

# Curriculum Vitae of Romeil Sandhu

## Personal Data:

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## Short Bio & Overview:

Romeil Sandhu is 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 control for machine learning and autonomous systems and **2018 NSF CAREER Award** for work on geometric optimization of time-varying networks. Romeil first received his B.S. and M.S. degrees from the Georgia Institute of Technology in Electrical Engineering in 2006 and 2009, respectively. Then, under the direction of Professor Allen Tannenbaum, he completed his Ph.D. in 2011 in computer vision and machine learning. Prior to his academic position at Stony Brook, he formed a startup providing government services leading to a successful exit. His current research interest spans data science areas that includes complex networks, computer vision, machine learning, misinformation modeling, biomedical informatics, and risk analysis with a common underlying interest lying on the intersection of geometry, statistics, and control.

## Education:

1. **Ph.D. in Electrical Engineering**, Georgia Institute of Technology, January 2011.  
Thesis: Statistical Methods for 2D Image Segmentation and 3D Pose Estimation
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** 2017 – Present  
Adjunct Assistant Professor, Computer Science & Applied Mathematics Dept.
2. **Stony Brook University** 2016 – Present  
Assistant Professor, Biomedical Informatics Dept.\*  
\*Appointment in College of Engineering and Applied Sciences (CEAS)
3. **Data Science Consultant** 2007 – Present  
Industrial Consultant
4. **Stony Brook University** 2014 – 2016  
Post-Doctoral Fellow, Computer Science and Applied Math Dept.
5. **Harper Laboratories, LLC** 2011 – 2014  
President & Co-Founder
6. **Minerva Research Group** 2007 – 2011  
Graduate Research Assistant, ECE Dept.
7. **Georgia Institute of Technology** 2006 – 2007  
Graduate Teaching Assistant, ECE Dept.

## Current (Funded) Research Area Summary:

1. **Geometric Optimization and Control of Time-Varying Networks:**

This research focuses on optimizing statistical 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. Active areas of research include optimal 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 in healthcare informatics, cancer biology, biological resistance, distributed malware, to risk analysis.

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

2. **Interactive Machine Learning and Vision via Feedback Control**

This research focuses on the interplay of geometry and control to advance feedback control-based methods applied towards machine learning and vision tasks. Examples of such work in this area includes the usage of developing control-theoretic principles to allow for human-user computer interaction to perform manifold sculpting and situational awareness/reconstruction in real-time/post-data collection. Applications of this research span several areas with a primary focus on autonomous (cyber-physical) systems. The underlying mathematical interests lies in PDEs, feedback control, information geometry, and differential geometry to enable effective HCI performance.

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

**Professional Activities:**

1. **Service:**

Academic Senator (College of Engineering), Stony Brook University  
Faculty Search Committee (BMI Dept.), Stony Brook University  
Graduate Admissions Committee (BMI Dept.), Stony Brook University  
Journal Reviewer, IEEE Biomedical and Health Informatics  
Journal Reviewer, IEEE Transactions on Pattern Analysis and Machine Intelligence  
Journal Reviewer, IEEE Transactions on Image Processing  
Journal Reviewer, SIAM Journal on Scientific Computing

Note I: Developing a newly defined educational outreach program for highschool dependents of U.S. Veterans for FY 2018 (via recent NSF CAREER award).

2. **Industrial Consulting:**

Sigmattech Incorporated (2016-Present)  
Harper Laboratories, LLC (2014-2017)  
Scientific Systems Company, Inc. (2014-2015)  
Trex Enterprises (2010-2011)  
United Technologies Research Center (2009-2010)  
MIT Lincoln Laboratories (2007-2009)

**Selected Awards / Honors:**

1. NSF CAREER Award (2018)
2. AFOSR YIP (“Career”) Award (2018)
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)

## 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 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)** Fall 2014  
Course Description: An introduction to the mathematical, physical, and computational principles underlying modern medical imaging systems.
5. **Stony Brook University: BMI 540** Fall 2017  
Course Description: This course introduces advance probability and statistical modeling methods in biomedical-informatics.

### Relevant Talks:

1. Missile Defense Agency, DV Group Spring 2017  
Title: “Geometry and Control Based Discrimination”
2. IEEE Control and Decision Conference Fall 2016  
Title: “Geometry of Correlation Networks for Studying Biology”
3. Missile Defense Agency, QS Group Fall 2016  
Title: “Quantifying & Managing Supply Chain Risk”
4. Stony Brook University, Biomedical Informatics Dept. Spring 2016  
Title: “System Identification and Waterbed Effects of Dynamical Systems”
5. Johns Hopkins University, Electrical Engineering Dept. Spring 2016  
Title: “A Network Geometric Approach to Analyzing Complex Systems”
6. Missile Defense Agency, Redstone Arsenal Spring 2013  
Title: “Examining Anti-Corrosion and Pin-Hole Effects”
7. Aviation and Missile Research Development Center, Redstone Arsenal Fall 2012  
Title: “Next Generation Approaches for AMPM Architectures”
8. IEEE American Control Conference Summer 2011  
Title: “Robust Aim Point Estimation for 3DLADAR Imagery”
9. Carnegie Mellon University, Dept. of Mathematics Summer 2010  
Title: “Pose Estimation in Visual Tracking and Medical Imaging”
10. Israel Institute of Technology, Dept. of Electrical Engineering Fall 2009  
Title: “Dynamics in Point Set Registration”
11. IEEE Conference on Decision and Control Fall 2009  
Title: “Statistical Shape Learning for 3D Tracking”
12. IEEE Computer Vision and Pattern Recognition Summer 2009  
Title: “Non-Rigid 2D Image Segmentation and 2D3D Pose Estimation”
13. Decision and Control Symposium, Georgia Tech Spring 2008  
Title: “Particle Filtering for Registration of 2D/3D Point Sets with Stochastic Dynamics”
14. IEEE Computer Vision and Pattern Recognition Spring 2008  
Title: “Robust 3D Pose Estimation and Efficient 2D Region-Based Segmentation
15. SPIE Medical Imaging Conference Fall 2007  
Title: “A New Distribution Metric for Image Segmentation”
16. 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 Biological Networks”
3. **Mahsa Torkaman** (Department: Computer Science) Spring 2018  
Title: “Mathematical Methods in Quantitative Medical Imaging”

### Ph.D. Students (Mentorship)

1. **Arjun Krishna** (Department: Computer Science)  
Research Area: Interactive Machine Learning via Feedback Control
2. **Bipul Islam** (Department: Computer Science)  
Research Area: Network Geometry of Multilayered Systems Towards Misinformation

### Master Students (Mentorship)

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

### Relevant Publications

1. **Romeil Sandhu**. “Classifying Time-Varying Complex Networks on the Tensor Manifold.” *arXiv.1708.07904*. (2018). Note: *In Submission*.
2. 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)
3. Mahsa Torkaman, **Romeil Sandhu**, and Allen Tannenbaum. “Extraction of breast lesions from ultrasound imagery: Bhattacharyya gradient flow approach. *SPIE Medical Imaging*. (2018)
4. 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)
5. Yongxin Chen, FD Cruz, **Romeil Sandhu**, Andrew Kung, Prabjot Mundi, Joesph Deasy, and Allen Tannenbaum. “Pediatric Sarcoma Data Forms a Unique Cluster Measured via the Earth Movers Distance.” *Nature (Scientific Reports)*. (2017)
6. Jeremy Lerner, **Romeil Sandhu**, Yongxin Chen, Allen Tannenbaum, “Machine Learning for Joint Classification and Segmentation” *Emerging Applications of Control and System Theory*. (2017)
7. **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. “Ricci Curvature: An Economic Indicator for Market Fragility and Systemic Risk.” *Science (Science Advances)*, (2016).
8. **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. “Laplacian Global Similarity of Networks.” *International Symposium on Mathematical Theory of Networks and Systems*. (2016).
9. **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).
10. 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).
11. Lipeng Ning, **Romeil Sandhu**, Tryphon Georgiou, and Allen Tannenbaum. “Matricial Wasserstein and Unsupervised Tracking.” *International Symposium on Mathematical Theory of Networks and Systems*. (2016).
12. **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>

13. **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).
14. **Romeil Sandhu**, Tryphon Georgiou, Ed Reznik, Liangjia Zhu, Yasin Senbabaoglu, and Allen Tannenbaum. "Graph Curvature for Differentiating Cancer Networks." *Nature (Scientific Reports)*, (2015).
15. 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).
16. 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).
17. **Romeil Sandhu**, Ayelet Dominitz, and Allen Tannenbaum. "Volumetric Mapping of Genus Zero Objects via Mass Preservation and Conformal Mapping." arXiv:1205.1225, (2012).
18. **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).
19. Jehoon Lee, **Romeil Sandhu**, and Allen Tannenbaum. "Monte Carlo Sampling for Visual Pose Tracking." *International Conference on Image Processing (ICIP)*, 501-504 (2011).
20. **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).
21. 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).
22. **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).
23. 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).
24. **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).
25. **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).
26. **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).
27. 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).
28. **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).
29. **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, 2010.

## **References\***

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