

# Rushil Anirudh

## Resumé

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### Research interests

- Deep learning with a focus on: Scientific Machine Learning, Computational Imaging, Unsupervised Learning, Healthcare.
- Machine learning on non-Euclidean domains (manifolds, graphs)
- Studying high dimensional data/functions using geometry and topology.

### Education

- March 2016 **PhD**, *Arizona State University*, Tempe, *GPA 3.95/4.00*.  
Advisor: Dr. Pavan Turaga  
Thesis: Statistical and Dynamical Modeling of Riemannian Trajectories with Application to Human Movement Analysis
- June 2012 **MS**, *Arizona State University*, Tempe.
- April 2010 **B.Tech**, *National Institute of Technology Karnatka (NITK)*, Surathkal, India.

### Honors & Awards

- Invited to participate in the Dagstuhl seminar on Interpretability in ML [\[Link\]](#) (Nov 2019)
- Placed 2/50 in LLNL's Annual Research Slam Competition with a prize of \$3000. (Oct 2018)
- Awarded Outstanding Reviewer for Journal Computer Methods in Bio-medicine. (Aug 2018)
- My work was profiled by LLNL [\[Link\]](#) (Aug 2018)
- Featured on LLNL's Data Science Institute Spotlight [\[Link\]](#) (July 2018)
- NVIDIA's AI blog featured our paper on GANs for Inverse Problems [\[Link to Article\]](#) (June 2018)
- Invited to perform Academic Program Review at Arizona State University. (Apr 2018)
- Awarded Outstanding Reviewer for Journal Pattern Recognition. (Oct 2017)
- Travel grant of \$350 to attend DCC 2015. (Apr 2015)
- Co-Chair of the annual tech symposium with a budget of \$50K. (Oct 2009)
- Head of IEEE chapter with a 300+ strong student body. (July 2009 - April 2010)
- Gold medal for being among the top 0.1% in India in Chemistry by CBSE (June 2006)

### Industry Experience

- 10/19 - Now **Director**, *Data Science Institute's Open Data Initiative*.  
Leading the effort to curate and organize LLNL's rich data ecosystem towards the goal of open sourcing science datasets to drive scientific machine learning. [\[webpage\]](#)
- 7/18 - Now **Computer Scientist**, *Lawrence Livermore National Laboratory*.  
Projects: Deep Learning for Computational Imaging, Inverse Problems, Unsupervised Learning; Scientific Machine Learning; Machine Learning in Healthcare. [\[Group webpage\]](#)

- 10/16 - 7/18 **Postdoctoral Researcher**, *Lawrence Livermore National Laboratory*.  
Contributing to various research efforts in machine learning, deep learning, computer vision, and high dimensional data analysis.
- 4/16 - 10/16 **Postdoctoral Researcher**, *IBM Research - Almaden*, San Jose, CA.  
Contributing to the image analytics aspect of the medical sieve grand challenge, which is a long-term exploratory project to build a next generation cognitive assistant with advanced analytical knowledge to assist in radiology and cardiology. [[Group webpage](#)]
- Summer 2015 **Research Scholar**, *Lawrence Livermore National Laboratory*, Livermore, CA.  
Efficient lung nodule detection and segmentation from CT scans, using 3D convolutional neural networks. Implemented a system that could train 3D CNNs on CT scans to efficiently search for potential lung nodules. The system works with weak labels provided by an expert, and estimates the true 3D ground truth before training.  
Mentors: Dr. Peer-Timo Bremer and Dr. Jayaram J. Thiagarajan.
- Summer 2014 **Intern**, *Dropcam Inc. (now part of Nest Labs/Google)*, San Francisco, CA.  
Explored methods to estimate accuracy of human detectors with minimal supervision. Involved using statistical group testing to sample from large pools of unlabeled data and estimating the performance of various human detectors. Implemented a working prototype in Python.  
Mentor: Dr. Jason Laska.
- Summer 2013 **Research Intern**, *Intuitive Surgical Inc.*, Sunnyvale, CA.  
Worked on developing, and testing new sensor processing and fusion algorithms for robust real-time surgical robotic navigation. Implemented a working prototype in C++, while interfacing with, and testing on a new type of sensor  
Mentor: Dr. Vincent Duiendam.
- Summer 2009 **Undergraduate Intern**, *Institut polytechnique de Grenoble (INPG)*, France.  
Developed an interface to study the spatio-temporal model of the retina and understand how patients with macular degeneration performed image categorization.

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## Academic Experience

- 9/11 - 3/16 **Research Assistant**, *Arizona State University*.  
Developing tools and systems to understand and analyze trajectories on Riemannian manifolds. We apply these tools to model human movement from videos and sensor streams. In many cases, the data collected is highly non-linear, requiring a thorough generalization of machine learning from first principles. We also have a focus on building computationally efficient systems, exploring ideas of compression, dimensionality reduction and latent space analysis on manifolds. Applications for this work currently are for activity recognition, movement quality assessment, mobile health-care.
- Feb 2012 **EMERGE Crowd Sensing Team**.  
Developed a real-time motion analysis system that would “understand” the crowd engagement and drive 3D graphics as a feedback for an art exhibit. EMERGE was featured on WIRED magazine. [[Link to Festival](#)]
- Summer 2011 **Programmer**, *Dynamics of Perception, Action & Cognition Lab*, Tempe, AZ.  
Developed an easy interface with methods such as multifractal detrended fluctuation analysis, largest Lyapunov exponent for real-time analysis of time series data from optical sensors.
- 1/11 - 12/11 **fMRI based validation of the Homunculus**, Tempe, AZ.  
Mapping the functionality of different parts of the motor cortex using segmentation methods on fMRI images, from subjects performing various motor tasks.

## Grant Awards

- PI on Grant to Curate LLNL's Data Ecosystem for \$55K/year (Oct 2019 - Sep 2020)
- Co-PI on LDRD Research Grant on Robust ML for \$500K/year (Oct 2019 - Sep 2022)
- Co-PI on LDRD Research Grant on Neuroscience & ML for \$500K/year (Oct 2018 - Sep 2021)
- Co-PI on LDRD Research Grant on ML for ECG Modeling for \$280K/year (Oct 2017 - Sep 2019)

## Selected Publications

For an exhaustive list please see my [Google Scholar page](#)

1. *MimicGAN: Robust Projection onto Image Manifolds with Corruption Mimicking* Minor revisions at Intl. Journal of Computer Vision (IJCV) Special Issue on GANs. [arxiv:1912.07748](#), Jan 2020.
2. *Unsupervised Dimension Selection using a Blue Noise Spectrum* at ICASSP 2019 [arxiv:1810.13427](#), May 2019.
3. *Bootstrapping Graph Convolutional Neural Networks for Autism Spectrum Disorder Classification.* at ICASSP 2019 [arXiv:1704.07487](#), May 2019.
4. **R. Anirudh**, H. Kim, J.J. Thiagarajan, K.A. Mohan, K. Champley, T. Bremer, *Lose The Views: Limited Angle CT Reconstruction via Implicit Sinogram Completion.* Spotlight (~10% acceptance rate) in IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2018.
5. **R. Anirudh**, P. Turaga, and A. Srivastava, *Optimization Problems Associated with Manifold-Valued Curves with Applications in Computer Vision*, Book Chapter in Convex Optimization Methods in Imaging Science, (Ed: Vishal Monga) Springer 2017.
6. A. Marathe, **R. Anirudh**, et al., *Performance Modeling under Resource Constraints Using Deep Transfer Learning*, at Super Computing (SC 2017).
7. **R. Anirudh**, J. Su, A. Srivastava and P. Turaga, *Elastic Functional Coding of Riemannian Trajectories*, in IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), 2017.
8. N. Shroff, **R. Anirudh**, and R. Chellappa, *Summarization and Search over Geometric Spaces*, Book Chapter in Riemannian Computing in Computer Vision, (Ed: Pavan Turaga, Anuj Srivastava) Springer 2016.
9. **R. Anirudh** and P. Turaga, *Geometry-based Adaptive Symbolic Approximation for Fast Sequence Matching on Manifolds.*, International Journal of Computer Vision (IJCV), 2016.
10. **R. Anirudh**, J.J. Thiagarajan, PT. Bremer, H. Kim, *Lung Nodule Detection using 3D Convolutional Neural Networks Trained on Weakly Labeled Data*, SPIE-MI (Medical Imaging), 2016.
11. **R. Anirudh**, V. Venkataraman, K. Natesan, and P. Turaga, *A Riemannian Framework for Statistical Analysis of Topological Persistence Diagrams*, in DiffCVML - CVPR Workshops, 2016.

12. **R. Anirudh**, J. Su, A. Srivastava and P. Turaga, *Elastic Functional Coding of Human Actions: From Vector-Fields to Latent Variables*, in IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015.
13. **R. Anirudh** and P. Turaga, *Interactively Test Driving an Object Detector: Estimating Performance on Unlabeled Data*, IEEE Winter Conference on Applications of Computer Vision (WACV), 2014.

### Manuscripts and Reports

1. *Improved Surrogates in Inertial Confinement Fusion with Manifold and Cycle Consistencies*. Under review [arXiv:1912.08113](https://arxiv.org/abs/1912.08113), Jan 2020. [\[github\]](#)
2. *Function Preserving Projection for Scalable Exploration of High-Dimensional Data* Under review [arXiv:1909.11804](https://arxiv.org/abs/1909.11804), Sep 2019. [\[github\]](#)
3. *Statistical and Dynamical Modeling of Riemannian Trajectories with Applications to Human Movement Analysis*. PhD Dissertation, Arizona State University, 2016.

### Skills

Programming C++, Java, Python, Matlab

Packages OpenCV (computer vision), basic OpenGL, data analysis packages in Python (scikit learn, pandas), Deep learning (Tensorflow, Keras)

### Service

- Mini-Symposium Organizer on *Constraints in ML* at SIAM Mathematics of Data Science, May 2020 [\[program\]](#)
- Session Chair at Asilomar 2020
- Program Committee: CVPR, ICCV, AAAI, ICML, ECCV, ICVGIP, ICPR, MOCO 2016, ACCV 2012.
- Journal Reviewer: IEEE Transactions on Medical Imaging, ACM-Computing Surveys, Pattern Recognition Letters, Pattern Recognition, Computer Vision and Image Understanding, IEEE Trans. Image Processing.
- Student Volunteer for ACM Multimedia 2011, Scottsdale, AZ.