Chinmay Talegaonkar

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EDUCATION

Indian Institute of Technology Bombay, *Mumbai, India* Jul'15-Present
B.Tech. in Electrical Engineering

- **Major CGPA:** 9.00/10
- **Minor Degree:** Dept. of Computer Science & Engineering

PUBLICATIONS

- **Chinmay Talegaonkar**, Ajit V. Rajwade
  "Performance Bounds For Tractable Poisson Denoisers With Principled Parameter Tuning" [Paper]
  Accepted for oral presentation at the 6th IEEE Global Conference on Signal and Information Processing (2018)

EXPERIENCE

NVIDIA - Compute Developer Technology Team May'18-Jul'18
Optimizing Capsule Networks and DBSCAN *Bangalore*

- The internship involved two separate projects. The first focussed on optimizing the performance of Capsule Networks (a *Deep Learning* architecture) on PyTorch and CUDA. To reduce uncoalesced memory accesses and shared memory bank conflicts in the batched GEMM operations, we developed customized CUDA kernels for optimizing the implementation of the routing layer & backpropagation in the network. We also used mixed precision training for the Capsule Layer to get faster convergence rates with FP16 data types. Using these techniques we achieved **twice** the cumulative **speed up** compared to the naive implementation on PyTorch. We dispatched our customized kernels as a PyTorch extension.

- The second project was aimed at parallelizing the end-to-end implementation of DBSCAN and porting the algorithm for GPUs using CUDA. We used CUTLASS to formulate distance matrix computation of the dataset as a GEMM operation. We also augmented batched clustering in our implementation to handle larger datasets. Our implementation of DBSCAN under this project was included in the recently released NVIDIA Rapids library which is a GPU accelerated platform for Machine Learning and Data Science.

Parallelizing Monte Carlo Simulations May'17-Jul'17
Prof. Dirk Kroese *University of Queensland, Australia*

Monte Carlo methods are highly parallelizable and hence using GPUs for such computations gives a massive speed up compared to a CPU. Also, using a GPU on a single machine is easier than using a distributed computing framework like MPI. This project involved devising a data-parallel implementation of the Cross Entropy method using CUDA. We Solved the Max-Cut problem & maximized the output of a non-convex peak detector using Cross Entropy optimization. Obtained an amortized **speed up** of **3000**x on a NVidia Kepler GPU as compared to a CPU for maximizing the output of the peak detector function. Report here.

RESEARCH PROJECTS

Fourier Phase Retrieval from Clipped Poisson Corrupted Measurements Aug'18-Present
Prof. Ajit Rajwade *Computer & Science Engineering, IIT Bombay*

The problem of Fourier Phase Retrieval, i.e. recovery of a signal given only the Fourier magnitudes comes up in many fields like Astronomy, Optical Imaging and Crystallograhpy. Our work aims to extend the existing semi-definite convex optimization based lifting schemes for handling both Poisson noise and clipping of the magnitude measurements and prove performance bounds for our methods. We are also looking into compressive phase retrieval from Poisson corrupted measurements of signals that are sparse in canonical basis. So far we have achieved good results at low intensities for recovery from Poisson corrupted measurements in a compressive, non-compressive as well as clipped scenario by solving our modified objective functions using CVX. We plan to submit our work to ICIP 2019. The next step is to make our algorithms scalable for large images using iterative proximal gradient based approaches, since CVX is not scalable for large matrices.

Denoising using Variance Stabilization Transforms Jan'18-May'18
Prof. Ajit Rajwade *Computer Science & Engineering, IIT Bombay*

The project was aimed at denoising Poisson corrupted images using a tractable Anscombe Transform based Residual magnitude estimator for recovering compressive measurements. Since the estimator is based on the variance stabilization approach, it is well suited for handling Poisson noise. Moreover it reduces the effort of parameter tuning required by regularized negative log-likelihood based methods since the parameter used in our estimator depends only on the signal length. The reconstructions we obtained are comparable to the

existing negative log likelihood based methods like SPIRAL-TAP. We also derived reconstruction error bounds for denoising using this algorithm and analyzed the effect of sparsity and intensity on the reconstructions to verify the algorithm's behaviour in accordance with the derived performance bounds.

Detecting Non-Thermal emission in IRAS16164-5046 Dec'17
Prof. Sarita Vig *Indian Institute of Space Science and Technology*

We analyzed the data collected by GMRT, Pune at 610 MHz for the start forming IRAS region. Performed Data reduction using AIPS (Astronomical Image Processing Software) to obtain the image. Using spectral index mapping, we detected signs of non-thermal emission in a bow-shock in the star forming region. We further proposed that the existence of the non-thermal radiation can be attributed to Diffusive shock acceleration in the bow-shock. Project presentation here.

MISCELLANEOUS PROJECTS

Multi-Agent Game Play using Reinforcement Learning Aug'18-Nov'18
Prof. Shivaram Kalyankrishnan *CS 747: Reinforcement Learning*

The project involved training an agent for playing against other agents in the Pommerman gaming environment. We modified the feature space of the problem setup to improve the agent's gameplay using Proximal Policy optimization (PPO). For enhancing the agent's performance, we leveraged experience replay and imitation learning principles in the form of the Deep Q learning from demonstrations (DQfD) using tensorforce, which allowed our agent to learn strategies played by an efficient rule based agent and then improve upon them. Report here and video here.

Parkaway - An IoT based No-Parking lock system May'17-Jul'17
SINE Lab, IIT Bombay *Innovation Cell, IIT Bombay*

Developed an admin interface using Node.js and MySQL back-end to facilitate automated real time communication through SMS between the lock and server of an IoT based No-Parking lock system. Incorporated Google Maps API with the back-end interface for real time monitoring of the locks. Code here.

Gridless Estimation of Saturated Signals Spet'18-Nov'18
Prof. Debraj Chakraborty *EE 638: Estimation and Identification*

Compared the performance of atomic norm minimization and a compressed sensing formulation for recoverng a signal composed of decaying sinusoidals from noiseless clipped measurements. Report here.

Face Swap using Poisson Blending Sep'17-Nov'17
Prof. Ajit Rajwade *CS 663: Digital Image Processing*

Used Affine Transform to align and re-scale two face images using their facial features. Implemented the mixed gradients variant of the Poisson solver to seamlessly swap the image. Code here.

Microprocessor Design - *RISC architecture, Pipelining, VHDL* Aug'17-Dec'17
Prof. Virendra Singh *EE 309: Microprocessor Design*

Designed and implemented a six-staged Pipelined architecture of a multicycle RISC processor using VHDL. The architecture was augmented with hazard mitigation techniques and data forwarding. Code here.

Markov Chain Monte Carlo Methods Sep'17-Nov'17
Prof. Gaurav Kasbekar *EE 325: Probability and Random Processes*

Explored algorithms like Metropolis Hastings, Gibbs Sampling and Hamiltonian Monte Carlo. Investigated the use of MCMC in the Restricted Boltzmann Machines (RBMs) and Contrastive Divergence. Report here.

Portable Cell Phone Charger Jan'18-Apr'18
Prof. Joseph John *EE 344: Electronics Design Lab*

Designed and created a Buck-Boost converter to regulate the energy harvested by solar and vibrational energy. Harvested vibrational energy using principles of electromagnetic induction and piezoelectricity. Report here.

ACADEMIC ACHIEVEMENTS

- Secured All India Rank **425** in entrance exam to the **IIT**s amongst **120,000** candidates. [2015]
- Represented India at the 10th **International Junior Science Olympiad, Pune, India** and was awarded a **Silver Medal** amongst 250 students from over 40 nations. [2013]
- Awarded a **branch change** to Electrical B.Tech. for exceptional academic performance in first year. [2016]
- Awarded the Kishore Vaigyanik Protsahan Yojana Scholarship with an **All India Rank 9** among over **50,000** candidates for aptitude in Basic Sciences and Research. [2014]
- Holder of the National Talent Search Scholarship awarded to **1000** students in the country. [2011]

COURSES UNDERTAKEN

- **Computer Science -** Data Structures and Algorithms, Computer Networks, Operating Systems, Digital Image Processing, Advanced Image Processing
- **Machine Learning -** Intro. to Machine Learning, Optimization Techniques, Reinforcement Learning
- **Electrical Engineering -** Data Analysis and Interpretation, Signals & Systems, Digital Systems, Probability & Random Processes, Microprocessors, Communication Systems, Control Systems, Digital Signal Processing, Digital Communications, Estimation & Identification
- **Mathematics -** Linear Algebra, Calculus, Differential Equations, Complex Analysis

TECHNICAL SKILLS

- **Programming Languages:** C++, Python, ngspice, Bash, VHDL
- **Web Development:** HTML5, CSS3, Javascript, Angular-JS, Bootstrap, MySQL, MongoDB, Node.js
- **Softwares and Packages:** OpenCV, Git, Octave, MATLAB, PyTorch, Quartus, Slurm, LaTeX, CUDA, AIPS

RESPONSIBILITIES

- **Event Manager, Inter IIT Tech meet** (2018-Present) - Member of the organizing team of the 7th Inter IIT Tech meet to be held at IIT Bombay. Responsible for conducting an astrophysics themed hackathon.
- **Editorial Board Member, Insight** (2017-18) - Part of Insight, the institute media body with an online readership of about **half a million** users/year. Spearheaded a myriad of initiatives like a web series about views of professors on student life in campus and reportage of various events happening in the institute.
- **Resource Person & Student Facilitator, HBCSE Olympiad Cell** - Involved in selection & training of a 5 member student team to represent India at the 11th IOAA 2017. Assisted the Convener of the Olympiad with the back-end software and other proceedings of IOAA 2016, held in India.
- **Department Academic Mentor** (2018-Present) - Selected for academic & personal mentoring of sophomores on the basis of peer-review. Helping 2 junior undergraduates overcome academic difficulties.
- **Teaching Assistant** - *Quantum Physics* in Fall '16 and *Machine Learning Crash Course* in Summer '17. Conducted a special help session for Quantum Physics in Fall '18.

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[1]Incase the links to the report and code are not accessible in PDF, refer to the same CV (long) hosted on https://chinmay0301.github.io/