

Saurabh Dash

Curriculum Vitae

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Research Interests

Dynamical Systems, Geometric Deep Learning, Generative Models, Neuromorphic Algorithms, Efficient & Robust Deep Learning in edge, Brain-Machine Interfaces

Education

- 2019-Present **PhD**, *Electrical & Computer Engineering*, Georgia Institute of Technology, GPA - 4/4.
2014-2019 **Dual Degree (B.S. + M.S.)**, *Electronics & Electrical Communications Engineering + Minor, Computer Science*, Indian Institute of Technology, Kharagpur, GPA - 9.17/10.

Publications

- 2020 *Hessian-Driven Unequal Protection of DNN Parameters for Robust Inference*. International Conference on Computer Aided Design (ICCAD), 2020
2020 *Physics-Incorporated Convolutional Recurrent Neural Networks for Source Identification and Forecasting of Dynamical Systems*. arXiv preprint
2017 *Low Power Implantable Spike Sorting Scheme based on Neuromorphic Classifier with Supervised Training Engine*. IEEE Computer Society Annual Symposium on VLSI (ISVLSI), 2017
2015 *Low Cost Autonomous Navigation and Control of a Mechanically Balanced Bicycle*. Transportation Electrification Conference (ITEC), 2015

Internships

- May 2018 - **Summer Intern**, Texas Instruments, India
July 2018 Developed digital signal processing algorithms for tracking and correction of sampling clock jitter in high speed ADCs.
Received a full-time offer to join as a Digital Signal Processing Engineer.
May 2017 - **Visiting Student Researcher**, Nanyang Technological University, Singapore
July 2017 Advisor: Dr.Arindam Basu
Explored a novel hardware amenable re-wiring training rule to train binary and multi-bit synapses for neuromorphic classifiers to power the next generation of implantable Brain-Computer Interfaces.

Other Research Experiences

- Jan 2020 - **Deep Generative Models: A study**
April 2020 Advisors: Dr.Matthieu Bloch, GeorgiaTech | Academic Project
Implemented and compared various aspects of deep generative modelling approaches - Generative-Adversarial Networks, Variational Autoencoders and Normalizing Flows.
Studied how recent variants like Wasserstein GAN(GP), β -VAE, Glow etc. mitigated issues faced by the original approaches.
Jan 2020 - **Circuit Partitioning Using Graph Neural Networks**
April 2020 Advisors: Dr.Sung-Kyu Lim, GeorgiaTech | Academic Project
Implemented a deep-learning based fully differentiable approach to solve the problem of circuit partitioning using Graph Convolutional Networks.
July 2017 - **Low Power On-Chip Learner for a Neuromorphic Classifier**
April 2019 Undergraduate and Masters' Dissertation
Advisors: Dr.Indrajit Chakrabarti, IIT Kharagpur and Dr.Arindam Basu, NTU Singapore
Developed and implemented network rewiring rule based sub-threshold analog circuits that can be incorporated on chip to train a neuromorphic classifier.
Nominated by the panel for the best B.Tech Thesis award.

- August 2017 **Neuronal Encoding/Decoding and Synaptic Plasticity in Visual Cortex**
 - November 2017 Advisor: Prof. Sharba Bandyopadhyay | Academic Project
 Used STA and PSTH to estimate parameters from stimulus input and response spikes. Applied Information theory based distance metrics like Van Rossum and Victor-Purpura to quantify discrimination between stimuli.
 Modelled the spiking behaviour of subplate and L4 neurons, with thalamic inputs from both eyes. Used STDP and Hebbian plasticity to simulate learning and ocular dominance in early stages of development.
- February 2015 - April 2019 **Kharagpur RoboSoccer Students' Group** | Embedded Electronics Team Head
 Advisors: Dr. Jayanta Mukhopadhyay, Dr. Sudeshna Sarkar, Dr. A.K. Deb
 Developed and fabricated embedded systems based on AVR and ARM microcontrollers and FPGA based architectures. Designed and implemented a proprietary brushless DC motor Controller for the robots. Devised Fuzzy and PID controllers for precision speed control of brushless DC Motors.
- March 2016 - April 2016 **Analog Transmitter-Receiver for Energy Efficient, High Speed Data Communication**
 Advisor: Dr. Mrigank Sharad
 Explored various topologies like cascade, feedback and inductive peaking for a transmitter-receiver circuit for High Speed, Energy Efficient Communication.
- May 2016 - July 2016 **VLSI Summer School, IIT Kharagpur**
 Advisor: Dr. Mrigank Sharad
 RTL Design for hamming Distance based pattern matching using Synopsys Design and IC Compiler. Design of low noise amplifier for biomedical frontend, involving capacitive feedback, active common-mode feedback using Cadence Virtuoso along with noise and stability analysis. Analysis and design of various RFIC components like VCO, PLL, Mixer and Power Amplifier.
- October 2016 - November 2016 **Recolorization of Greyscale Images using Convolutional Neural Networks**
 Academic Project
 Developed a novel Convolutional Neural Network architecture inspired by VGG-16 for recolorization of greyscale images on TensorFlow.
- December 2014 - March 2016 **i-Bike: Autonomous Bicycle with Dual Modes of Navigation**
 Developed a mathematical model of the bicycle control system. Designed and optimised the embedded architecture based on AVR and ARM microcontrollers for improved battery life. Explored various algorithms for path planning and sensors for obstacle detection and avoidance.

Achievements

- Scholarships
- Georgia Tech ECE Fellowship
 - Kishore Vaigyanik Protsahan Yojna (Young Scientist Award), 2013
- Awards
- Received the **Order of Merit** at IIT KGP for distinguished performance in the field of Technology
 - Member of the **Gold** winning Product Exhibition team at the 5th inter IIT Tech Meet
 - Member of the **Bronze** winning Human Computer Interface team at the 5th inter IIT Tech Meet
 - Member of the **Bronze** winning team in FIRA MiroSot 2015 held at Daejeon, South Korea
 - Contingent Head** of the first Indian Team to qualify for RoboCup 2017 held at Nagoya, Japan
 - Member of the **Gold** winning team in KPIT Sparkle 2015 - an inter collegiate innovation challenge
 - Member of the **Gold** winning team in intra collegiate Hardware Modelling 2015
 - Won **Bronze** in IEEE Hardware hackathon for a smart walking aid for the visually challenged
- Scholastic Achievements
- Ranked among the top 0.1% students in IIT-Joint Entrance Examination among 485,000 students
 - Ranked in top 0.1% in Royal Australian Chemical Quiz in 2011 and 2012

Relevant Courses

- Statistical Machine Learning
- Digital Signal Processing
- Analysis of Algorithms
- Computer Architecture
- Math. Foundations of ML
- Analysis I
- Artificial Intelligence
- Architectural Design of ICs
- Information Theory
- Computational Neuroscience
- VLSI Physical Design Automation
- Semiconductor Devices

Technical Competencies

Frameworks	PyTorch, jax, TensorFlow
Miscellaneous	Git, Xilinx ISE, Cadence Virtuoso, Synopsys Design and IC Compiler, Proteus, Eagle
Platforms	ARM Cortex A7(RaspberryPi) & Cortex M4, AVR, Mips, Intel 8051
Languages	python, MATLAB, C, AVR-C, C++, C#, bash

Interests and Activities

- Mentored a group of 20 students for a 7 day IEEE certified workshop leading to the design of an autonomous target finding turret
- Director, IIT KGP Model United Nations 2015 and Member of the IIT Kharagpur Debating Society
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