

Anindya Bijoy Das

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- Summary**
- Won **Karas Award** for outstanding dissertation in Iowa State University in 2022
 - Highly experienced in coding, specifically in **Python** and **MATLAB** and their toolboxes
 - Got best paper awards; also got research and teaching excellence awards in Iowa State University
 - Highly experienced in carrying out large-scale simulations in **AWS** using **MPI** toolbox
 - Research experience in federated Learning, distributed computations, signal processing etc.
 - Research interest: AI/ML algorithms, Data Analytics, Cloud & Edge Computing, Signal Processing etc.
- Education**
- PhD** in Electrical Engineering in Iowa State University **May 2022**
- Major Professor: Dr. Aditya Ramamoorthy
 - Specialization: Signal Processing, **Minor: Mathematics**
- M.Engg.** from Electrical and Computer Engineering in Iowa State University **May 2018**
- B.Sc.** in EEE, in Bangladesh University of Engineering & Technology (BUET) **Jul 2014**
- Research Grant**
- A Grant of \$73,000:** awarded by Autonomous and Connected Systems of Purdue Engineering Initiatives to conduct research on AI tensor computations in edge network.
- Professional Experiences**
- 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
- Research Assistant**, Iowa State University **May 2019-May 2022**
Conducting research on straggler mitigation in distributed computations, developing novel theorems to enhance numerical stability and computation speed and carrying out necessary simulations in AWS
- Teaching Assistant**, Iowa State University **Aug 2016-May 2019**
Conducted Laboratory Courses: Introduction to Circuits and Instruments and Introduction to AC Circuits and Motors. Duties also include preparing exam rubrics, grading the exams, office hours etc.
- Lecturer**, Presidency University, Bangladesh **Feb 2015-Jul 2016**
Undergraduate Courses instructed: Numerical Methods, Digital Signal Processing (theory and laboratory), Electronics, Engineering Electromagnetics, Programming Language (C), Properties of Materials. Duties also include preparing the corresponding course outlines, preparing exam questions etc.
- Selected International Journals**
- 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”, **IEEE Journal on Selected Areas in Communications**, 2023.
- A. B. Das**, A. Ramamoorthy, D. J. Love and C. G. Brinton, “Distributed Matrix Computations with Low-weight Encodings”, **IEEE Journal on Selected Areas in Information Theory**, 2023.
- A. B. Das** and A. Ramamoorthy,, “A Unified Treatment of Partial Stragglers and Sparse Matrices in Coded Matrix Computation”, **IEEE Journal on Selected Areas in Information Theory**, 2022.
- A. B. Das** and A. Ramamoorthy, “Coded sparse matrix computation schemes that leverage partial stragglers,” **IEEE Transaction on Information Theory**, 2022.
- A. B. Das**, A. Ramamoorthy and N. Vaswani, “Efficient and Robust Distributed Matrix Computations via Convolutional Coding,” **IEEE Transaction on Information Theory**, 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”, **IEEE Sig. Proc. Mag.**, 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”, **Biomed. Sig. Proc. and Control**, Elsevier, 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”, **Biomed. Sig. Proc. and Control**, 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”, **Sig., Img. and Vid. Proc.**, 2016.

Manuscripts Under Review

J. Kim, T. Kim, **A. B. Das**, S. Hosseinalipour, D. J. Love and C. G. Brinton, “Coding for Gaussian Two-Way Channels: Linear and Learning-Based Approaches”, under review.

B. Lee, **A. B. Das**, D. J. Love, C. G. Brinton and J. V. Krogmeier, “Constant Modulus Waveform Design with Interference Exploitation for DFRC Systems: A Block-Level Approach”, under review.

M. S. Oh, **A. B. Das**, T. Kim, D J. Love and C. G. Brinton “ Minimum Description Feature Selection for Complexity Reduction in Machine Learning-based Wireless Positioning”, under review.

Selected Conference Papers

S. Wagle, **A. B. Das**, D. Love and C. Brinton, “A Reinforcement Learning-Based Approach to Graph Discovery in D2D-Enabled Federated Learning”, IEEE Glob. Comm. Conf. (**GLOBECOM**), 2023.

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

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

A. B. Das and A. Ramamoorthy, D. Love and C. Brinton, “Coded Matrix Computations for D2D-Enabled Linearized Federated Learning”, IEEE Intl. Conf. Acoustics, Speech, & Sig. 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”, 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”, IEEE Conf. Elec. Comp. Engr. (**ICECE**), 2016.

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

A. B. Das and M. I. H. Bhuiyan, “Bessel k-form parameters in the dual tree complex wavelet transform domain for the detection of epilepsy and seizure”, (**ICECE**), 2014

A. B. Das, M. I. H. Bhuiyan and S M S. Alam, “A Statistical Method for Automatic Detection of Seizure and Epilepsy in the Dual Tree Complex Wavelet Transform Domain”, (**ICIEV**), 2014

Research Experiences

Improving communication delay and privacy in Federated Learning

- Developed algorithms for linearized federated learning in a **D2D setting** for data offloading
- Utilized the **heterogeneity** of the clients and exploited the stragglers to enhance the overall speed
- Reduced communication delay and **privacy** leakage for some specific federated learning settings

Improving the numerical stability of distributed matrix computations

- Novel connections among convolutional codes, **block Toeplitz Matrices** and the condition number
- **Recovery error has been reduced** by 2 orders of magnitude than other baselines
- One of the **fastest decoding** schemes: no need of division and multiplication

Enhancing the overall speed of distributed sparse matrix computations

- Resilience to optimal number of stragglers while maintaining low-weight encodings
- Developed combinatorial design based methods to leverage the partial stragglers
- Preserving sparsity and leveraging stragglers lead to the enhancement of the worker node speed

Classification of EEG data for detection of epilepsy and epileptogenic zone

- Modeled the wavelet subbands of EEG data with suitable probability density functions (NIG, BKF)
- Utilized SVM and kNN classifiers to classify EEG datasets with at least 4% higher accuracy
- Worked on practical datasets: CHB-MIT datasets, Bern-Barcelona dataset, Bonn EEG dataset etc.

Awards

Karas Award, 2022, Iowa State University

For the Outstanding Dissertation in Mathematical and Physical Sciences and Engineering

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

National Science Foundation (NSF) Travel Grant

For travelling to Paris, France for International Symposium on Information Theory (ISIT), 2019

1st Position, Best Paper Award

IEEE Intl. Conf. on Electrical Engineering and Info. and Comm. Tech. (ICEEICT), 2015

2nd Position, Best Paper Award

IEEE Intl. Conf. on Electrical Info. and Comm. Tech. (EICT), 2013

National Champion, in the higher secondary category

Bangladesh Mathematical Olympiad, 2008

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

Statistical Machine Learning

Detection and Estimation Theory

Data Analytics

Linear Algebra

Non-linear Programming

Abstract Algebra

Convex Optimization

Real Analysis

Undergrad Courses

Random Signals and Processes

Numerical Methods

Digital Signal Processing I & II

Probability and Statistics

Digital Communication

Digital Electronics

Signals and Systems

Microprocessor & interfacing

Properties of Materials

Students Guided

- **Myeung Suk Oh**, a PhD student
Developing a low-complexity pilot assignment scheme using multi-agent deep reinforcement learning framework which can be incorporated in O-RAN cell free massive MIMO architecture. Our paper is accepted in IEEE Journal on Selected Areas in Communications (**Impact Factor: 16.4**).
- **Satyavrat Wagle**, a PhD student.
Developing a decentralized reinforcement learning methodology for D2D graph discovery that promotes communication of data-points over trusted yet reliable links to enhance the convergence of any federated learning process. Our paper is accepted in IEEE Glob. Comm. Conf. (GLOBECOM), 2023.
- **Junghoon Kim**, a PhD student.
Developing linear and learning-based coding schemes to enhance the communication reliability and to improve the power management in Gaussian two-way channels. Our manuscript is under review.
- **Byunghyun Lee**, a PhD student.
Design of constant modulus waveform with spatial-range sidelobe suppression for dual-functional radar and communication systems. Our manuscript is currently under review.
- **Ashwin Natraj**, a PhD student.
Finding the optimal number of hops in a multi-hop wireless system to maximize the overall throughput and to minimize the overall delay. Our manuscript is currently under preparation.
- **Seohyun Lee**, an undergraduate (junior) student.
Finding the optimal graph for D2D data exchange among the clients to enhance the convergence of unsupervised federated learning, while maintaining the security and the power allocation constraints.

Undergrad Projects

- Linear Predictive Coding
- Restoration of Images corrupted by Impulse Noise
- Coding and Decoding through Viterbi Algorithm
- Optimization Technique of Linear Antenna Array Synthesis by Taguchi's Method
- Design of 8-bit Computer Architecture design using Assembly Language
- Multi-variable Polynomial Regression
- Design & implementation of a Digital Multi-meter with Computer Interfacing
- Design & implementation of a One Digit Calculator
- University Course Registration System design using C Programming Language

Graduate Projects

- **Image recognition from CIFAR-10 dataset using deep residual learning**
 - 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**
 - Reviewed different types of GANs and their corresponding properties
 - Implemented deep convolutional GANs to upscale images by 4× factor
- **Classification of '20 Newsgroups' dataset using Bayes Classifier**
 - 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**
 - 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

- 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

- 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

- Reviewing the idea of ADMM for optimization algorithms
- Estimation of the underlying pdf parameters for EEG data using ADMM

Optimization algorithms and machine learning for X-ray CT Images

- Developed a regularized MM algorithm to recover images from sparse sampling
- Appropriate CT image reconstruction from Limited Angle Projections

Membership Member, **Sigma Xi**, The Scientific Research Honor Society (May 2022 - Present)
Member, IEEE (June 2019 - Present)
Member, Information Theory Society (June 2019 - Present)
Member, Signal Processing Society (April 2023 - Present)

Attended Workshops **IEEE Intl. Conf. on Acoustics, Speech and Sig. Proc. (ICASSP)** , Rhodes, Greece, 2023
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 Intl. Math Olympiad 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, TWC etc.
Other Journals: PLOS ONE, IEEE Access, BSPC, IET Image Processing etc.
International Conferences: ICASSP, Globecom, ISIT etc.

Others

- **Invited talk**, arranged by IEEE Sig. Proc. Society, Bangladesh Chap., 2019
- Certified as **‘Preparing Future Faculty Associate’** by Iowa State University
- Served as an examiner for **National Mathematical Olympiad** in Bangladesh
- Attended courses on **Quantum Computation** and **Quantum Info. Theory**
- Served as a tutor for *3rd* and *4th* grade kids in the program **Cymath-kids**

References **Dr. Aditya Ramamoorthy**, Email: adityar@iastate.edu
Professor, Electrical and Computer Engineering, Iowa State University

Dr. Christopher Brinton, Email: cgb@purdue.edu
Assistant Professor, Electrical and Computer Engineering, Purdue University

Dr. Namrata Vaswani, Email: namrata@iastate.edu
Professor, Electrical and Computer Engineering, Iowa State University

Dr. David Love, Email: djlove@purdue.edu
Professor, Electrical and Computer Engineering, Purdue University