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## Contact Information

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## Research Interests

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- Nonlinear dynamics and chaos.
- Dynamics on and structure of complex networks.
- Synchronization.
- Cardiac dynamics.
- Wireless communications networks.

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## Education

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- Ph.D., Applied Mathematics, University of Maryland, College Park, May 2005. Advisors: Edward Ott, Brian R. Hunt.
- M.S., Mathematics, Universidad de los Andes, Colombia, May 2002. Advisor: Sergio Fajardo.
- B.S., Physics, Universidad de los Andes, Colombia, March 1999. Advisors: Victor Tapia, Rolando Roldán.

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## Professional Appointments

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- August 2008 - Present: Assistant Professor, Applied Mathematics Department, University of Colorado, Boulder, Colorado, USA.
- August 2006 - June 2008: Postdoctoral Researcher, Physics Department, Northeastern University, Boston, Massachusetts, USA.
- June 2005 - June 2006: Postdoctoral Researcher, Institute for Research in Electronics and Applied Physics, University of Maryland, College Park, Maryland, USA.
- January 2002 - May 2005: Graduate Research Assistant, Institute for Research in Electronics and Applied Physics, University of Maryland, College Park, Maryland, USA.

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## Students

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- Daniel B. Larremore, Ph.D., completed May 2012.
- Marshall Y. Carpenter, M.S., completed May 2012.
- Per Sebastian Skardal, Ph.D., expected May 2013.
- Dane R. Taylor, Ph.D., expected May 2013.
- Warren Lord, Ph.D., expected May 2016.

## Publications

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### Publications in Peer-Reviewed Journals

1. Daniel B. Larremore, Marshall Y. Carpenter, Edward Ott, and **Juan G. Restrepo**, Statistical Properties of Avalanches in Networks, *Phys. Rev. E* **85**, 066131 [11 pages] (2012).
2. Dane Taylor, **Juan G. Restrepo**, Network-specific approach to percolation in networks with bidirectional links, *Europhysics Letters* **98**, 16007 [6 pages] (2012).
3. Per Sebastian Skardal, Alain Karma, **Juan G. Restrepo**, Unidirectional Pinning and Hysteresis of Spatially Discordant Alternans in Cardiac Tissue, *Physical Review Letters* **108**, 108103 [5 pages] (2012).
4. Per Sebastian Skardal, **Juan G. Restrepo**, Hierarchical Synchrony of Phase Oscillators in Modular Networks, *Phys. Rev. E* **85**, 016208 [8 pages] (2012).
5. Per Sebastian Skardal, Edward Ott, **Juan G. Restrepo**, Cluster Synchrony in Systems of Coupled Phase Oscillators with Higher-Order Coupling, *Phys. Rev. E* **84**, 036208 [10 pages] (2011).
6. Wai Shing Lee, **Juan G. Restrepo**, Edward Ott, Thomas M. Antonsen, Dynamics and Pattern Formation in Large Systems of Spatially-Coupled Oscillators with Finite Response Times, *Chaos* **21**, 023122 [14 pages] (2011).
7. Dane Taylor, **Juan G. Restrepo**, Network connectivity during mergers and growth: Optimizing the addition of a module, *Phys. Rev. E* **83**, 066112 [7 pages] (2011).
8. Daniel B. Larremore, Woodrow L. Shew, Edward Ott, and **Juan G. Restrepo**, Effects of network topology, transmission delays, and refractoriness on the response of coupled excitable systems to a stochastic stimulus, *Chaos* **21**, 025117 [10 pages] (2011).
9. Daniel B. Larremore, Woodrow L. Shew, **Juan G. Restrepo**, Predicting criticality and dynamic range in complex networks: effects of topology, *Physical Review Letters* **106**, 058101 [4 pages] (2011).
10. Dane Taylor, Edward Ott, and **Juan G. Restrepo**, Spontaneous synchronization of coupled oscillator systems with frequency adaptation, *Phys. Rev. E* **81**, 046214 [8 pages] (2010).
11. **Juan G. Restrepo** and Alain Karma, Spatiotemporal intracellular calcium dynamics during cardiac alternans, *Chaos* **19**, 037115 [15 pages] (2009).
12. **Juan G. Restrepo** and Alain Karma, Line-defect patterns of unstable spiral waves in cardiac tissue, *Physical Review E* **79**, 030906(R) [4 pages] (2009).
13. **Juan G. Restrepo**, James N. Weiss, and Alain Karma, Calsequestrin Mediated Mechanism for Cellular Calcium Transient Alternans, *Biophysical Journal* **85**, 3767 [23 pages] (2008).

14. Aman Mahajan, Yohannes Shiferaw, Daisuke Sato, Ali Baher, Riccardo Olcese, Lai-Hua Xie, Ming-Jim Yang, Peng-Shen Chen, **Juan G. Restrepo**, Alain Karma, Alan Garfinkel, Zhilin Qu, and James N. Weiss, A rabbit ventricular action potential model replicating cardiac dynamics at rapid heart rates, *Biophysical Journal* **94**, 392 [19 pages] (2008).
15. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Weighted percolation on directed networks, *Physical Review Letters* **100**, 058701 [4 pages] (2008).
16. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Approximating the largest eigenvalue of network adjacency matrices, *Physical Review E* **76**, 056119 [6 pages] (2007).
17. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Emergence of synchronization in complex networks of interacting dynamical systems, *Physica D* **224**, 114 [9 pages] (2006).
18. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Characterizing the dynamical importance of network nodes and links, *Physical Review Letters* **97**, 094102 [4 pages] (2006).
19. **Juan G. Restrepo**, Brian R. Hunt, and Edward Ott, Scaling of branching in arterial and bronchial trees, *Physical Review Letters* **96**, 128101 [4 pages] (2006).
20. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Emergence of coherence in complex networks of heterogeneous dynamical systems, *Physical Review Letters* **96**, 254103 [4 pages] (2006).
21. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Synchronization in large directed networks of coupled phase oscillators, *Chaos* **16**, 015107 [10 pages] (2006).
22. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Onset of synchronization in large networks of coupled oscillators, *Physical Review E* **71**, 036151 [12 pages] (2005).
23. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Desynchronization waves and localized instabilities in oscillator arrays, *Physical Review Letters* **93**, 114101 [4 pages] (2004).
24. **Juan G. Restrepo**, Edward Ott, and Brian R. Hunt, Spatial patterns of desynchronization bursts in networks, *Physical Review E* **69**, 066215 [11 pages] (2004).

### **Publications in Peer-Reviewed Conference Proceedings**

1. Prasanna Madhusudhanan, **Juan G. Restrepo**, Youjian (Eugene) Liu, and Timothy X. Brown, Multi-Tier Network Performance Analysis Using a Shotgun Cellular System, Proc. IEEE Global Telecommunications Conference (Globecom), Houston, Texas, USA, Dec. 2011.
2. Prasanna Madhusudhanan, **Juan G. Restrepo**, Youjian (Eugene) Liu, and Timothy X. Brown, Modeling of Interference from Cooperative Cognitive Radios for Low Power Primary Users, Proc. IEEE Global Telecommunications Conference (Globecom), Miami, Florida, USA, Dec. 2010.

3. Prasanna Madhusudhanan, **Juan G. Restrepo**, Youjian (Eugene) Liu, and Timothy X. Brown, Carrier to Interference Ratio Analysis for the Shotgun Cellular System, Proc. IEEE Global Telecommunications Conference (Globecom), Honolulu, Hawaii, USA, Nov. 2009.

### Accepted Manuscripts

1. Prasanna Madhusudhanan, **Juan G. Restrepo**, Youjian (Eugene) Liu, Timothy X. Brown, Downlink Coverage Analysis in a Heterogeneous Cellular Network. Accepted at IEEE Global Telecommunications Conference 2012 (Globecom), peer-reviewed conference proceeding. Preprint at <http://arxiv.org/abs/1206.4723>.
2. Per Sebastian Skardal and **Juan G. Restrepo**. Synchronization of Kuramoto Oscillators in Networks of Networks. Accepted at Proceedings of the 2012 International Symposium on Nonlinear Theory and its Applications, **not peer-reviewed** conference proceeding. October 22 - 26, 2012, Palma, Mallorca, Spain. Preprint at <http://arxiv.org/abs/1206.3822>.
3. Prasanna Madhusudhanan, **Juan G. Restrepo**, Youjian (Eugene) Liu, Timothy X. Brown, Kenneth R. Baker, Stochastic Ordering based Carrier-to-Interference Ratio Analysis for the Shotgun Cellular Systems. Accepted at IEEE Wireless Communications Letters, peer-reviewed journal. Preprint at <http://arxiv.org/abs/1110.3280>.

### Submitted Manuscripts

1. Per Sebastian Skardal, Jie Sun, Dane Taylor, Juan G. Restrepo, Universality and Full Phase-Locking in Correlated Oscillator Networks, submitted to and in review at Physical Review Letters. Preprint at <http://arxiv.org/abs/1208.4540>.
2. Per Sebastian Skardal, Dane Taylor, **Juan G. Restrepo**, Complex macroscopic behavior in systems of phase oscillators with adaptive coupling, submitted to and in review at Physica D. Preprint at <http://arxiv.org/abs/1207.3102>.
3. Prasanna Madhusudhanan, **Juan G. Restrepo**, Youjian (Eugene) Liu, Timothy X. Brown, and Kenneth Baker, Generalized Carrier to Interference Ratio Analysis for the Shotgun Cellular System, submitted to and in review at IEEE Transactions on Communications. Preprint at <http://arxiv.org/abs/1002.3943>.

### Submitted Book Chapters

1. “Critical Dynamics in Complex Networks”, submitted to Dietmar Plenz and Ernst Niebur, editors of a book entitled “Self Organized Criticality in Neural Systems”, which will be published in the summer of 2013 as a focus issue in the Wiley series “Reviews of Nonlinear Dynamics and Complexity”.

### Theses

1. “Synchronization in networks of coupled oscillators”, Doctoral Thesis, Applied Mathematics and Scientific Computation, University of Maryland at College Park, 2005.

2. “Representation of measures by hyperfinite games”, Master Thesis, Mathematics, Universidad de los Andes, Bogotá, Colombia, 2002.
3. “The role of flat space-time in the formulation of gravitational theories”, Undergraduate Thesis, Physics, Universidad de los Andes, Bogotá, Colombia, 1999.

## Talks

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### Invited Conference and Workshop talks

- “Pinning and memory of period-2 dynamics in cardiac tissue”, Dynamics Days, Bethesda, Maryland, January 2012.
- “Criticality and Statistics of Avalanches in Network Cascading Processes”, NICO Frontier Workshop, Northwestern University, December 2011.
- “Dynamic Range in Networks of Coupled Excitable Systems”, SACNAS Conference, San José, California, October 2011.
- “Intermittent Synchronization in Adaptive Networks of Coupled Oscillators”, SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, May 2011.
- “The dynamic range in networks of coupled excitable systems”, Nonlinear Dynamics on Networks Workshop, University of Maryland, College Park, April 2010.
- “Local adaptation in oscillator networks”, SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, May 2009.
- “Characterizing the dynamical importance of network nodes and links”, SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, May 2007.

### Invited Colloquia

- “Criticality and Dynamic Range in Network Cascading Processes”, George Mason University, Physics Department Colloquium, February 2012.
- “Synchronization of coupled oscillators: from pedestrians to clocks”, JILA Colloquium, January 2011.
- “Synchronization of oscillators with noisy frequency adaptation”, University of Colorado at Colorado Springs, Mathematics Department Colloquium, November 2009.
- “Synchronization of oscillators with noisy frequency adaptation”, University of Denver, Physics Department Colloquium, November 2009.

### Recent Seminar and Contributed Talks

- Applied Dynamics Seminar, University of Maryland, College Park, April 2011.
- National Institute of Mental Health, National Institutes of Health (NIH), May 2010.
- Applied Dynamics Seminar, University of Maryland, College Park, May 2010.
- Dynamics Seminar, Applied Math Department, CU-Boulder, January 2010.
- Applied Dynamics Seminar, University of Maryland, College Park, November 2009.
- Condensed Matter Seminar, Physics Department, CU-Boulder, October 2009.
- Applied Mathematics Seminar, Mathematics Department, Colorado State University, March 2009.
- Dynamics Seminar, Applied Math Department, CU-Boulder, January 2009.

- Dynamics Seminar, Applied Math Department, CU-Boulder, January 2009.
- Complex Networks Seminar, Applied Math Department, CU-Boulder, October 2008.
- Dynamics Seminar, Applied Math Department, CU-Boulder, September 2008.
- Center for Complex Network Research, Northeastern University, Boston, Massachusetts, MA, June 2008.
- APS March Meeting, New Orleans, March 2008.

## Teaching

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### Courses Developed

- Dynamics on Networks, APPM 7400, Fall 2011. New graduate course.

### Courses Taught

- Mathematical Modeling, APPM 4380/5380: Fall 2010, Fall 2011.
- Intermediate Numerical Analysis II, APPM 4660: Spring 2011.
- Introduction to Nonlinear Dynamics and Chaos, APPM 3010: Fall 2009.
- Differential Equations and Linear Algebra, APPM 2360: Fall 2008, Spring 2009, Spring 2012.

## Other Professional Activities

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- Participated in the NSF 2009 CDI preliminary proposal review panel, February 23-24, 2009.
- Peer reviewed manuscripts for the journals Physical Review Letters, Physical Review E, Physica D, Nonlinearity, Chaos, European Physics Letters.
- Member of the Society of Industrial and Applied Mathematics (SIAM) and the American Physical Society (APS).

## Awards

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- Magna cum laude B.S. Physics degree, Universidad de los Andes, 1999.
- Best term GPA award, Universidad de los Andes, Spring 1998.
- “Andres Bello” award for the best Bogotá score in the Colombian national school leaving exam, ICFES, 1993.

## Service

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### Conferences and mini-symposia organized

- Dynamics Days US 2013, Denver, Colorado, January 2013. Chair of the organizing committee.
- Mini-symposium on “Criticality and Dynamic Range in Neuronal Networks”, SIAM Conference on Applications of Dynamical Systems, Snowbird, Utah, 2011. Co-organizer.

## **Ph.D. Dissertation Committees**

- Brock Mosovsky, Applied Mathematics, 2012.
- Chester P. Rubbo, Physics, 2012.
- Daniel B. Larremore, Applied Mathematics, 2012.
- Zachary Alexander, Applied Mathematics, 2012.
- Jerrad Hampton, Applied Mathematics, 2012.
- Kye Taylor, Applied Mathematics, 2011.
- Jinyu Li, Applied Mathematics, 2010.

## **Master's Dissertation Committees**

- Juan Ramirez Jr, Electrical, Computer, and Energy Engineering, 2012.
- Jason De Salvo, Applied Mathematics, 2010.
- Naveen Mysore Balasubramanya, Electrical, Computer, and Energy Engineering, 2010.
- Prasanna Madhusudhanan, Electrical, Computer, and Energy Engineering, 2010.
- Jason Boorn, Applied Mathematics, 2009.
- Pradeep Narayan, Electrical and Computer Engineering, 2008.

## **Departmental Committees**

- Colloquium Chair, 2012-2013
- Instructor Search Committee, 2011-2012.
- PDE Preliminary Exam Committee, 2010, 2011.
- Graduate Committee, 2010-2011.
- Instructor Search Committee, 2008-2009.

## **Miscellaneous Service**

Co-organized the CU-Boulder Applied Math Dynamics and Complex Systems Seminar, 2009-2012.