

Anindya Bijoy Das

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Summary	<ul style="list-style-type: none">• Won Karas Award for outstanding dissertation in Iowa State University in 2022• Working on Federated Learning to reduce communication delay and privacy leakage• Highly experienced in coding, specifically in Python and MATLAB• Carried out large-scale simulations in AWS using MPI toolbox• Got best paper awards; research and teaching excellence awards
Education	<p>PhD in EE in Iowa State University May 2022</p> <ul style="list-style-type: none">• Major Professor: Dr. Aditya Ramamoorthy• Specialization: Signal Processing, Minor: Mathematics <p>M.Engg. in EE in Iowa State University May 2018</p> <p>B.Sc. in EEE, in Bangladesh Univ. of Eng. & Tech. Jul 2014</p>
Research Grant	<p>Grant of \$73,000: awarded by Autonomous and Connected Systems of Purdue Engineering Initiatives to conduct research on AI tensor computations in edge network.</p>
Professional Experiences	<p>Postdoctoral Researcher in ECE in Purdue University May 2022 - Present Conducting research on federated learning, edge computation, and machine learning applications in communications and guiding PhD students for their research under the direction of Prof. David Love and Prof. Christopher Brinton</p> <p>Research Assistant, Iowa State University May 2019-May 2022 Conducting research on straggler mitigation in distributed computations: development of novel theorems and carrying out necessary simulations in AWS</p> <p>Teaching Assistant, Iowa State University Aug 2016-May 2019 Conducted Laboratory Courses: Introduction to Circuits and Instruments, Introduction to AC Circuits and Motors</p> <p>Lecturer, Presidency University, Bangladesh Feb 2015-Jul 2016 Courses instructed: Numerical Methods, Digital Signal Processing (theory and laboratory), Electronics, Engineering Electromagnetics, Programming Language (C)</p>
Students Guided	<ul style="list-style-type: none">• Myeung Suk Oh, a PhD student. Topic: O-RAN Cell-Free Massive MIMO• Junghoon Kim, a PhD student. Topic: Two-way Gaussian Channel• Satyavrat Wagle, a PhD student. Topic: D2D-enabled Federated Learning• Byunghyun Lee, a PhD student. Topic: Sidelobe Suppression in Radar Systems• Seohyun Lee, an undergrad student. Topic: Unsupervised Federated Learning
International Journals	<p>A. B. Das and A. Ramamoorthy, "A Unified Treatment of Partial Stragglers and Sparse Matrices in Coded Matrix Computation", IEEE Jour. on Sel. Areas in Info. Th., vol. 3, no. 2, pp. 241-256, 2022.</p> <p>A. B. Das and A. Ramamoorthy, "Coded sparse matrix computation schemes that leverage partial stragglers," in IEEE Trans. on Info. Theory, vol. 68, no. 6, pp. 4156-4181, 2022.</p>

A. B. Das, A. Ramamoorthy and N. Vaswani, “Efficient and Robust Distributed Matrix Computations via Convolutional Coding,” in **IEEE Trans. on Info. Theory**, vol. 67, no. 9, pp. 6266-6282, 2021.

A. Ramamoorthy, **A. B. Das** and L. Tang, “Straggler-Resistant Distributed Matrix Computation via Coding Theory: Removing a Bottleneck in Large-Scale Data Processing”, in **IEEE Sig. Proc. Mag.**, vol. 37, no. 3, pp. 136-145, 2020.

M. M. Rahman, M. I. H. Bhuiyan and **A. B. Das**, “Classification of focal and non-focal EEG signals in VMD-DWT domain using ensemble stacking”, in **Biomedical Signal Processing and Control**, Elsevier, vol. 50, pp. 72-82, 2019.

A. B. Das and M. I. H. Bhuiyan, “Discrimination and classification of focal and non-focal EEG signals using entropy-based features in the EMD-DWT domain”, in **Biomedical Signal Processing and Control**, Elsevier, vol. 29, pp. 11-21, 2016.

A. B. Das, M. I. H. Bhuiyan and S M S. Alam, “Classification of EEG signals using normal inverse Gaussian parameters in the DT-CWT domain for seizure detection”, in **Signal, Image and Video Processing**, Springer, vol. 10, pp. 259-266, 2016.

**Manuscript
Under Review**

A. B. Das, A. Ramamoorthy, D. J. Love and C. G. Brinton, “Distributed Matrix Computations with Low-weight Encodings”, under review in **IEEE Jour. on Sel. Areas in Info. Th.**.

M. S. Oh, **A. B. Das**, S. Hosseinalipour, T. Kim, D. J. Love and C. G. Brinton, “A Decentralized Pilot Assignment Methodology for Scalable O-RAN Cell-Free Massive MIMO”, under review in **IEEE Jour. on Sel. Areas in Comm.**.

**International
Conference
Papers**

A. B. Das and A. Ramamoorthy, D. J. Love and C. G. Brinton, “Preserving Sparsity and Privacy in Straggler-Resilient Distributed Matrix Computations”, in Annual Allerton Conf. on Comm., Control, and Comput. (**Allerton**), 2023.

A. B. Das and A. Ramamoorthy, D. J. Love and C. G. Brinton, “Distributed Matrix Computations with Low-weight Encodings”, in IEEE Intl. Symp. on Info. Theory (**ISIT**), 2023.

A. B. Das and A. Ramamoorthy, D. J. Love and C. G. Brinton, “Coded Matrix Computations for D2D-Enabled Linearized Federated Learning”, in IEEE Intl. Conf. on Acoustics, Speech, & Signal Proc. (ICASSP), 2023.

A. B. Das and A. Ramamoorthy, “An Integrated Method to Deal with Partial Stragglers and Sparse Matrices in Distributed Computations”, accepted in IEEE Intl. Symp. on Info. Theory (**ISIT**), 2022.

A. B. Das and A. Ramamoorthy, “A Unified Treatment of Partial Stragglers and Sparse Matrices in Coded Matrix Computation”, IEEE Info. Theory Workshop (**ITW**), 2021.

A. B. Das and A. Ramamoorthy, “Coded sparse matrix computation schemes that leverage partial stragglers”, IEEE Intl. Symp. on Info. Theory (**ISIT**), 2021.

A. B. Das, A. Ramamoorthy and N. Vaswani, “Efficient and Robust Distributed Matrix Computations via Convolutional Coding”, IEEE Intl. Symp. on Info. Theory (**ISIT**), 2021.

A. B. Das and A. Ramamoorthy, “Distributed Matrix-Vector Multiplication: A Convolutional Coding Approach”, IEEE Intl. Symp. on Info. Theory (**ISIT**), 2019.

A. B. Das, A. Ramamoorthy and L. Tang, “ C^3LES : Codes for Coded Computation that Leverage Stragglers”, in IEEE Info. Theory Workshop (**ITW**), 2018.

A. B. Das and M. I. H. Bhuiyan, “Discrimination of Focal and Non-focal EEG Signals using Entropy-based Features in EEMD and CEEMDAN Domains”, in IEEE Intl. Conf. on Elec. and Comp. Engineering (**ICECE**), 2016.

S. K. Bashar, **A. B. Das** and M. I. H. Bhuiyan, “Motor Imagery Movements Detection of EEG Signals using Statistical Features in the DTCWT Domain”, in IEEE Intl Conf. on Elec. Eng. and Info. Comm. Tech. (**iCEEiCT**), 2015.

M. I. H. Bhuiyan and **A. B. Das**, “A subband correlation-based method for the automatic detection of epilepsy and seizure in the dual tree complex wavelet transform domain”, IEEE Conf. on Biomed. Eng. and Sci. (**IECBES**), 2014.

Research Experiences

Improving communication delay and privacy in Federated Learning

- Developed an algorithm for linearized federated learning in a **D2D setting**
- Utilized the **heterogeneity** of the clients to enhance the job completion speed
- Reduced overall delay and **privacy** leakage by limited data transmission

Improving numerical stability of distributed matrix computation

- Developed convolutional coding based method for optimal straggler resilience
- Connections to **block Toeplitz Matrix** provide bounds on condition number
- The **recovery error has been reduced** by 2 orders of magnitude than others
- One of the **fastest decoding** schemes: no need of division and multiplication

Enhancing the speed of distributed matrix computation

- Developed combinatorial design based methods to leverage the stragglers
- Novel connections with **Graph Theory** provide improved performance
- Worker node computation can be at least $2\times$ **faster** for sparse matrices

Classification of EEG data for detection of epilepsy and epileptogenic zone

- Modeled the subbands of EEG data with suitable probability density functions
- Utilized different classifiers: SVM, kNN etc. to classify practical EEG datasets
- Worked with practical datasets acquired by Children Hospital Boston and MIT
- The overall accuracy has been improved significantly (by around 4%)

Awards

Karas Award, 2022, for the Outstanding Dissertation in Mathematical and Physical Sciences and Engineering at Iowa State University

Research Excellence Award, fall-2021, Department of Electrical and Computer Engineering, Iowa State University

Teaching Excellence Award, fall-2020, Department of Electrical and Computer Engineering, Iowa State University

1st Position, best paper award, IEEE International Conference on Electrical Engineering and Information and Communication Technology (ICEEICT), 2015

2nd Position, best paper award, IEEE Conf. on Elec. Info. & Comm. Tech., 2013

National Champion, higher secondary, Bangladesh Math Olympiad, 2008

Relevant Projects	Image recognition from CIFAR-10 dataset using deep residual learning <ul style="list-style-type: none"> • Implemented convolutional neural network in TensorFlow using GPU • Utilized different related functions and parameters to achieve higher accuracy 	
	Generative adversarial networks (GAN) in image super-resolution <ul style="list-style-type: none"> • Reviewed different types of GANs and their corresponding properties • Implemented deep convolutional GANs to upscale images by $4\times$ factor 	
	Classification of ‘20 Newsgroups’ dataset using Bayes Classifier <ul style="list-style-type: none"> • Implemented multinomial naive Bayes model to classify $20k$ documents • Compared the performance between MLE and Bayes model for text clustering 	
	Prediction of a time series sequence using recurrent neural network <ul style="list-style-type: none"> • Implemented TF-based RNN for the prediction of multidimensional data • Trained the RNN to use the information of long sequences 	
	Application of decision tree for ‘Breast Cancer Wisc. (Original)’ dataset <ul style="list-style-type: none"> • Utilized sklearn (scikit-learn) toolbox to implement decision tree • Visualized the decision trees for k-fold cross-validation 	
	Designing the university course registration system using C <ul style="list-style-type: none"> • Designing a system where students can enter and register or drop courses • Implementing all the primary concepts of programming languages 	
	Review of ADMM and its applications <ul style="list-style-type: none"> • Reviewing the idea of ADMM for optimization algorithms • Estimation of the underlying pdf parameters for EEG data using ADMM 	
Research Interest	Optimization algorithms and machine learning for X-ray CT Images <ul style="list-style-type: none"> • Developed a regularized MM algorithm to recover images from sparse sampling • Appropriate CT image reconstruction from Limited Angle Projections 	
	Distributed Computation Deep Machine Learning Quantum Computation	Federated Learning Information Theory Edge Computation
Technical Skills	Programming Languages: C, Python, 8086 Assembly Language Numerical Analysis and Signal Processing: MATLAB Deep Learning Toolbox: TensorFlow, Torch, Keras Parallel Computation: AWS, MPI, Cuda, Cudnn Document Preparation & Illustration: LATEX, MS Office Circuit Design tools: Proteus, PSPICE, Orcad, Simulink	
Graduate Courses	Deep Machine Learning Non-linear Programming Convex Optimization Abstract Algebra Statistical Machine Learning	Data Analytics Linear Algebra Detection and Estimation Theory Real Analysis Design Theory and Assoc. Schemes

Undergraduate Courses	Random Signals and Processes Numerical Methods Signals and Systems Digital Signal Processing I & II	Probability and Statistics Digital Communication Digital Electronics Microprocessor & interfacing
Professional Membership	Member, IEEE (June 2019 - Present) Member, Information Theory Society (June 2019 - Present) Member, Signal Processing Society (April 2023 - Present)	
Campaigns & Workshops	North American Sch. of Info. Theory , British Columbia, 2021, & Boston, 2019 Midwest Machine Learning Symposium (MMLS) , Wisconsin, 2019 IEEE Intl. Symp. on Info. Theory (ISIT) , Melbourne, 2021 & Paris, 2019 Bangladesh Math Camp for the selection of Bangladesh Team for IMO 2007	
Leadership Experiences	Secretary , Bangladesh Student Association, August 2019 - August 2021 Organizer , Signal Processing Workshop, Presidency University, 2016	
Reviewer Experiences	IEEE Transactions: TCOM, TPDS, TPAMI, TNSRE etc. Others: PLOS ONE, IEEE Access, BSPC, IET Image Processing etc.	
Others	<ul style="list-style-type: none"> • Invited talk, arranged by IEEE Sig. Proc. Society, Bangladesh Chap., 2019 • Certified as ‘Preparing Future Faculty Associate’ by Iowa State University • Received NSF Travel Grant to present my work in ISIT-2019, Paris, France • Attended courses on Quantum Computation and Quantum Info. Theory • Volunteer tutor for <i>3rd</i> and <i>4th</i> grade kids in the program Cymath-kids 	
References	<p>Dr. Aditya Ramamoorthy Professor, Electrical and Computer Engineering, Iowa State University Email: adityar@iastate.edu</p> <p>Dr. Christopher Brinton Assistant Professor, Electrical and Computer Engineering, Purdue University Email: cgb@purdue.edu</p> <p>Dr. David Love Professor, Electrical and Computer Engineering, Purdue University Email: djlove@purdue.edu</p>	