Nesar Ramachandra

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Current position

Postdoctoral Researcher, Cosmological Physics and Advanced Computing Group, Argonne National Laboratory, Aug, 2018 - Present

Associate Fellow, Kavli Institute for Cosmological Physics, University of Chicago, March, 2019 - Present

Prior experience

Senior Fellow - Kavli Summer Program on Astrophysics, University of California, Santa Cruz, June, 2019 - Aug, 2019.

Graduate researcher - Cosmological Physics and Advanced Computing (CPAC) Group, Argonne National Laboratory, Jan, 2018 - Aug, 2018.

HEP-Center for Computational Excellence Fellow - High Energy Physics Division, Argonne National Laboratory, June, 2017 - Aug, 2019.

Research Scholar - Tata Institute of Fundamental Research Centre for Interdisciplinary Science, Hyderabad, India, Jan, 2013 - July, 2013.

Visiting Research scholar - Indian Institute of Astrophysics, Bangalore, India, Jan 2012 - Jan 2013.

Academic background

Ph.D. (Hons.) Physics, University of Kansas, 2018.

Integrated M.S. (Hons.) Physics, Birla Institute of Technology and Science (BITS) Pilani, India, 2012.

Research interests

Scientific machine learning, Bayesian inference, high-performance computing, astrophysical data analysis, numerical methods, topological and geometrical techniques.

Projects

1. Automated Model Inference for Cosmological Structure Formation, Laboratory Directed Research and Development (LDRD) program, Argonne National Laboratory.
2. SciDAC-4: Inference and Machine Learning at Extreme Scales, U.S. Department of Energy.

Mentorship

1. Summer interns: Claire Guilloteau (IRAP), Ting-Yun Cheng (University of Nottingham), Kate Storey-Fisher (NYU), Madeline Lucey (University of Texas Austin)
2. Longer term students: James Butler (University of Chicago), Xiaofeng Dong (University of Chicago)

Publications

In preparation

1. **N. Ramachandra**, A. Fadikar, J. Chaves-Montero, S. Habib, K. Heitmann: Photometric Redshift Inference using Synthetic Training of Gaussian Mixture Models.
2. K. Fukami, R. Maulik, **N. Ramachandra**, K. Taira, K. Fukagata: Voronoi CNNs: Interfacing unstructured data with convolutional architectures for fluid flow super resolution.
3. A. Hearin, **N. Ramachandra**, J. DeRose, M. Becker: SHAMnet: Differentiable Abundance Matching.
4. **N. Ramachandra**, M. Binois, S. Habib, K. Heitmann: Gaussian Process Emulation of CMB Power Spectra with Autoencoder-based Dimensional Reduction.

Under review

1. R. Maulik, T. Botsas, **N. Ramachandra**, M. Lachlan, I. Pan: Latent-space time evolution of non-intrusive reduced-order models using Gaussian process emulation, *arXiv:2007.12167*.
2. **N. Ramachandra**, G. Valogiannis, M. Ishak, K. Heitmann (for the LSST Dark Energy Science Collaboration): Matter Power Spectrum Emulator for f(R) Modified Gravity Cosmologies, Submitted to Physical Review D, *arXiv:2010.00596*.
3. Y. Wang, **N. Ramachandra**, E. Salazar-Canizales, H. Feldman, R. Watkins, K. Dolag: Peculiar Velocity Estimation from Kinetic SZ Effect using Deep Neural Networks, Submitted to Monthly Notices of the Royal Astronomical Society, *arXiv:2010.03762*.
4. T. Cheng, M. Huertas-Company, C. Conselice, A. Aragón-Salamanca, B. Robertson, **N. Ramachandra**: Beyond the Hubble Sequence – Exploring Galaxy Morphology with Unsupervised Machine Learning, Submitted to Monthly Notices of the Royal Astronomical Society *arXiv:2009.11932*.
5. K. Storey-Fisher, M. Huertas-Company, **N. Ramachandra**, F. Lanusse, A. Leauthaud, Y. Luo, S. Huang: Anomaly Detection in Astronomical Images with Generative Adversarial Networks, Submitted to NeurIPS 2020 workshop on Machine Learning and the Physical Sciences.
6. K. Fukami, R. Maulik, **N. Ramachandra**, K. Fukagata, K. Taira: Probabilistic neural network-based reduced-order surrogate for fluid flows, Submitted to NeurIPS 2020 workshop on Machine Learning and the Physical Sciences.
7. S. Madireddy, N. Li, **N. Ramachandra**, J. Butler, P. Balaprakash, S. Habib, K. Heitmann: A Modular Deep Learning Pipeline for Galaxy-Scale Strong Gravitational Lens Detection and Modeling, Submitted to Thirty-Fifth AAAI Conference on Artificial Intelligence.

Peer-reviewed articles

1. **R. Maulik**, K. Fukami, N. Ramachandra, K. Fukagata, K. Taira : Probabilistic neural networks for fluid flow model-order reduction and data recovery, *Physical Review Fluids*, 5, 104401, 2020.
2. M. Lucey, Y. Ting, **N. Ramachandra**, K. Hawkins: From the Inner to Outer Milky Way: A Photometric Sample of 2.6 Million Red Clump Stars, *Monthly Notices of the Royal Astronomical Society*, Volume 495, Issue 3, Pages 3087–3103.
3. L. Bleem *et al.* (incl. **N**. Ramachandra): The SPTpol Extended Cluster Survey, *The Astrophysical Journal Supplement Series*, Volume 247, Number 1.
4. S. Madireddy, N. Li, **N. Ramachandra**, P. Balaprakash, S. Habib: Modular Deep Learning Analysis of Galaxy-Scale Strong Lensing Images, *Machine Learning and the Physical Sciences Workshop at the 33rd Conference on Neural Information Processing Systems (2019)*.
5. **N. Ramachandra**: Topology, Geometry and Morphology of the Dark Matter Web (Doctoral Dissertation), *ProQuest Dissertations & Theses Global database*, Publication Number: 10845180.
6. N. Libeskind *et al.* (incl. **N**. Ramachandra): Tracing the cosmic web, *Monthly Notices of the Royal Astronomical Society*, Volume 473, Issue 1, Pages 1195-1217.
7. **N. Ramachandra**, S. Shandarin: Dark matter haloes: a multistream view, *Monthly Notices of the Royal Astronomical Society*, Volume 470, Issue 3, p. 3359-3373.
8. **N. Ramachandra**, S. Shandarin: Topology and geometry of the dark matter web: a multistream view, *Monthly Notices of the Royal Astronomical Society*, Volume 467, Issue 2, p.1748-1762.
9. **N. Ramachandra**, S. Shandarin: Multi-stream portrait of the Cosmic web, *Monthly Notices of the Royal Astronomical Society*, Volume 452, Issue 2, p.1643-1653.

Selected talks

1. **N. Ramachandra**: Cosmology using Scientific Machine Learning, AI & HPC Seminar, Argonne National Laboratory, 2020.
2. **N. Ramachandra**, S. Madireddy, N. Li, P. Balaprakash, S. Habib: Probabilistic Deep Learning for Galaxy-Scale Strong Lensing Studies, University of Chicago, 2020.
3. **N. Ramachandra**, G. Valogiannis, M. Ishak, K. Heitmann: Matter Power Spectrum Emulator for f(R) Modified Gravity Cosmologies, Science Highlight Plenary talk, LSST-DESC July 2020 Virtual Meeting, 2020.
4. **N. Ramachandra**: Scientific Machine Learning using Astrophysical Simulations, Conference on Data Analysis, Santa Fe, 2020.
5. **N. Ramachandra**: Scientific machine learning with synthetic astrophysical data, Machine Learning Tools for Research in Astronomy Ringberg, Germany, 2019.
6. **N. Ramachandra**: Deep Generative models and Astrophysical Image emulation, Machine Learning in the Era of Large Astronomical Surveys, Santa Cruz, 2019.
7. **N. Ramachandra**, G. Valogiannis, M. Ishak, K. Heitmann: Gaussian Process Emulators for Modified Gravity Summary Statistics, LSST-DESC meeting, Paris, France, 2019 (remote).
8. **N. Ramachandra**, M. Binois, S. Habib, K. Heitmann: Suite of Gaussian Process emulators for cosmological inference problems, Likelihood-free inference workshop, Flatiron Institute, New York, 2019.

9. **N. Ramachandra**, M. Binois, S. Habib, K. Heitmann: Cosmology meets Machine learning: Emulation of CMB Power Spectra, Astro seminar, University of Kansas, Lawrence, 2019.
10. **N. Ramachandra**, M. Binois, S. Habib, K. Heitmann: Variational autoencoders for the emulation of cosmological functions, KICP Postdoc Symposium, University of Chicago, 2019.
11. **N. Ramachandra**, P. Larsen: Cosmic Emulators for next generation surveys, Accurate lensing in the era of precision Cosmology, University of California, Berkeley, 2019.
12. **N. Ramachandra**, S. Habib, K. Heitmann: Cosmological analysis pipelines through Neural Networks, American Physical Society April Meeting, Columbus, Ohio 2018.
13. **N. Ramachandra**, S. Madireddy, N. Li, P. Balaprakash, S. Habib: Deep learning pipelines for lensing analysis, Astrophysics Seminar, University of Kansas, 2017.
14. **N. Ramachandra**, S. Madireddy, N. Li, P. Balaprakash, S. Habib: Strong Lensing analysis using Deep Neural Networks, Young Scientists Symposium, Argonne National Laboratory, 2017.
15. **N. Ramachandra**: Emulation of the halo mass function, SAMSI Research Triangle Park, North Carolina, 2017
16. **N. Ramachandra**, S. Shandarin: Topology and geometry of the dark matter web, American Physical Society April Meeting, Washington D.C, 2017
17. **N. Ramachandra**, S. Shandarin: The Multi-stream portrait of the cosmic web, American Physical Society April Meeting, Salt Lake City, Utah, 2016.
18. **N. Ramachandra**, S. Shandarin: The Multi-stream structures of the cosmic web, Canadian-American-Mexican Graduate Students Physics Conference at Oaxaca, Mexico, 2015.
19. **N. Ramachandra**, S. Shandarin: The dynamical structure of the cosmic web, MidAmerican Regional Astrophysics Conference at The University of Missouri, 2015.

Honors & awards

Kavli Summer Program fellowship grant, 2019.

Physics and Astronomy Department Scholarship, University of Kansas, 2018.

Division of Astrophysics Travel grant, American Physical Society, 2018.

Graduate Research travel award, University of Kansas, 2017.

High Energy Physics - Center for Computational Excellence summer fellowship, 2017.

SAMSI Travel grant, Astrophysical population emulation workshop, 2017.

Division of Astrophysics Travel grant, American Physical Society, 2016.

SAMSI Travel grant, ASTRO workshop, 2016.

Graduate Research Competition Award, University of Kansas, 2016.

National Science Foundation, the American Physical Society and the Sociedad Mexicana de Fisica travel grant, CAM conference, 2015.

Junior research fellowship, Council for Scientific and Industrial Research, Government of India, 2012.

Innovation in Science Pursuit for Inspired Research (INSPIRE) fellowship, Department of Science and Technology, Government of India, 2008 - 2012.

Professional service & outreach

Co-organizer: AI, Statistics and Machine Learning Journal Club, Argonne National Laboratory, 2019.

Reviewer: Future Investigators in NASA Earth and Space Science and Technology, FINESST program, 2019-2020.

Co-organizer: Workshop on Advanced Statistical Methods Meet Machine Learning, 2018-2019

Referee, The Astrophysical Journal - IOPscience, Monthly Notices of Royal Astronomical Society - Oxford University Press, Astronomy and Computing - Elsevier Publishing, Journal of Cosmology and Astroparticle Physics - IOP Publishing.

Member: Rubin Observatory Legacy Survey of Space and Time (LSST)- Dark Energy Science Collaboration (DESC), 2018.

President: Society of Physics Students, The University of Kansas chapter, 2015 - 2018.

Founding Member: KUbeSat team - a University of Kansas miniature satellite Mission that won the SPS Chapter Research Award by American Institute of Physics, 2016-2018.

Member: American Physical Society (APS), 2014.

Chief Organizer: TEDxBITSGoa conference, India, 2011.