhny Novgorod, Russia. 12/17-19/2014. **Keynote speaker**
49. A. Kelley*, J. T. Schwabedal, and A. Shilnikov. Robustness and Multifunctionality of Reduced CPG Models. 2014 SIAM Conference on the Life Sciences, Charlotte, NC, 08/407/2014. Contributed talk
50. J. T. Schwabedal*, A. Neiman and A. Shilnikov. Robust Design of Polyrhythmic Neural Circuits. 2014 SIAM Conference on the Life Sciences, Charlotte, NC, 08/407/2014. Contributed talk
51. D. Alacam* and A. Shilnikov. Network Bursting in Inhibitory Neural Circuits. 2014 SIAM Conference on the Life Sciences, Charlotte, NC, 08/407/2014. Poster
52. J. Collens*, A. Kelley*, D. Alacam*, T. Xing*, J. T. Schwabedal, and A. Shilnikov. Intrinsic Mechanisms for Pattern Generation in Three-Node Networks. 2014 SIAM Conference on the Life Sciences, Charlotte, NC, 08/407/2014. Poster
53. A. Kelley* and A. Shilnikov. Two-Theta Neuron: Phase Models for Bursting Networks. 2014 SIAM Conference on the Life Sciences, Charlotte, NC, 08/407/2014. Poster
54. J. Wojcik*, R. Clewley, J. Schwabedal and A. Shilnikov. Key bifurcations of bursting polyrhythms in central pattern generators. International Workshop on Neurodynamics, Castro-Urdiales, Spain, 06/14-17/2014. **Keynote speaker**
55. R. Barrio, M.A. Martinez, S. Serrano, M. Lefranc and A. Shilnikov. Describing chaotic structures in the Hindmarsh-Rose model of bursting neurons. International Workshop on Neurodynamics, Castro-Urdiales, Spain, 06/14-17/2014. **Keynote speaker**
56. M. Rodriguez, R. Barrio, S. Serrano and A. Shilnikov. Computational tools for analysis of bursting polyrhythms in 3-cell CPG. International Workshop on Neurodynamics, Castro-Urdiales, Spain, 06/14-17/2014. **Organizer**
57. R. Barrio, T. Xing*, and A. Shilnikov. Towards a symbolic quest into homoclinic chaos. The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications Madrid, Spain. 06/07- 11/ 2014
58. R. Barrio, M.A. Martinez, S. Serrano, M. Lefranc and A. Shilnikov. Describing chaotic structures in the Hindmarsh-Rose model of bursting neurons. The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications Madrid, Spain. 06/07- 11/ 2014
59. M. Rodriguez, R. Barrio, S. Serrano and A. Shilnikov. Computational tools for analysis of bursting polyrhythms in 3-cell CPG. The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications Madrid, Spain. 06/07- 11/ 2014
60. A. Shilnikov. Rhythms in Central pattern generators. SDG workshop Challenges arising in singularly perturbed dynamical systems. Kingscliff. Australia. 06/10-13/2014. **Keynote speaker**
61. A. Shilnikov, J Wojcik*, R Clewley and J Schwabedal. Key bifurcations of bursting polyrhythms in 3-cell central pattern generators. XXXIII Dynamic Days. GaTech, Atlanta, Jan 2-5, 2014. Contributed talk
62. T. Xing*, J. Wojcik, R. Barrio and A. Shilnikov. Chaos, stirred not shaken. XXXIII Dynamic Days. GaTech, Atlanta, Jan 2-5, 2014. **Best Poster Award**
63. A. Kelley* and A. Shilnikov. Two Theta neuron: Phase models for bursting activity in multifunctional central pattern generators. XXXIII Dynamic Days. GaTech, Atlanta, Jan 2-5, 2014. Poster
64. A. Shilnikov, Phase-lag maps for rhythmic activity patterns in central pattern generators. Q-Bio Summer school UCSD. San Diego, July 30, 2013. **Invited lecturer**
65. A. Shilnikov, Voltage maps revealing dynamics transitions in individual neuron models. Q-Bio Summer school UCSD. San Diego, July 30, 2013. **Invited lecturer**
66. T. Xing*, R. Barrio and A. Shilnikov, Chaos stirred not shaken. LP Shilnikov memorial conference. Nizhny Novgorod, Russia, July 5-9, 2013. **Organizer**
67. R. Clewley, J. Wojcik* and *A. Shilnikov,* Bifurcations of bursting polyrhythms in 3-cell central pattern generators. SIAM Meeting on Applied Dynamical Systems, May 19-23, 2013. **Organizer**

68. T. Xing*, R. Barrio, J, Wojcik and A. Shilnikov, Chaos stirred not shaken. 2013 B&B Retreat, GSU, Atlanta, April 5 2013. Poster
69. M. Bazhenov, G. Krishnan*, and AL. Shilnikov, Ionic dynamics mediate pattern generation in epilepsy. SIAM Meeting on Applied Dynamical Systems, May 19-23, 2013. **Invited**
70. T. Xing*, and A. Shilnikov, Symbolic tools for deterministic chaos. SIAM Meeting on Applied Dynamical Systems, May 19-23, 2013. Contributed talk
71. R. Barrio, M. Lefranc, M.A. Martinez, S. Serrano and A. Shilnikov, Topological structures and parameter-sweeping techniques in the Hindmarsh-Rose neuron model. SIAM Meeting on Applied Dynamical Systems, May 19-23, 2013. Contributed talk
72. A. Kelley*, J. Youker* and AL. Shilnikov, 2θ neuron model for 3-cell inhibitory central pattern generators. SIAM Meeting on Applied Dynamical Systems, May 19-23, 2013. Poster
73. T. Xing*, R. Barrio, J, Wojcik and A. Shilnikov, Kneading Invariants for the elucidation of chaos. SIAM Meeting on Applied Dynamical Systems, May 19-23, 2013. Poster. **Best Poster Award**
74. A. Shilnikov: Elements of bifurcation theory for bursting patterns in multifunctional Central Pattern Generator models. Workshop Mathematics and Biology: a Roundtrip in the Light of Suns and Stars. Leiden, The Netherlands, April 14-19, 2013. **Keynote speaker**
75. R. Clewley, J. Wojcik* and *A. Shilnikov, Bifurcation of bursting polyrhythms in 3-cell CPGs*. Mathematical Biosciences Institute, Columbus, OH. March 18023, 2013. Poster
76. T. Xing*, R. Barrio, J, Wojcik* and A. Shilnikov, Symbolic tools for deterministic dynamics. International Conference on Dynamics of Differential Equations, GaTech, Atlanta, March 16-20, 2013. **Invited**
77. T. Xing*, R. Barrio, J, Wojcik* and A. Shilnikov, Chaos stirred not shaken. International Conference on Dynamics of Differential Equations, Gatech, Atlanta, March 16-20, 2013. Poster
78. T. Xing*, J. Wojcik*, R. Barrio and A. Shilnikov, Kneading in Shimizu-Morioka Model. Georgia Scientific Computing Symposium (GSCS), Georgia State University, February 23rd, 2013
79. R. Clewley, J. Wojcik* and *A. Shilnikov, Bifurcation of bursting polyrhythms in 3-cell CPGs*. Mathematical Biosciences Institute, Columbus, OH. October 2, 2012. Poster.
80. G. Krishnan*, A. Shilnikov, M. Bazhenov, Novel bursting mode leads to seizure termination. "Bernstein Conference 2012. Munich, Germany, September 12-14, 2012
81. T. Xing*, R. Barrio and A. Shilnikov, Kneadings, Symbolic Dynamics and Painting Lorenz Chaos. International Conference on Theory and Applications in Nonlinear Dynamics. Seattle, WA, August, 26-30 2012. **Invited**
82. J. Wojcik*, R. Clewley, A. Shilnikov, Bifurcations of bursting polyrhythms three-cell motifs. International Conference on Theory and Applications in Nonlinear Dynamics. Seattle, WA, August, 26-30 2012
83. J. Wojcik*, and A. Shilnikov, Dynamics in Models of Individual and Networked Neurons. Mini-symposium "Dynamics in Models of Individual and Networked Neuron." SIAM 2012 Life Sciences, San Diego, CA, August 7-10, 2012
84. J. Wojcik*, R. Clewley, A. Shilnikov, Basic bifurcations of polyrhythmic bursting in three-cell inhibitory motifs. Workshop "Principles of Motor Pattern Generation: Experiments and Modeling." 2012 Computational Neuroscience meeting, Atlanta, GA, July 24-27, 2012. Co-organizer
85. J. Wojcik*, R. Clewley, A. Shilnikov, Phase-lag return mappings for a 3-cell multifunctional central pattern generator. 2012 Computational Neuroscience meeting, Atlanta, GA, July 24-27, 2012
86. S. Jalil*, D. Allen*, and A. Shilnikov, Modeling study of a Central Pattern Generator in the Melibe seaslug. 2012 Computational Neuroscience meeting, Atlanta, GA, July 24-27, 2012
87. A. Shilnikov, A. Neiman, K. Dierkes* and B. Lindner. Voltage oscillations and response dynamics in a model of sensory hair cells. 2012 Computational Neuroscience meeting, Atlanta, GA, July 24-27, 2012

88. R. Barrio, F. Blesa, S. Serrano* and A. Shilnikov. Homoclinic spirals: theory and numerics. Dynamical Systems: 100 years after Poincaré, Gijón, September 2012
89. R. Barrio and A. Shilnikov and S. Serrano*. Symbolic Dynamics for Painting Chaos: Homoclinic spirals. Dynamics, Topology and Computations, Bedkewo, Poland, June 24-30, 2012
90. J. Wojcik*, and A. Shilnikov, Principle bifurcations of bursting polyrhythms in small network. 7th Crimean School and Workshop. Mellas, Crimea, Ukraine, May 20-27, 2012
91. S. Jalil*, D. Allen*, and A. Shilnikov, Minimal configuration models for experiment-based central pattern generator of Melibe. 12th Experimental Chaos and Complexity Conference, University of Michigan**,** May 16-19, 2012
92. J. Wojcik*, and A. Shilnikov. Return phase-lag mapping approach uncover multi-rhythmicity in 3-cell CPGs with mixed synapses. 12th Experimental Chaos and Complexity Conference, University of Michigan**,** May 16-19, 2012
93. S. Jalil*, D. Allen*, and A. Shilnikov, Experimental phase relation captured by model central pattern generator. Section: Mathematical Biology and Neuroscience. Carolina Dynamical Systems Symposium, Clemson University, MC, April 13-15, 2012
94. T. Xing*, J. Wojcik* and A. Shilnikov, Kneading on the Lorenz systems and Shimizu-Morioka model. Carolina Dynamical Systems Symposium, Clemson University, MC, April 13-15, 2012
95. J. Wojcik*, R. Clewley, A. Shilnikov, Phase-lag return mappings for control of polyrhythms in bursting 3-cell networks. Section: Mathematical Biology and Neuroscience. Carolina Dynamical Systems Symposium, Clemson University, MC, April 13-15, 2012
96. S. Jalil*, I. Belykh, and A. Shilnikov, Stability analysis of phase-locked bursting in inhibitory neuron networks. Brains and Behavior Annual Spring Retreat, Georgia State University, April 2012
97. S. Jalil*, D. Allen*, and A. Shilnikov, Experimental phase relation captured by model central pattern generator. Brains and Behavior Annual Spring Retreat, Georgia State University, April 2012
98. S. Jalil*, D. Allen*, and A. Shilnikov, A model for a central pattern generator in the Melibe seaslug., Georgia State University Undergraduate Conference, March 26, 2012
99. Kelley*, J. Youker*, and A. Shilnikov. Reduced phase models for 3-cell CPG. Georgia State University Undergraduate Conference, March 26, 2012.

Colloquium and Seminar Presentations

1. AL. Shilnikov, Sinister saga of making CPG models. University of Ohio, March 14, 2017
2. AL. Shilnikov, New era of symbolic dynamics for chaotic systems. Humboldt University, Berlin, Germany, July 14, 2016.
3. AL. Shilnikov, Dynamical basics of central pattern generators. Integrative BioSystems Institute at Georgia Institute of Technology, Atlanta. Nov 4, 2015
4. AL. Shilnikov, Plausible and phenomenological models of multifunctional central pattern generators. Monash University, Melbourne, Australia. Aug 24, 2015
5. AL. Shilnikov, Homoclinic chaos. Potsdam University, Germany, Aug 3, 2015
6. AL. Shilnikov. Dynamics of Neural Circuits. 2015 KSU Math Circle Summer Camp. June 18, 2016
7. AL. Shilnikov, Key Bifurcations of Bursting Polyrhythms in Central Pattern Generators. University of Utrecht, the Netherlands, 01/7/2015
8. AL. Shilnikov, Mathematical Neuroscience. Invited lecture. University of Nizhny Novgorod, Russia, 12/25/2014
9. AL. Shilnikov, CPG networks as dynamical systems. Neuroscience Institute, GSU, 11/02/2014
10. AL. Shilnikov, Homoclinic chaos. Kennesaw State University, 10/09/2014
11. AL. Shilnikov, Symbolic quest into homoclinic chaos. University of Sydney, Australia, 06/06/201

12. AL. Shilnikov, Key bifurcations of bursting polyrhythms in 3-cell CPGs. SEMINARI DE SISTEMES DINAMICS UB-UPC. Barcelona, Spain, June 26 2013
13. AL. Shilnikov, Chaos stirred not shaken. Imperial College, London, UK, 05/11/2013
14. AL. Shilnikov, Key bifurcations of bursting polyrhythms in 3-cell CPGs. Imperial College, London, UK, June 12 2013
15. AL. Shilnikov, Key bifurcations of bursting polyrhythms in 3-cell CPGs. Bristol, UK, June 7, 2013.
16. AL. Shilnikov, Symbolic Toolkit for Exploration of Deterministic Chaos. Exeter University and Online AG Dynamics Seminar, UK, June 7 2013.
17. AL. Shilnikov, Dynamical foundation of neuroscience. Department of Mathematics and Statistics, GSU, March 14, 2013.
18. A. Shilnikov, Mathematical Neuroscience. University Zaragoza, Spain. March 1 and 8, 2013.
19. J. Wojcik*, R. Clewley, and A. Shilnikov, Bifurcations in CPG networks, Bernstein center, Humboldt University, Berlin, Germany, Jan 15, 2013.
20. T. Xing* and A. Shilnikov, Symbolic Toolkit for Exploration of Deterministic Chaos. Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Germany, Jan 8, 2013.
21. AL. Shilnikov, Dynamics and bifurcations in bursting neuronal networks: central pattern generators. LP Shilnikov Seminar: Institute for Applied Mathematics Cybernetics, Nizhny Novgorod. March 22, 2012
22. A. Kelley*, J. Youker*, and A. Shilnikov. Reduced phase models for 3-cell CPG. Spineless Neuroscience Forum, Georgia State University, February 2012.
23. J. Wojcik*, R. Clewley, and A. Shilnikov, Bifurcations in 3-cell motifs. Spineless Neuroscience Forum, Georgia State University, February 2012.
24. S. Jalil*, D. Allen*, and A. Shilnikov, A four neuron CPG model for swimming behavior in Melibe. Spineless Neuroscience Forum, Georgia State University, February 2012.

Statement of Interests and Goals for Instruction

In GSU, I have successfully and routinely lectured a whole range of mathematical courses, from low-level 1000 undergraduate through 8000 graduate courses. The list spans the entire calculus and linear algebra sequences, mathematical modeling, college algebra, ordinary and partial differential equations, vector calculus, vector geometry, and real analysis, as well as the courses that I developed and proposed: applied and advanced topics in dynamical systems, mathematical biology, computational neuroscience and dynamical principles of neuroscience.

The interdisciplinary perspectives in my research help me illuminate the bridges between mathematics, biology, and computations in the classroom. I firmly believe in the importance of inclusiveness and public outreach in the scientific profession, and have experience employing cross-disciplinary approaches in programs to increase public awareness of science and encourage the growth of a diverse, vibrant mathematical community.

In the last 5 years, I have actively taken part in updating, developing and redesigning the curriculum for applied mathematics and cross-listed courses for Neuroscience Institute and Department of Mathematics and Statistics, including Mathematical Biology I and II, Applied Dynamical Systems, Advanced Topics in Dynamical Systems, Dynamical Foundations of Neuroscience.

I find that extending respect and courtesy towards students encourages them to adopt a more pro-active attitude about their education. Learning about the students prior and intended future academic, professional and research experiences is one way I do this. I also make sure I am aware of students' individual strengths and weaknesses as they develop throughout a course. At the beginning, I like to survey my class about their backgrounds so that I can adapt the course accordingly. I am enthusiastic about the challenge of gearing my teaching toward the varied perspectives that students have on math. I am patient with students who get stuck on an exercise or a concept, or who require additional time in class or outside it. Additional attention to an individual's difficulties in class usually benefits all the students because it encourages a spirit of openness and community in the classroom.

Mathematics is an exciting field. Teaching mathematics is a great pleasure but also presents a great deal of responsibility. Teaching mathematics is teaching how to think in abstract terms and to communicate ideas with utmost precision. Mathematics is a language that keeps one's mind clear and well-organized. I see my role as a mathematics instructor as teaching this language to students. As with any other language, mathematics is best learned when it is presented within a real-life context. As my general research interests are in mathematical modeling in life science applications, I often use examples and problems derived from my own research to supplement the examples in the textbook. I do understand though, that most of the undergraduate students will not choose a career in mathematics, and that is why I always try to carefully explain the basic ideas along with elaborating on formulae and technical details. In my opinion, sustaining high standards while merely covering a twenty-year-old curriculum is insufficient. It is necessary to adapt the curriculum and methods for teaching to the needs of the future workforce. I see multiple ways to achieve this goal.

There is a dire need for mathematics to be integrated with concepts from other scientific disciplines, especially as modern sciences become increasingly interdisciplinary. Because of the cross-disciplinary nature of my own research, I always use my recent examples and research findings in classroom teaching. I believe that students should be exposed to the current scientific trends and shown the modern mathematical problems arising from these trends. For instance, recent developments in computational neuroscience and biology can serve as a source of contemporary applications for dynamical systems. An instructor needs to utilize the power of technological progress in the classroom and take advantage of the rapidly growing level of computer and software applications. Students should be provided with hands-on experience in researching a subject. This is typically achieved by doing an independent study and/or an individual research project.

Computational sciences are closely related to modem technology, and I always show my students the benefits of using computers for their individual projects. Computer technology has revolutionized the way we process the quantitative information, and this is precisely why we find it such an attractive tool. I use new findings from ongoing projects for teaching applied mathematics and physics courses to spark student interest. Another important educational aspect is that my research findings have been included in recent mathematics textbooks, both graduate and undergraduate, and in several articles in the peer-reviewed open-access encyclopedia Scholarpedia, of which I am a curator. Various multimedia supplements such as our recent movies illustrating network dynamics and bifurcations in Poincare return mappings for various neural models and systems with strange chaotic attractors have been posted on www.youtube.com for open access and in-class demonstrations.

It is my philosophy that students should work hard and learn the material, and enjoy the course. Therefore. I always thoroughly prepare for classes but leave room for spontaneous discussions. To stimulate creative thinking and capture students' attention I often discuss challenges in mathematical problems at the beginning of class. While lecturing on a new material, I try to encourage in class

discussions and welcome all questions from students. These discussions serve as feedback and enhance class participation. In my experience, self-study and home assignments provide an excellent opportunity for students to learn and comprehend the material in high-level courses compared to formal in-class tests.

The courses taught between 2012/01 and 2016/12

- Spring 2012: MATH 3435 INTRODUCTORY LINEAR ALGEBRA – 4.3
- Fall 2012: MATH 3260 DIFFERENTIAL EQUATIONS – 3.8
- Fall 2012: MATH 8515 DYNAMICAL FOUND NEUROSCIENCE – 4.5
- Spring 2013: on leave
- Fall 2013: MATH 3260 DIFFERENTIAL EQUATIONS – 4.2
- Fall 2013: MATH 8540 ORD DIFF EQUAT & DYN SYSTEMS – 3.8
- Spring 2014: MATH 3435 LINEAR ALGEBRA I – 4.6
- Fall 2014: MATH 3260 DIFFERENTIAL EQUATIONS – 3.9
- Fall 2014: MATH 8515 DYNAMICAL FOUND NEUROSCIENCE – 4.3
- Fall 2014: NEUR 8340 DYNAMICAL FOUND NEUROSCIENCE – 5.0
- Spring 2015: MATH 6275 APPLIED DYNAMICAL SYSTEMS – 4.5
- Fall 2015: MATH 1220 SURVEY OF CALCULUS – 2.3
- Fall 2015: MATH 3260 DIFFERENTIAL EQUATIONS – 2.8
- Spring 2016: MATH 3435 LINEAR ALGEBRA I – 3.4
- Fall 2016: MATH 4991 SENIOR SEMINAR – 4.3
- Fall 2016: NEUR 8340 DYNAMICAL FOUND NEUROSCIENCE – 4.3

My student evaluations in Fall 2015 are not as high as I would like them to be. I point out though that there was a chain of objective and subjective reasons for that. First, that the entry-level MATH 1220 SURVEY OF CALCULUS is the course (the only one that non-math undergraduates should take and pass through and that I never taught before) was the very last-minute replacement for the planned MATH 8540 Advanced Dynamical Systems in my teaching load that was rather unexpected and stressful because there was neither a sample syllabus for this class nor the textbook that was given to me after a month-long delay. I could not get samples of past tests on a timely basis from my math peers either. Second, I realized too late and that was my fault partially that should not have used and relied on service of one designated TA to ensure the smooth and effective teaching, test grading, book keeping etc., of my 2015 Fall and 2016 Spring classes as it was done always before and will be in the future.

I emphasize, that whenever teach an undergraduate course, a few students from the class always come to do independent research studies in my lab. The last Fall 2015 - Spring 2016 classes were not exception, despite seemingly low average student perceptions: four undergrads - M. Harb, M. Crane. A. Tuffana and K. Scully have done independent research studies under my supervision since then, already presented and will present their research at various local and nationwide meetings. Moreover, a quarter of my current MATH 4275/6275 class in Spring 2017 is formed by my past students from the 2015-16 MATH 3435 and MATH 3260 classes.

Student Research

Teaching is a highly rewarding process, as it gives the positive feedback that every professor needs to become a more effective scholar. Teaching or mentoring also includes the supervision of student research

at undergraduate and graduate levels. I am pleased to demonstrate my teaching effectiveness as a mentor through my publication record and an impressive history activity of conference presentations with students (and postdocs) from my lab since 2012.

My research team - Shilnikov Lab – has been built around my own research projects and has included diverse and outstanding researchers, including students from a wide variety of cultures and disciplinary backgrounds. Since 2012 have supervised 9 PhD students (3 to completion, and one transferred to the Math PhD program), and 3 visiting students from Italy, Iran, USA, and two international students from Russia and Germany. In addition, during the reported period I have supervised 4 postdocs whose positions were funded by their home governments and science foundations, and who have come from overseas to study and work in my lab at GSU. In the last five years, I have received an uncountable number of requests from students, postdocs and junior researcher from all over the world, who would like to study in my lab.

I mentor my students and postdocs to achieve research excellence. There of my PhD students have received best paper awards at major meetings in the field:

- T. Xing - 2013 SIAM Applied Dynamical Systems.
- J. Wojcik - 2013 SIAM Applied Dynamical Systems.
- T. Xing - 2014 Dynamics Days.
- A. Kelly - 2016 Volga Neuroscience Conference.

My former students and postdocs have established themselves as independent researchers in academia and R&D industries: Dr. Jalil is a Postdoctoral Fellow at the University of Texas Health Science Center at Houston (USA); Dr. J. Wojcik is a Research Scientist at ATA Corp. (USA); Dr. J. Schwabedal has obtained a research position at Max Plank Institute (Germany); Dr. E. Gunay is an Assistant Professor at Eciyes University (Turkey), and Drs. Tokmak and M. Fen have secured faculty positions at Middle East Technical University (Tukey).

Recently, Dr. Wojcik and I have started working on a join research project partnering GSU with industry to seek external support and consulting.

Since 2012 I have published 10 papers with students as co-authors. My students have presented their research at many (50+) national and international conferences, including SIAM Applied Dynamical Systems, SIAM Life Sciences, Dynamic Days, Computational Neuroscience etc.

PhD studies of J. Wojcik, T. Xing and D. Alacam have been supported by my past and current extremal and internal grants.

I have supervised research of 8 undergraduate students in my lab since 2012, who were supported by NSF REU and B&B summer fellowships, and B&B pilot grants.

My lab research was highlighted in an Applied Dynamical Systems SIAM quarterly bulletin.

Post-Doctoral fellows

- Dr. F. Tokmak (2014-15), funded by the Education Ministry of Turkey.
- Dr. M. Fen (2014-15), funded by the Education Ministry of Turkey.
- Dr. J. Schwabedal (2013-2015), funded by German Research Council (CRDF).
- Dr. E. Gunay (2011-2012), funded by the Education Ministry of Turkey.

Ph.D. Students

Current

- Deniz Alacam, 06/2012 – present, B&B fellow, Mathematics & Statistics (graduation in Summer 2017)
- Jarod Collens, 05/2014 – present, B&B fellow, Neuroscience Institute, (graduation in Spring 2017)
- Krishna Posuluri, 08/2014 – present, Neuroscience Institute
- Aaron Kelley, 08/2012 – present
- Huiwen Ju, 08/2015 – present, Neuroscience Institute
- Liza Latach, 08/2015 – 08/2016, Neuroscience Institute, transferred to Bioinformatics PhD program at Department of Mathematics and Statistics.

Defended

- Tingli Xing, Ph.D. Thesis. Department of Mathematics and Statistics and Neuroscience Institute, Georgia State University, July 2015
- Sajiya Jalil, Ph.D. Thesis Stability analysis of phase-locked bursting in inhibitory neuron networks. Department of Mathematics and Statistics and Neuroscience Institute, Georgia State University, March 2012.
- Jeremy Wojcik, Ph.D. Thesis Neural Cartography: Computer assisted Poincare return maps for biological oscillators. Department of Mathematics and Statistics and Neuroscience Institute, Georgia State University, May 8, 2012.

Visiting PhD students

- Matteo Lodi, 9-12/2016, University of Genoa, Italy; funded by University of Genoa.
- Alireza Dehghan, 10/2016 – present, Tabriz University, Iran; on Iranian government funds.

Member of the defense committees

- Malcolm Devoe (MS, Mathematics and Statistics), defended in May 2012.
- Bryce Chung (PhD, Neuroscience Institute), 09/2014 – 03/2017.
- Sunitha Basodi (PhD, Computer Science Department), 2015 – current.

Undergrads Honors Projects

- Mohamed Harb (Physics) B&B Summer Fellowship $2,000, 2016.
- Drake Knopper (Physics) GSU Honor college, 2014-2015.
- Anna Noriega (Mathematics & Statistics) B&B Summer Fellowship $2,000, 2014.
- Drake Knopper (Physics) B&B Summer Fellowship $2,000, 2014.
- Joseph Youker (Mathematics & Statistics) “Reduced phase models of CPGs” B&B Summer Fellowship $2,000 and NSF REU, Summer 2011, Summer 2013
- Dane Allen (Mathematics & Statistics) “CPG model of the Melibe”, funded through NSF REU. Summer 2012

Visiting undergraduate students

- Lu Hong, 6-8/2014, Wabash College (USA), on his own funds.

Future goals

I plan to continue improving my effectiveness as a teacher, which is reflected in positive and rewarding student evaluations. I will continue integrating research activities into the undergraduate and graduate curriculum through developing cross-disciplinary undergraduate and graduate courses in the fields of mathematics, biological sciences, as well as propose a new dual level course on financial mathematics, based on dynamical system theory. I will continue to mentor undergraduate and graduate research projects, present and publish scholarly articles with my students as co-authors in highly-ranked journals in our trans-disciplinary field. I truly enjoy watching young scientists grow as they discover how much fun science and research can be.

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May 24, 2013

Congratulations, Ms. Xing!

This is to certify that you and Dr. Jeremy Wojcik were awarded the Red Sock Award on May 22, 2013, during the 2013 SIAM Conference on Dynamical Systems (DS13).

The Red Sock Award is awarded by the SIAM Activity Group on Dynamical Systems (SIAG/DS) for the best poster presentation in dynamical systems by a student or postdoc at the biennial SIAM Conference on Dynamical Systems as judged by a scientific committee. Four winning posters are selected at the conference. The award was established by James A. Yorke, who traditionally presents each winner with a red sock.

Title: Chaos: Stirred Not Shaken

Awardees: Jeremy Wojcik and Tingli Xing, Georgia State University
Co-authors: Roberto Barrio, University of Zaragoza, Spain
Andrey Shilnikov, Georgia State University

Thank you for your participation in the poster competition, and congratulations again to you on this well-deserved award!

Charlie Doering
Charles Doering
Co-Chair, DS13 Organizing Committee

George Haller
George Haller
Co- Chair, DS13 Organizing Committee

cc: Professor Roberto Barrio, University of Zaragoza, Spain
Professor Andrey Shilnikov, Georgia State University

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May 24, 2013

Congratulations, Dr. Wojcik!

This is to certify that you and Ms. Tingli Xing were awarded the Red Sock Award on May 22, 2013, during the 2013 SIAM Conference on Dynamical Systems (DS13).

The Red Sock Award is awarded by the SIAM Activity Group on Dynamical Systems (SIAG/DS) for the best poster presentation in dynamical systems by a student or postdoc at the biennial SIAM Conference on Dynamical Systems as judged by a scientific committee. Four winning posters are selected at the conference. The award was established by James A. Yorke, who traditionally presents each winner with a red sock.

Title: Chaos: Stirred Not Shaken

Awardees: Jeremy Wojcik and Tingli Xing, Georgia State University
Co-authors: Roberto Barrio, University of Zaragoza, Spain
Andrey Shilnikov, Georgia State University

Thank you for your participation in the poster competition, and congratulations again to you on this well-deserved award!

Charlie Doering
Charles Doering
Co-Chair, DS13 Organizing Committee

George Haller
George Haller
Co-Chair, DS13 Organizing Committee

cc: Professor Roberto Barrio, University of Zaragoza, Spain
Professor Andrey Shilnikov, Georgia State University

Service

Professional and Organizational Leadership

Here at GSU I have helped build a strong nonlinear dynamics group. Since 2000 the group has grown from one scholar, myself, to nine faculty members: Drs. I. Belykh, M. Dhamala, R. Osan, V. Bondorenko, R. Clewley, Y. Jiang, G. Cymbalyuk, and V. Molkov. The group has been successful in securing external funding- about $4M in external support from the national grant agencies, as well as active in organizing local, national and international meetings; and effective in recruiting talented students, postdocs, and new faculty to GSU. Its rapid and passionate development has helped GSU establish its renowned reputation as a leading research institution in nonlinear dynamics for living systems with the emphasis upon mathematical and computational neuroscience.

I have served on various departmental, college and university level committees science 2012: Neuroscience Institute P&T Committee (2009-2014); Math P&T Committee (2009-2014); Math Graduate Program Committee, member (2000-present); Math Research Committee, member (2002-2014); Mathematics Undergraduate Subcommittee, member (2004-present); Mathematics Graduate Committee, member (2004-present); GSU Art&Science College Executive committee, member (2016-present); GSU Art & Sciences College P&T committee, member (2014-2016, on leave).

I have also served on two GSU 2CI hiring committees, 2012-2016, and have been a member of three Ph.D. defense committees.

I have remained a founding (from GSU) and acting member of the extramural Center for Nonlinear Dynamics at Georgia Institute of Technology (since 2001).

I have served on the Editor Boards of the Journal of Mathematical Neuroscience, and the Journal of Discontinuity, Nonlinearity and Complexity, and have been a Guest Editor of the Journal of Bifurcations and Chaos for several recent issues. I have just been appointed as an Editor of Dynamical Systems focus-area of the newly launched journal Frontiers in Applied Mathematics and Statistics. I have served as the reviewer for all major journals in my focus-area many times in the last 5 years, and for several recent textbooks.

I have (co)-organized many international conferences, workshops and sessions in USA, Spain, and Russia, including several local conferences on math and computational neuroscience held at GSU. During the last five years, I have organized multiple workshops at bi-annual SIAM Applied Dynamical Systems meetings in 2013 and 2015, and at annual Computational Neuroscience Meetings in 2012, 2014 and 2016. I was a co-organizer and a co-chair of Workshop “Advanced Course on New Trends in Applied Bifurcation Analysis,” in Castro-Urdiales, Spain, in 2012 and 2014, as well as the annual 2015 Mathematical Biology meeting held with 500 participants held at GSU in 2015. I have co-organized a series of the L.P. Shilnikov memorial meetings on Bifurcations and Strange Attractors in Nizhni Novgorod in 2013-16, bringing together more than 400 participants from 25 countries. I was a Chair of Computational Neuroscience section, which was one of four scopes of the 2016 Volga Neuroscience Conference, July 24-31, 2017.

I have obtained 3 travel grants through the UK Office of Naval Research: $12,000 (2014), $12,000 (2015) and $15,000 (2016) to support PhD students, postdocs and researchers from all over the world (except for USA) to attend 2014-2016 LP Shilnikov conferences on dynamical systems held at Nizhny Novgorod University (Russia), as well as 2016 Volga Neuroscience Conference. The grants were administered through the Imperial College (the UK) due to bureaucratical reasons.

I was invited to serve on the Expert Panel (2013-2015) appointed by the Skoltech (Moscow, Russia) - MIT (Boston, USA) partnership committee to on-site visit, review and make recommendations to the research programs in physics, biology, supercomputers, mathematics, and life sciences of 4 best research universities in Russia that have been funded through $850M “5in100 Best Universities” strategic plan launched by the Ministry of Higher Education of Russian Federation in 2013-2015.

I have been an ad-hoc review for NSF, and similar national funding agencies in the Netherlands, Poland, India and Russia.

I have invited several eminent scholars, including Drs. J. Rinzel (NYU), E. Marder (Brandeis), to visit GSU and present their research at B&B distinguished lecture series, as well as invited Dr. Forger (Michigan U), who is now considered for a GSU Eminent Scholar position.

I have initiated the GSU-Genoa University (Italy) research partnership and student exchange program.

Future goals

I plant to continue my service to GSU and my colleagues as a good citizen, a journal editor and reviewer, a conference organizer, a peer recruiter and a host to our visitors, and as an informal leader and the founder of the trans-disciplinary nonlinear group at GSU to ensure its further extension.