

# Subhradeep Roy, Ph.D.

Assistant Professor  
Department of Mechanical Engineering,  
California State University, Northridge

✉ subhradeep.roy@csun.edu

☎ +1 540 200-5627

🌐 [Complex Dynamical Systems Laboratory](#)

## Goal Statement

My research goal is to advance the understanding of complex dynamics in networked man-made systems, and self-organizing biological systems that inform robust control algorithms in distributed multi-agent systems. To meet my research objectives, I take interdisciplinary and data-driven approach to study diverse living and non-living systems, and simultaneously develop novel data analytic tools that are useful to detect the features of real-world interactions. In these systems, I study the influence of pairwise interactions on the higher-order system dynamics. My work focus on systems including biologically inspired robotic swarms, brain-connectivity network and traffic and transportation networks. I aim to prepare future engineers and equip them with skills in theoretical, computational, and data analysis techniques to tackle issues related to complex dynamical systems, enabling them to predict and control such systems by incorporating research into undergraduate and graduate courses, and engaging them in my research.

## Research Interests (alphabetical order)



automated discovery, causal discovery, complex dynamical systems, control, decentralized multi-agent and autonomous systems, information theory, network inference and analysis, robotics, time-series analysis, traffic and transportation network

## Teaching Interests (alphabetical order)

Undergrad: differential equations, dynamics, engineering mathematics, solid mechanics and machine design, statics, synthesis and analysis of mechanisms and machines, system dynamics and control

Graduate: complex dynamical systems, continuum mechanics, linear systems theory, nonlinear dynamics, numerical methods, probability & statistics, random process, robot mechanics and control

## Education

08/2012 – 06/2017	■ <b>Ph.D. in Engineering Mechanics</b> <b>Virginia Tech (VT)</b> Dissertation: Multiscale views of multi-agent interactions in the context of collective behavior <a href="#">↗</a>	
08/2010 – 05/2012	■ <b>M.Tech in Mechanical Engineering</b> <b>Indian Institute of Technology (IIT) Kanpur</b> Mechanics & Applied Mathematics Group <a href="#">↗</a> Specialization: <i>solid mechanics &amp; design</i>	
08/2006 – 06/2010	■ <b>B.E. in Mechanical Engineering</b> <b>Indian Institute of Engineering Science and Technology Shibpur</b>	

## Professional Appointments



08/2019 – present	■ <b>Assistant Professor</b>	<b>California State University Northridge (CSUN)</b> Department of Mechanical Engineering
08/2017 – 07/2019	■ <b>Postdoctoral Fellow</b>	<b>Virginia Tech</b> Physical Computing Laboratory
08/2013 – 06/2017	■ <b>Graduate Research Assistant</b>	<b>Virginia Tech</b> Complex Systems Laboratory, <a href="#">↗</a>
08/2012 – 05/2015	■ <b>Instructor and Graduate Teaching Assistant</b>	<b>Virginia Tech</b> Department of Biomedical Engineering & Mechanics
08/2010 – 05/2012	■ <b>Graduate Teaching &amp; Research Assistant</b>	<b>IIT Kanpur</b> Department of Mechanical Engineering

## Honors and Awards

- 2021 ■ Nominated for *Future Technology Leader Award* - 2021 Engineers' Council of San Fernando Valley (award will be announced on Feb, 2021)
- 2020 ■ Invited speaker at *Exemplars in Engineering Research*, Department of Research, The California State University, Office of the Chancellor, 03 September 2020.
- 2017 ■ Manuel Stein Scholarship (Department of Biomedical Engineering & Mechanics, VT)  
■ Virginia Tech Graduate Student Assembly Travel Award
- 2016 ■ Student Support (IEEE IWCSN)
- 2015 ■ Conference Travel Award (ASME Dynamic Systems and Control Conference)  
■ Student Support (KI-Net workshop)
- 2012 ■ Pratt Presidential Graduate Fellowship, (Engineering Science & Mechanics Program, VT)
- 2010-12 ■ GATE Scholarship (Mechanical Engineering Department, IIT Kanpur)

## Journal Publications (†= corresponding author, \* = students directly supervised, ° = mentee)

### Published/ In Press/ Accepted

- J1 S Roy<sup>†</sup>**  
*Quantifying interactions among car drivers using information theory*  
**Chaos**, Volume 30(11), 113125, 2020 (Impact Factor: 2.8)
- J2 S Roy<sup>†</sup>, M Shirazi, B Jantzen and N Abaid**  
*Effect of visual and auditory sensing cues on collective behavior in Vicsek models*  
**Physical Review E** Volume 100(6), 062415, 2019 (Impact Factor: 2.3)
- J3 S Roy<sup>†</sup>, K Howes<sup>°</sup>, R Mueller, S Butail and N Abaid**  
*Extracting information flow between flying bat pairs using model-free methods*  
**Entropy**, Volume 21(1), 42, 2019 (Impact Factor: 2.5)
- J4 C Beauchene, S Roy, R Moran, A Leonessa and N Abaid**  
*Comparing brain connectivity metrics: a didactic tutorial with a toy model and experimental data*  
**Journal of Neural Engineering**, Volume 15(5), 056031, 2018 (Impact Factor: 4.1)
- J5 S Roy<sup>†</sup> and B Jantzen**  
*Detecting causality using symmetry transformations*  
**Chaos**, Volume 28(7), 075305, 2018 (Impact Factor: 2.8)
- J6 S Roy and N Abaid**  
*Interactional dynamics of same-sex marriage legislation in the United States*  
**Royal Society Open Science**, Volume 4(6), 170130, 2017 (Impact Factor: 2.5)  
[Featured in Virginia Tech News](#)  [and Technology Org](#) 
- J7 L Rao, S Roy and S Das**  
*Diffusion mediated coagulation and fragmentation based study of domain formation in lipid bilayer membrane*  
**Physica B: Condensed Matter**, Volume 505, 74-83, 2017 (Impact Factor: 1.9)
- J8 S Roy and N Abaid**  
*On the effect of collaborative and antagonist interactions on synchronization and consensus in networks of conspecific agents*  
**IEEE Transactions on Automatic Control**, Volume 61(12), 4063-4068, 2016  
(Impact Factor: 5.6)

**J9 S Roy and N Abaid**

*Leader-follower consensus in numerosity-constrained networks with dynamic leadership*

**Chaos**, Volume 26(11), 116309, 2016 (Impact Factor: 2.8)

### **Manuscripts in progress**

**J10 C Shea-Blymyer, S Roy and B Jantzen**

*Identifying dynamical similarity with partial information*

(in preparation)

**J11 J Lemus\* and S Roy<sup>†</sup>**

*Composite effect of audition and vision in a two-dimensional Vicsek model*

(in preparation)

### **Peer-reviewed Conference Publications** (<sup>†</sup>= corresponding author, \* = students directly supervised)

**C1 J Lemus\* and S Roy<sup>†</sup>**

*The effect of simultaneous auditory and visual sensing cues in a two-dimensional Vicsek model*

**ASME 2020 Dynamic Systems and Control Conference (DSCC)**, (paper accepted)

**C2 A Hashimoto, S Roy, C Shea-Blymyer, B Jantzen and N Abaid**

*Differentiation of collective behavior based on automated discovery of dynamical kinds*

**ASME 2018 Dynamic Systems and Control Conference (DSCC)**, pp. V003T30A008

**C3 C Beauchene, S Roy, J Simon, A Leonessa and N Abaid**

*Closed-loop control of the frequency response of the virtual brain model*

**ASME 2017 Dynamic Systems and Control Conference (DSCC)**, pp. V001T37A001

**C4 S Roy and N Abaid**

*Data-based method for extracting navigational leadership between two bats*

**Proceedings of XXIV International Congress of Theoretical and Applied Mechanics (ICTAM 2016)**

**C5 S Roy and N Abaid**

*Consensus of conspecific agents via collaborative and antagonistic interactions*

**ASME 2015 Dynamic Systems and Control Conference (DSCC)**, pp. V003T37A004

**C6 S Roy and N Abaid**

*Leader-follower consensus modeling representative democracy*

**2015 International Conference of Control, Dynamic Systems, and Robotics (CDSR)**, Paper No. 156

### **Invited Talks**

- 1 “Study of interactions in complex dynamical systems.” Exemplars in Engineering Research, September 2020, Department of Research, The California State University, Office of the Chancellor
- 2 “Study of interactions in complex dynamical systems.” College of Computing and Informatics, May 2020, University of North Carolina at Charlotte
- 3 “Differentiation of Collective Behavior Based on Automated Discovery of Dynamical Kinds.” 2018 Philosophy and Physical Computing Workshop, June 2018, Virginia Tech

4 “Social interaction networks: bioinspired abstract modeling and data-driven analyses of wild bat pairs.”

[Applied Mathematics Colloquium Seminar](#), 

Nov 2017, University of North Carolina, Chapel Hill

5 “Multiscale views of multi-agent interactions in the context of collective behavior.” Network Dynamics and Simulation Science Laboratory (NDSSL), Dec 2016, Virginia Tech

### Selected Oral Presentations (presenter underlined)

---

- 1 J Lemus and S Roy , “The effect of simultaneous auditory and visual sensing cues in a two-dimensional Vicsek model” ASME 2020 Dynamic Systems and Control Conference, Oct 2020, virtual conference)
- 2 S Roy, “Engineering with bio-inspired interactions.” Industry Advisory Board Meeting, November 2019, CSUN
- 3 S Roy and N Abaid, “Extracting information flow between animals in the wild.” 2017 Southeast Regional Society for Integrative & comparative biology (rSICB) Meeting, Nov 2017, Virginia Tech
- 4 S Roy and N Abaid, “Extracting information flow between animals in the wild.” Bioinspired Science & Technology (BIST) seminar, Nov 2017 Virginia Tech
- 5 S Roy and N Abaid, “Interactional dynamics of same-Sex marriage legislation in the United States.” 2017 SIAM Conference on Applications of Dynamical Systems, May 2017, Snowbird, Utah
- 6 S Roy and N Abaid, “Extracting information flow between animals in the wild” 2017 SIAM Conference on Applications of Dynamical Systems, May 2017, Snowbird, Utah
- 7 S Roy and N Abaid, “Data-based method for extracting navigational leadership between two bats.” IEEE International Workshop on Complex Systems and Networks, Nov 2016, Atlanta
- 8 S Roy and N Abaid, “Data-based method for extracting navigational leadership between two bats.” 24th International Congress of Theoretical and Applied Mechanics (ICTAM), Aug 2016, Montreal, Canada
- 9 S Roy and N Abaid, “Consensus of conspecific agents via collaborative and antagonistic interactions.” ASME 2015 Dynamic Systems and Control Conference, Oct 2015, Columbus, Ohio
- 10 S Roy and N Abaid, “Synchronization and consensus over networks inspired by bats.” Bioinspired Science & Technology (BIST) seminar, Sep 2015, Virginia Tech
- 11 S Roy and N Abaid, “Consensus and synchronization over biologically-inspired networks: from collaboration to antagonism.” 2015 SIAM Conference on Applications of Dynamical Systems, May 2015, Snowbird, Utah
- 12 S Roy and N Abaid, “Leader-follower consensus modeling representative democracy.” 2015 International Conference of Control, Dynamic Systems, and Robotics (CDSR), May 2015, Ottawa, Canada
- 13 S Roy and N Abaid, “Consensus and synchronization over biologically-inspired networks: from collaboration to antagonism.” Collective dynamics and model verification: Connecting kinetic modeling to data, Apr 2015, Arizona State University School of Mathematical and Statistical Sciences, Tempe, Arizona

## Organized conference sessions

---

- *Data-driven analysis and modeling of real-world dynamical systems* for the 2021 SIAM Conference on Applications in Dynamical Systems, co-organizing with Sachit Butail (upcoming)

## Teaching

---

- As an **Assistant Professor** (in the Dept. of Mechanical Engineering, at CSUN)
  - As a tenure-track faculty, I have a teaching load of eight courses (24 units) per year. I received a course release of 12 units and six units in the first and second years, respectively, for course design and development.
  - **Spring 2021:**
    - \* ME 515 - Dynamics of Machines (*graduate course*)
    - \* ME 280 - Differential Equations for Mechanical Engineers (*undergraduate course*)
    - \* ME 384 - System Dynamics: Modeling, Analysis and Simulation (*undergraduate course*)
  - **Fall 2020:**
    - \* ME 415 (section 01) - Kinematics of Mechanisms (*undergrad senior elective course*)
    - \* ME 415 (section 02) - Kinematics of Mechanisms (*undergrad senior elective course*)
    - \* ME 280 - Differential Equations for Mechanical Engineers (*undergraduate course*)
  - **Spring 2020:**
    - \* ME 515 - Dynamics of Machines (*graduate course*)
    - \* ME 280 - Differential Equations for Mechanical Engineers (*undergraduate course*)
  - **Fall 2019:**
    - \* ME 520 - Robot Mechanics and Control (*graduate course*)
    - \* ME 415 - Kinematics of Mechanisms (*undergrad senior elective course*)
      - Duties in the above classes – developing syllabus, course material & course projects, **implementing active learning strategies**, classroom instruction, preparing assignments & exams, grading, holding office hours.
- As an **Instructor**
  - At IIT Kanpur:
    - \* ME 371, 471 - M.E. Laboratory I and II (Spring 2011, Spring 2012)
  - At Virginia Tech:
    - \* ESM 4004 - Instrumentation & Experimental Mechanics (Spring 2013)
      - Duties in the above classes – classroom instruction, conducting experiments, developing lectures, exams and assignments, grading, holding office hours.
- As a **Teaching Assistant**
  - At Virginia Tech:
    - \* ESM 2304 - Dynamics (Spring 2015)
    - \* ESM 2104 - Statics (Fall 2012, Spring 2014, Fall 2014)
    - \* ESM 6504 - Ideal Flow (Fall 2013) (*graduate level course*)
    - \* ESM 2204 - Mechanics of Deformable Bodies (Summer 2013)
  - At IIT Kanpur:
    - \* ME 321 - Advanced Mechanics of Solids (Fall 2010, Fall 2011)

## Submitted Grant Proposals

---

- At CSUN
  - 2020-21 Research, Scholarship, and Creative Activity Award (RSCA) (submitted in Spring 2020)  
Proposal Title: *Sensory integration and the interplay among sensory modalities to study emergent behavior in multi-agent systems*  
Role: Principal Investigator
  - 2020 Research & Sponsored Programs - Summer Grant Program (submitted in Spring 2020)  
Proposal Title: *Multisensory integration in multi-agent systems*  
Role: Principal Investigator
- External
  - DARPA-PA-18-02-02: Artificial Intelligence Research Associate (AIRA) (submitted in Fall 2018)  
Proposal Title: *SYMian: Dynamical symmetries for physics-based AI*  
Role: Co-Investigator

## Advising and Mentoring

---

- Master's Thesis Committee Chair at CSUN
  - 1 Douglas Hull (Feb 2020 -), Department of Mechanical Engineering
  - 2 Jeremy Lemus (Feb 2020 -), Department of Mechanical Engineering.
- Master's Thesis Committee Member at CSUN
  - 1 Bryan Ghoslin, Department of Mechanical Engineering.
- Graduate mentor for NSF EAGER project (Spring 2018 – July 2019)

Topic: Model-free classification of collective behavior based on automated detection of symmetry from video data  
*Graduate students:* Zachary Shifrel and Alexander Tolbert from Department of Philosophy, Virginia Tech  
*Undergraduate student:* Rishabh Anand from Department of Computer Science, Virginia Tech  
*High school student:* Lim Derp
- Graduate mentor for NSF BRIGE (Spring 2015 - Fall 2017)

Topic: Developing a model of collective behavior in bat swarms using acoustic communication and applications in robotic systems  
*Undergraduate student:* Kayla Howes from Department of Engineering Science & Mechanics, Virginia Tech
- Graduate mentor for NSF RET (Spring 2014)

Topic: Sensory feedback and the effects on synchronous running in groups  
*Undergraduate student:* Nicole Capella from Department of Engineering Science & Mechanics, Virginia Tech  
*K-12 teacher:* Thomas Collins

## News Coverage

---

- Technology Org [↗](#)
- Virginia Tech News [↗](#)

## Service and Outreach

---

- Service
- **Faculty search & screen committee**, Department of Mechanical Engineering, CSUN
    - AY 19-20
    - AY 20-21 (also serving as *Equity & Diversity* representative)
  - **Course coordinator** for ME 280, Department of Mechanical Engineering, CSUN
  - **Graduate Committee Student Representative**, Department of Biomedical Engineering & Mechanics, VT  
(Fall 2013 - Spring 2014)
  - **Journal Reviewer:** IEEE Transactions on Control Systems Technology, IEEE Transactions on Circuits and Systems I: Regular Papers, The European Physical Journal, IEEE Transactions on Automatic Control, International Journal of Bifurcation and Chaos, Bulletin of Mathematical Biology
  - **Conference Reviewer:** American Control Conference, ASME Dynamic Systems and Control Conference, International Conference on Robotics and Automation
- Outreach
- Co-organized and presented for bat and robotics-themed summer camp activity at the Price House Nature Center, Blacksburg, Virginia.  
(Summer 2014, Summer 2015, Summer 2016)

## Computational/ Digital Resources

---

- Software – MATLAB, Mathematica, Maple, R, AutoCAD, SolidWorks, LaTeX, Python, learning management systems (Canvas, Scholar)
- Operating Systems – Windows, Linux

## Professional Affiliations

---

American Society of Mechanical Engineers (ASME)  
Society for Industrial and Applied Mathematics (SIAM)

## Other

---

- Organizing committee member of Bengali Student Association at Virginia Tech: organized and implemented cultural and social events (Fall 2014, Fall 2015)
- Photography & Art contest, Virginia Tech: third place (2014), second place (2015)

## References

---

### Nicole Abaid

Associate Professor  
Department of Mathematics  
Virginia Tech,  
460 McBryde Hall, Blacksburg, VA 24061.  
✉ nabaid@vt.edu  
☎ +1 540-231-5516

### Benjamin Jantzen

Associate Professor  
Department of Philosophy  
Affiliate of the Department of Computer Science  
Virginia Tech,  
226 Major Williams, Blacksburg, VA 24061.  
✉ bjantzen@vt.edu  
☎ +1 540-231-1766

### Sachit Butail

Assistant Professor  
Department of Mechanical Engineering  
Northern Illinois University,  
DeKalb, IL 60115.  
✉ sbutail@niu.edu  
☎ +1 815-753-9987

### Sovan Lal Das

Associate Professor  
Mechanical Engineering Department  
Indian Institute of Technology Palakkad  
✉ sovan@iitpkd.ac.in,  
✉ sovandas@iitk.ac.in  
☎ +91-3222-282926