BISWADIP DEY
Associate Research Scholar and Lecturer
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Research Interests

My research interest spans various aspects of systems science and control theory. In particular, I am interested in nonlinear and optimal control, and their applications in collaborative robotics and autonomous systems.

Education

- **Doctor of Philosophy** — Aug 2009 – Feb 2015
  University of Maryland, College Park — *College Park, MD, USA*
  - **Major:** Electrical & Computer Engineering - Controls
  - **Dissertation:** Reconstruction, Analysis and Synthesis of Collective Motion

- **Master of Technology** — Jul 2006 – Jul 2008
  Indian Institute of Technology - Bombay — *Mumbai, India*
  - **Major:** Systems & Control Engineering
  - **Master's Thesis:** Stabilizing a Flexible Beam on a Cart: A Distributed Port-Hamiltonian Approach

- **Bachelor of Engineering** — Jun 2002 – May 2006
  Jadavpur University — *Kolkata, India*
  - **Major:** Electrical Engineering
  - **Senior Thesis:** Model Reduction using Genetic Algorithm

Research Experience

- **Associate Research Scholar and Lecturer** — Mar 2017 – Present
  Postdoctoral Research Associate and Lecturer — Mar 2015 – Mar 2017
  Department of Mechanical & Aerospace Engineering, Princeton University — *Princeton, NJ, USA*
  - **Advisor**: N. E. Leonard
  - Introduced feedback controlled bifurcation in replicator-mutator dynamics
  - Proposed sufficient conditions for cluster synchronization in a network of nonlinear oscillators
  - Investigated parallel processing capability in human cognition and neural network architectures

- **Graduate Research Assistant** — Jun 2010 – Mar 2015
  Institute for Systems Research, University of Maryland — *College Park, MD, USA*
  - **Advisor:** P. S. Krishnaprasad
  - Proposed novel algorithms for data smoothing by using techniques from optimal control
  - Investigated flight strategies and sensorimotor feedback mechanisms in biological collectives
  - Designed and implemented bio-inspired control algorithms for collective behavior

- **Lab Manager** — Aug 2011 – Mar 2015
  Intelligent Servosystems Laboratory, University of Maryland — *College Park, MD, USA*
  - Developed a robotic test-bed involving Vicon motion capture system, Pioneer-3 robots and ROS

- **Summer Research Intern** — Jun 2012 - Aug 2012
  Intelligent Automation Inc. — *Rockville, MD, USA*
  - Designed a support vector machine (SVM) based clustering algorithm for RF source localization

- **Senior Research Fellow** — Jul 2008 - Jun 2009
  Interdisciplinary Program in Systems & Control Engineering, IIT Bombay — *Mumbai, India*
  - Studied infinite dimensional port-Hamiltonian systems and energy Casimir approach

Publications

Journal Publications

J7 K. Özcimder, B. Dey, R. Lazier, D. Trueman, A. Franci, N. E. Leonard, **Social decision-making driven by artistic explore-exploit tension**, Under Review (*Interdisciplinary Science Reviews*).

J6 J. Crall, B. Dey, A. N. Ford-Versypt, **Colony size and pesticide exposure: using an agent-based model to explore social buffering of neonicotinoid exposure in bumblebees**, Under Review (*Frontiers in Ecology and Evolution*).

J5 J. Crall, C. Switzer, R. Oppenheimer, S. Combes, N. Pierce, B. De Bivort, A. Ford-Versypt, B. Dey, A. Brown, M. Eyster, C. Guérin, **Chronic neonicotinoid exposure disrupts bumblebee nest behavior, social networks, and thermoregulation**. Under Review (*Science*).

J4 R. Pagliara, B. Dey, N. E. Leonard, **Bistability and Resurgent Epidemics in Reinfection Models**, To appear in *IEEE Control Systems Letters*.

J3 K. S. Galloway, B. Dey, **Collective motion under beacon-referenced cyclic pursuit**, *Automatica*, 91:17-26, May 2018.

J2 Z. Aminzare, B. Dey, E. N. Davison, N. E. Leonard, **Cluster synchronization of diffusively-coupled nonlinear systems: A contraction based approach**, *Journal of Nonlinear Science*, 1-23, Apr 2018.

J1 R. Banavar, B. Dey, **Stabilizing a flexible beam on a cart: A distributed port-Hamiltonian approach**, *Journal of Nonlinear Science*, 20(2):131-151, Apr 2010.

Peer-reviewed Conference Proceedings

C15 B. Dey, A. Franci, K. Özcimder, N. E. Leonard, **Feedback controlled bifurcation of evolutionary dynamics with generalized fitness**, To appear in the *Proceedings of ACC 2018*.

C14 K. S. Galloway, B. Dey, **Beacon-referenced mutual pursuit in three dimensions**, To appear in the *Proceedings of ACC 2018*.

C13 K. S. Galloway, B. Dey, **Constant bearing pursuit on branching graphs**, *56th IEEE Conference on Decision and Control (CDC)*, 4410-4415, Dec 2017.

C12 N. Alon, D. Reichmann, I. Shinkar, T. Wagner, S. Musslick, J. D. Cohen, T. Griffiths, B. Dey, K. Özcimder, **A graph-theoretic approach to multitasking**, *31st Conference on Neural Information Processing Systems (NIPS)*, Dec 2017.

C11 K. Özcimder, B. Dey, S. Musslick, G. Petri, N. K. Ahmed, T. L. Willke, J. D. Cohen, **A formal approach to modeling the cost of cognitive control**, *39th Annual Meeting of the Cognitive Science Society (CogSci)*, 895-900, July 2017.

C10 S. Musslick, A. M. Saxe, K. Özcimder, B. Dey, G. Henselman, J. D. Cohen, **Multitasking capability versus learning efficiency in neural network architectures**, *39th Annual Meeting of the Cognitive Science Society (CogSci)*, 829-834, July 2017.

C9 E. N. Davison, B. Dey, N. E. Leonard, **Synchronization bound for networks of nonlinear oscillators**, *54th Annual Allerton Conference on Communication, Control and Computing*, 1110-1115, Sep 2016.

C8 S. Musslick, B. Dey, K. Özcimder, M. M. A. Patwary, T. L. Willke, J. D. Cohen, **Controlled vs. automatic processing: A graph-theoretic approach to the analysis of serial vs. parallel processing in neural network architectures**, *38th Annual Meeting of the Cognitive Science Society (CogSci)*, 1547-1552, Aug 2016.

C7 K. S. Galloway, B. Dey, **Stability and pure shape equilibria for beacon-referenced cyclic pursuit**, *American Control Conference (ACC)*, 161-166, July 2016.

C6 K. Özcimder, B. Dey, R. J. Lazier, D. Trueman, N. E. Leonard, **Investigating group behavior in dance: An evolutionary dynamics approach**, *American Control Conference (ACC)*, 6465-6470, July 2016.

C5 K. S. Galloway, B. Dey, **Station keeping through beacon-referenced cyclic pursuit**, *American Control Conference (ACC)*, 4765-4770, July 2015.

C4 U. Halder, B. Dey, **Biomimetic algorithms for coordinated motion: Theory and implementation**, *IEEE International Conference on Robotics and Automation (ICRA)*, 5426-5432, May 2015.

C3 B. Dey, P. S. Krishnaprasad, **Control-theoretic data smoothing**, *53rd IEEE Conference on Decision and Control (CDC)*, 5064-5070, Dec 2014.

C2 B. Dey, P. S. Krishnaprasad, **Trajectory smoothing as a linear optimal control problem**, *50th Annual Allerton Conference on Communication, Control & Computing*, 1490-1497, Oct 2012.

C1 R. Banavar, B. Dey, **Stabilizing a flexible beam on a cart: A distributed port Hamiltonian approach**, *10th European Control Conference (ECC)*, 300-305, Aug 2009.

Pre-prints

P6 G. Petri, S. Musslick, K. Özcimder, B. Dey, N. K. Ahmed, T. L. Willke, J. D. Cohen, **Universal limits to parallel processing capability of network architectures**, [arXiv].

P5 B. Dey, P. V. Reddy, C. Chiu, K. Ghose, K. S. Galloway, T. K. Horiuchi, E. W. Justh, C. F. Moss, P. S. Krishnaprasad, **Context shapes bat flight behavior: Evidence from geometry of prey capture**.

P4 E. N. Davison, Z. Aminzare, B. Dey, N. E. Leonard, **Mixed mode oscillations and firing onset in coupled systems of FitzHugh-Nagumo type**.

P3 B. Dey, P. S. Krishnaprasad, **Trajectory reconstruction via optimal control**.

P2 K. Özcimder, B. Dey, S. Musslick, Z. Aminzare, T. L. Willke, J. D. Cohen, **A formal approach to the requirements for cognitive control in network architectures**.

P1 S. Musslick, B. Dey, K. Özcimder, N. Ahmed, T. L. Willke, J. D. Cohen, **A formal theory of cognitive control and automaticity: Learning, representation and multitasking in neural networks**.

Conference Presentations and Invited Talks (Selected)

- **Feedback controlled bifurcation of evolutionary dynamics with generalized fitness** (*Poster*, with A. Franci, K. Özcimder, N. E. Leonard), Dynamics Days, Jan 2018.
- **Controllability in a network of linear dynamical systems** (with E. N. Davison, N. E. Leonard), SIAM Workshop on Network Science, July 2017.
- **Diminishing returns with size for parallel computation capacity of neural architectures** (with G. Petri, S. Musslick, K. Özcimder, N. K. Ahmed, J. D. Cohen), International School and Conference on Network Science (NetSci), June 2017.
- **Synchronization and Related Phenomena in Networks of Diffusively-Coupled Fitzhugh-Nagumo Oscillators** (*Poster*, with E. N. Davison, Z. Aminzare, N. E. Leonard), Workshop on Brain Dynamics and Neurocontrol Engineering, Washington University in St. Louis, June 2017.
- **Using evolutionary dynamics to model structured improvisational dance** (with K. Özcimder, A. Franci, R. Lazier, D. Trueman, N. E. Leonard), SIAM Conference on Dynamical Systems, May 2017.
- **Synchronization in Neuronal Oscillator Networks**, Workshop on Control and Observability of Network Dynamics, Mathematical Biosciences Institute (MBI), Apr 2016.
- **Data Assimilation: Optimal Fitting, Cross-Validation, and Feedback Laws**, Workshop on Geometry of Collective Behavior: Control, Dynamics and Reconstruction, 53rd IEEE Conference on Decision and Control, Dec 2014.
- **Reconstruction, Analysis and Synthesis of Collective Motion**
  - Princeton University (*Oct 2014*); Harvard University (*Sep 2014*).
- **Control Theoretic Data Smoothing**, Indian Institute of Technology Bombay, Jan 2014.
- **Control Theoretic Tool for Trajectory Reconstruction** (*Poster*), Conference on Dynamics of Prey Capture and Escape, Janelia Farm Research Campus, HHMI, March 2013.

Teaching and Mentoring Experience (Selected)

- **Lecturer** (Princeton University)
  – Nonlinear Control (*Fall 2017*); Modern Control (*Fall 2015*)
- **Graduate Teaching Assistant** (University of Maryland)
  – Numerical Techniques in Engineering (*Fall 2009*)
- **Technical Guidance for PhD Students** (Princeton University)
  – Elizabeth N. Davison (*June 2015 - Present*): *Heterogeneity and Synchronization of Coupled Neuronal Oscillator Networks*
- **Mentor for Undergraduate Research Program**
  – Princeton University: Matthew Romer (*Feb 2017 - Present*)

– University of Maryland: Nosheen Moosvi (*Aug 2013 - May 2014*); Garrett Wenger (*Aug 2012 - May 2013*); Benjamin Flom (*May 2011 - Aug 2011*)

Scholastic Honours (Selected)

- 2014 George Harhalakis Outstanding Systems Engineering Graduate Student Award, Institute for Systems Research, University of Maryland.
- Clark School of Engineering Distinguished Graduate Fellowship 2009-2010, University of Maryland.

Professional Activity

- **Member:**
  - Institute of Electrical and Electronics Engineers (IEEE); Cognitive Science Society
- **Reviewer:**
  - CDC (2009, 2010, 2014-), ACC (2015-), ECC (2016), IROS (2016), NIPS (2016)
  - Top-tier control and multidisciplinary science journals (Automatica, IEEE TAC, IEEE TCNS, Systems & Control Letters, Proc. Royal Society A, Nature Scientific Reports, *etc.*)
- **Proposal Review Panel:**
  - National Science Foundation (2017)
- **Co-chair:**
  - ACC 2015 (Session on *Decentralized Control*); CDC 2014 (Session on *Optimal Control*)