

## Curriculum Vitae of Romeil Sandhu

### Personal Data:

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### Short Bio & Overview:

Currently an Assistant Professor at Stony Brook University with appointments in Biomedical Informatics, Computer Science, and Applied Mathematics & Statistics Departments and is the recipient of the **2018 AFOSR YIP Award** for work on interactive feedback control for autonomous systems and **2018 NSF CAREER Award** for work on geometric optimization of time-varying networks. First received his B.S. and M.S., and Ph.D. degrees from the **Georgia Tech** in **Electrical Engineering** in 2006, 2009, and 2011 respectively. Prior to my academic position at Stony Brook, formed a startup providing government services leading to a successful exit. My current research interest lies on the intersection of control, geometry, and statistics applied to problems rooted in networks, imaging, and learning in order to bridge the information gap (i.e., “closing the loop”) of intractable high dimensional statistical optimization problems.

### Education:

1. **Ph.D. in Electrical Engineering**, Georgia Institute of Technology, January 2011.  
Thesis: Statistical Methods for 2D Image Segmentation and 3D Pose Estimation  
Advisor: Allen Tannenbaum
2. **M.S. in Electrical Engineering**, Georgia Institute of Technology, May 2009.
3. **B.S. in Electrical Engineering**, Georgia Institute of Technology, May 2006.

### Previous Appointments:

1. **Stony Brook University** 2016 – Present  
Assistant Professor, College of Engineering and Sciences (CEAS)  
Department: Biomedical Informatics (Primary), Computer Science & AMS (Adjunct)
2. **DoD/Aerospace Consultant** 2007 – Present  
Industrial Consultant
3. **Harper Laboratories, LLC** 2011 – 2016  
President & Co-Founder
4. **Minerva Research Group** 2007 – 2011  
Graduate Research Assistant, ECE Dept.
5. **Georgia Institute of Technology** 2006 – 2007  
Graduate Teaching Assistant, ECE Dept.

### Selected Awards / Honors:

1. NSF CAREER Award (2018, Program: Energy, Power, Networks and Control)
2. AFOSR YIP Award (2018, Program: Control & Dynamics)
3. Graduate Research Fellowship (2007 – 2011, Georgia Tech)
4. Outstanding Graduate Teaching Assistant (2007, Georgia Tech)
5. Presidents Undergraduate Research Award (2005, Georgia Tech)
6. Highest Honors (2003 – 2006, Georgia Tech)

## Professional Activities:

### 1. Service:

National Science Foundation Panel Reviewer (Industry/Academic)  
Simons Summer Highschool Mentor, Stony Brook University  
Academic Senator (College of Engineering), Stony Brook University  
Faculty Search Committee (BMI Dept.), Stony Brook University  
Simons HS Program Admissions Committee, Stony Brook University  
Graduate Admissions Committee (BMI Dept.), Stony Brook University  
Graduate Admissions Committee (CS Dept.), Stony Brook University  
Journal Reviewer: IEEE TIP, IEEE PAMI, IEEE JBHI, SIAM SISC, CVIU  
Conference Reviewer: IEEE CDC, ACC, CVPR, ECCV, ICCV

### 2. Industrial Consulting:

Sigmatech Incorporated (2016-Present)  
Scientific Systems Company, Inc. (2014-2015)  
Trex Enterprises (2010-2011)  
United Technologies Research Center (2009-2010)  
MIT Lincoln Laboratories (2007-2009)

## Current (Funded) Research Summary:

### 1. Interactive 2D3D Control for Autonomous Systems

This research focuses on the interplay of geometry and control to advance feedback control-based methods applied towards autonomy in an interactive manner. Examples of such work in this area includes the usage of developing control-theoretic principles to allow for manifold sculpting and situational awareness. The underlying mathematical interests lies in PDEs, feedback control, information geometry, and differential geometry to enable effective operator in-loop performance. Applications of this research span several areas with a primary focus on autonomous systems to interactive machine learning and optimization.

**Project Funding:** 2018 Air Force Office of Scientific Research (AFOSR) Young Investigator Program (YIP) – 450K/3-Year

### 2. Geometric Optimization and Control of Time-Varying Networks

This research focuses on optimizing geometric & topological network properties to control dynamical systems often represented as weighted graphs that evolve over time. Research was the first to show that Ricci curvature is positively correlated with system's ability to dynamically adapt. Areas of research include mass transport, information/Riemannian geometry, as well as designing geometric flows capable of elucidating system-level fragility. Applications of this research are wide, and this program has been designed to be applied to a myriad of problems.

**Project Funding:** 2018 National Science Foundation CAREER Award – 500K/5-Year

## List of Past and Present Research Funding:

Below are on-going and past funding. Total current funding is **\$943,496.20**. Past funding includes **\$1,275,016.80** with total award of funding till date of **\$2,218,512.80**. Note: \* Represents projects funded as a private entity and both PI/co-PI were founders, i.e., 50% shared in subsequent funding.

### Current Funding:

1. **National Science Foundation CAREER Award** (FY: 2018 – 2023) **\$500,020.00**  
Project: Network Geometry for Analyzing Dynamical Systems  
Prime Role: sole-PI

2. **Air Force Office of Scientific Research YIP “Career”** (FY: 2018 – 2021) **\$443, 476.00**  
Project: Interactive Feedback Control for 2D3D Autonomous Systems  
Prime Role: sole-PI

### **Past Funding:**

3. **Air Force Research Laboratory** (FY: 2014 – 2016) **\$749,747.20**  
Project: Prototype and geometric modeled rad-hard chip sets (SBIR Phase II).  
Prime Role: co-PI, PI: Kevin Brenner\*

4. **Raytheon University Project** (FY: 2014 – 2015) **\$76,000.00**  
Project: Performed exploratory modeling research on Raytheon EKV/SM3 platforms.  
Subcontract Role: PI, co-PI: Kevin Brenner\*, Prime: Georgia Tech (Pass-Through, Direct Award)

5. **National Science Foundation** (FY: 2013 – 2014) **\$150,000.00**  
Project: Investigated geometric models for interconnect architectures (SBIR Phase I)  
Prime Role: co-PI, PI: Kevin Brenner\*

6. **Air Force Research Laboratory** (FY: 2013 – 2014) **\$149,696.34**  
Project: Investigated geometric models of rad-hard chip sets (SBIR Phase I).  
Prime Role: co-PI, PI: Kevin Brenner\*

7. **Missile Defense Agency** (FY: 2013 – 2014) **\$149,573.26**  
Project: Investigated simulated designs of AMPM missile platform (SBIR Phase I).  
Prime Role: co-PI, PI: Kevin Brenner\*

### **Teaching Experience:**

1. **Georgia Tech ECE 3710** Fall 2006, Spring 2007  
Course Description: An introduction to electric circuit elements and electric devices and a study of circuits containing such devices.
2. **Georgia Tech ECE 4580 (Guest Lectures)** Fall 2009, Spring 2010  
Course Description: Computational and theoretical aspects of computer vision. Application area includes robotics, autonomous vehicles, and image-guided surgery.
3. **Georgia Tech ECE 6560 (Guest Lectures)** Spring 2010  
Course Description: Algorithms for computer vision and image processing, emphasizing partial-differential equation and active contour methods. Topics include image smoothing and enhancement, edge detection, morphology, and image reconstruction
4. **Stony Brook University: CS 377 (Guest Lectures)** Spring 2016  
Course Description: An introduction to the mathematical, physical, and computational principles underlying modern medical imaging systems.
5. **Stony Brook University: BMI 540** Fall 2017, Fall 2018  
Course Description: This course introduces advance probability and statistical modeling methods in biomedical informatics

## Relevant Talks:

1. AFOSR Annual Young Investigator Meeting Fall 2018  
Title: “Interactive 2D3D Control”
2. Unified (Industry Talk) Fall 2018  
Title: “Data Science Is Not Just Deep Learning”
3. Missile Defense Agency, DV Group Spring 2017  
Title: “Geometry and Control Based Discrimination”
4. IEEE Control and Decision Conference Fall 2016  
Title: “Geometry of Correlation Networks”
5. Missile Defense Agency, QS Group Fall 2016  
Title: “Quantifying & Managing Supply Chain Risk”
6. Stony Brook University, Biomedical Informatics Dept. Spring 2016  
Title: “System Identification and Waterbed Effects of Dynamical Systems”
7. Johns Hopkins University, Electrical Engineering Dept. Spring 2016  
Title: “A Network Geometric Approach to Analyzing Complex Systems”
8. Missile Defense Agency, Redstone Arsenal Spring 2013  
Title: “Examining Anti-Corrosion and Pin-Hole Effects”
9. Aviation and Missile Research Development Center, Redstone Arsenal Fall 2012  
Title: “Next Generation Approaches for AMPM Architectures”
10. IEEE American Control Conference Summer 2011  
Title: “Robust Aim Point Estimation for 3DLADAR Imagery”
11. Carnegie Mellon University, Dept. of Mathematics Summer 2010  
Title: “Pose Estimation in Visual Tracking and Medical Imaging”
12. Israel Institute of Technology, Dept. of Electrical Engineering Fall 2009  
Title: “Dynamics in Point Set Registration”
13. IEEE Conference on Decision and Control Fall 2009  
Title: “Statistical Shape Learning for 3D Tracking”
14. IEEE Computer Vision and Pattern Recognition Summer 2009  
Title: “Non-Rigid 2D Image Segmentation and 2D3D Pose Estimation”
15. Decision and Control Symposium, Georgia Tech Spring 2008  
Title: “Particle Filtering for Registration of 2D/3D Point Sets with Stochastic Dynamics”
16. IEEE Computer Vision and Pattern Recognition Spring 2008  
Title: “Robust 3D Pose Estimation and Efficient 2D Region-Based Segmentation”
17. SPIE Medical Imaging Conference Fall 2007  
Title: “A New Distribution Metric for Image Segmentation”
18. SPIE Symposium on Electronic Imaging Summer 2007  
Title: “Tracking with a New Distribution Metric in a Particle Filtering Framework”

## Thesis Committee

1. **Jeremy Lerner** (Department: Applied Mathematics and Statistics) Fall 2017  
Title: “Rigid and Non-Rigid 2D-3D Pose Estimation Using the Bhattacharyya Coefficient and Locally Linear Embedding”
2. **Maryam Pouryahya** (Department: Applied Mathematics and Statistics) Spring 2018  
Title: “Discrete Ricci Curvature for the Analysis of Networks”
3. **Mahsa Torkaman** (Department: Computer Science) Spring 2018

Title: “Mathematical Methods in Quantitative Medical Imaging”

4. **Rena Elkin** (Department: Applied Mathematics and Statistics) Fall 2018  
Title: “Regularized Optimal Mass Transport for Medical Imaging Analysis and Visualization”

### Ph.D. Students (Mentorship)

1. **Sayontan Ghosh Faramarzi** (Department: Computer Science)
2. **Bipul Islam** (Department: Computer Science)

### Master Students (Mentorship)

1. **Onkar Deshpande** (Department: Applied Mathematics and Statistics)
2. **Jay Torasakar** (Department: Computer Science)

### Highschool Students (Mentorship)

1. **Neelay Trivedi** (Department: Simons Summer Program, Placement: Stanford University)
2. **Jagdeep Bhatia** (Department: Simons Summer Program, Placement: TBD)
3. **Shivansh Gupta** (Department: Simons Summer Program, Placement: TBD)

### Relevant Publications

1. Yixuan Lin, Kaiqing Zhang, Zhuoran Yang, Zhaoran Wang, Tamer Basar, **Romeil Sandhu**, Ji Liu. “A Communication-Efficient Multi-Agent Actor-Critic Algorithm for Distributed Reinforcement Learning.” *In Submission*. (2019)
2. Bipul Islam, Sayontan Ghosh, Ji Liu, **Romeil Sandhu**. “Discrete Ricci Flow and Controlling Network Entropy.” *In Submission*. (2019).
3. Sayontan Ghosh, Bipul Islam, Ji Liu, **Romeil Sandhu**. “Characterizing Distances of Dynamic Networks on the Tensor Manifold.” *In Submission*. (2019).
4. Bipul Islam, Sayontan Ghosh, Ji Liu, **Romeil Sandhu**. “Stereoscopic Reconstruction: An Interactive Feedback Control Framework.” *In Submission*. (2019).
5. Bipul Islam, Sayontan Ghosh, Noushin Faramarzi, **Romeil Sandhu**. “2D3D Operator Vision-Based Control.” *In Submission*. (2019).
6. Liangjia Zhu, Peter Karasev, Ivan. Kolseov, **Romeil Sandhu**, and A. Tannenbaum. “Interactive Image Segmentation From a Feedback Control Perspective,” *IEEE Transactions on Automatic Control*. (2018)
7. Mahsa Torkaman, **Romeil Sandhu**, and Allen Tannenbaum. “Extraction of breast lesions from ultrasound imagery: Bhattacharyya gradient flow approach. *SPIE Medical Imaging*. (2018)
8. Jeremy Lerner, **Romeil Sandhu**, Yongxin Chen, Allen Tannenbaum, “Machine Learning for Joint Classification and Segmentation” *Emerging Applications of Control and System Theory*. (2018)
9. Yongxin Chen, Jung Hun Oh, **Romeil Sandhu**, Joseph Deasy, and Allen Tannenbaum. “Transcriptional Responses to Ultraviolet and Ionizing Radiation: An Approach Based on Graph Curvature.” *IEEE International Conference on Bioinformatics and Biomedicine*. (2017)
10. Yongxin Chen, FD Cruz, **Romeil Sandhu**, Andrew Kung, Prabhjot Mundi, Joseph Deasy, and Allen Tannenbaum. “Pediatric Sarcoma Data Forms a Unique Cluster Measured via the Earth Movers Distance.” *Nature (Scientific Reports)*. (2017)
11. **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. “Ricci Curvature: An Economic Indicator for Market Fragility and Systemic Risk.” *Science (Science Advances)*, (2016).
12. **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. “Laplacian Global Similarity of Networks.” *International Symposium on Mathematical Theory of Networks and Systems*. (2016).

13. **Romeil Sandhu**, Sarah Tannenbaum, Tryphon Georgiou, and Allen Tannenbaum. "Geometry of Correlation Networks for Studying Biology of Cancer." *IEEE Conference on Decision and Control (CDC)*. (2016).
14. Maryam Pouryahya, Rena Elkin, **Romeil Sandhu**, Sarah Tannenbaum, Tryphon Georgiou, and Allen Tannenbaum. "Bakry-Emery Ricci Curvature on Weighted Graphs with Applications to Biological Networks." *International Symposium on Mathematical Theory of Networks and Systems*. (2016).
15. Lipeng Ning, **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. "Matricial Wasserstein and Unsupervised Tracking." *International Symposium on Mathematical Theory of Networks and Systems*. (2016).
16. **Romeil Sandhu**, Sarah Tannenbaum, Daniel Diolaiti, Andrew Kung, and Allen Tannenbaum. "A Quantitative Analysis of Localized Robustness of MYCN in Neuroblastoma." (2015). doi: <http://dx.doi.org/10.1101/037465>
17. **Romeil Sandhu**, Salah-Eddine Lamhamedi-Cherradi, Sarah Tannenbaum, Joseph Ludwig, and Allen Tannenbaum. "An Analytical Approach for Insulin-like Growth Factor Receptor 1 and Mammalian Target of Rapamycin Blockades in Ewing Sarcoma." arXiv:1509.03642, (2015).
18. **Romeil Sandhu**, Tryphon Georgiou, Ed Reznik, Liangjia Zhu, Yasin Senbabaoglu, and Allen Tannenbaum. "Graph Curvature for Differentiating Cancer Networks." *Nature (Scientific Reports)*, (2015).
19. Vachan Kumar, Ramy Nashed, Kevin Brenner, **Romeil Sandhu**, and Azad Naeemi. "Challenges and Opportunities for Graphene Interconnects at the End of the Roadmap." *IEEE International Symposium on Nanotechnology on Electromagnetic Compatibility*, 192-197 (2014).
20. Jehoon Lee, **Romeil Sandhu**, and Allen Tannenbaum. "Particle Filters and Occlusion Handling for Rigid 2D-3D Pose Tracking." *Computer Vision and Image Understanding (CVIU)*, 117, 922-93 (2013).
21. **Romeil Sandhu**, Ayelet Dominitz, and Allen Tannenbaum. "Volumetric Mapping of Genus Zero Objects via Mass Preservation and Conformal Mapping." arXiv:1205.1225, (2012).
22. **Romeil Sandhu**, Samuel Dambreville, Anthony Yezzi, and Allen Tannenbaum. "A Non-Rigid Kernel Based Framework for 2D3D Pose Estimation and 2D Image Segmentation." *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 33, 1098-1115 (2011).
23. Jehoon Lee, **Romeil Sandhu**, and Allen Tannenbaum. "Monte Carlo Sampling for Visual Pose Tracking." *International Conference on Image Processing (ICIP)*, 501-504 (2011).
24. **Romeil Sandhu**, Shawn Lankton, Samuel Dambreville, Scot Shaw, Dan Murphy, and Allen Tannenbaum. "A Robust Aim Point Tracking Algorithm for 3-D Laser Radar Imagery." *American Control Conference (ACC)*, 4634-4641 (2011).
25. Yi Gao, **Romeil Sandhu**, Gabor Fichtinger, and Allen Tannenbaum. "A Coupled Global Registration and Segmentation Framework with Application to Magnetic Resonance Prostate Imagery." *IEEE Transactions on Medical Imaging (TMI)*, 29, 1781-1794 (2010).
26. **Romeil Sandhu**, Samuel Dambreville, and Allen Tannenbaum. "Point Set Registration Via Particle Filtering and Stochastic Dynamics." *IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI)*, 32, 1459-1473 (2010).
27. Samuel Dambreville, **Romeil Sandhu**, Anthony Yezzi, and Allen Tannenbaum. "A Geometric Approach to Joint 2D Region-Based Segmentation and 3D Pose Estimation Using a 3D Shape Prior." *Society for Industrial and Applied Mathematics (SIAM)*, 3, 110-132 (2010).
28. **Romeil Sandhu**, Shawn Lankton, Samuel Dambreville, and Allen Tannenbaum. "Shape Learning for 3D Tracking." *Proceedings of the IEEE Conference on Decision and Control (CDC)*, 4637-4642 (2009).

29. **Romeil Sandhu**, Samuel Dambreville, Anthony Yezzi and Allen Tannenbaum. “Non-Rigid 2D-3D Pose Estimation and 2D Image Segmentation.” *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 786-794 (2009).
30. **Romeil Sandhu**, Samuel Dambreville, and Allen Tannenbaum. “Particle Filtering for Registration of 2D and 3D Point Sets with Stochastic Dynamics.” *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 1-8 (2008).
31. Samuel Dambreville, **Romeil Sandhu** Anthony Yezzi and Allen Tannenbaum. “Robust 3D Pose Estimation and Efficient 2D Region-Based Segmentation from a 3D Shape Prior.” *Proceedings of the European Conference on Computer Vision (ECCV)*, 169-182, (2008).
32. **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. “Tracking with a New Distribution Metric in a Particle Filtering Framework.” *Proceedings of the IS&T/SPIE Symposium on Electronic Imaging*, 6813, (2008).
33. **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. “A New Distribution Metric for Image Segmentation.” *Proceedings of the SPIE Medical Imaging*, 6914 (2008).

### **Thesis:**

1. **Romeil Sandhu**, “Statistical Methods for 2D Image Segmentation and 3D Pose Estimation, *Ph. D. Thesis*, Department of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA.

### **References\***

**\*References can be provided upon request.**