Srivatsan Rajagopal

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Keywords: C, C++, CUDA, Rust, Quantum Mechanics, Quantum Information Theory, Linear Algebra, Algorithms, Git, Linux, Cmake, Machine Learning, Docker

Visa Status: H1B change of status under progress.
Github Profile: https://github.com/chichieinstein
Google Scholar: https://scholar.google.com/citations?user=ENP63iEAAAAJ&hl=en

Experience

- ML Research Engineer, JASR systems — anticipated start date 10/24
- Postdoctoral Research Scholar in EE, UC San Diego, — 04/22 - Present
- Collaborated informally with Prof. Bharadia's group, — 10/21 - 04/22
- Preparation for career in ML and software development — 03/20 - 09/21
- Postdoctoral Research Associate in Physics, UIUC, — 09/19 - 03/20

Education

- PhD in Physics, **MIT, Cambridge, MA** — 07/13 - 08/19
- BTech in Engineering Physics, **IIT Delhi** — 08/09 - 06/13

Mentorship

- Radhika Mathuria, UC San Diego**,** mentored Master's thesis on cyclostationary signal processing.

Press Coverage

- Wireless anomaly characterization research covered in press

Awards

- Institute Silver Medal, 44th convocation of IIT Delhi for Academic Performance

Completed Projects

- **Wireless anomaly characterization using Machine Learning**
  - Used advanced machine learning algorithms to characterize anomalous wireless signals.
  - Effectively combined Transformers and 1D CNNs in an adversarial training framework, employing soft triplet loss for improved model robustness.
  - Delivered a model with **85%** classification accuracy on unseen data

- **Polyphase filter bank implementation on GPU**
  - Implemented a high-performance polyphase channelizer in CUDA C++, optimizing direct GPU core utilization, complete with bindings to the Rust programming language.
  - Attained a throughput of **763** Megasamples per second on a single GPU core. For comparison, typical software implementations on GPU Matlab provide a throughput of 500 Megasamples per second on a single GPU core.
  - Code resides in the **rustypfb repository** in my github profile.

- **Strip spectral correlation analyzer implementation on GPU**
    - Developed a high-performance version of the strip spectral correlation analyzer in CUDA C++, enabling real-time estimation of the cyclostationary spectral correlation function, complete with bindings to Rust,
    - Realized a throughput of **40** Megasamples per second on a single GPU core, scaling to achieve cyclostationary estimates at the rate of 100 Megasamples per second with just three GPUs, which is the maximum input sampling rate of software defined radios used in the project.
    - Code resides in the **rustycyclo repository** in my github profile.

- **Effective Actions for Anomalous Hydrodynamics**
    - Construction of hydrodynamic effective actions is useful to study the quantization of vortices, and also potentially in the onset of turbulence
    - Prior to this project, parity breaking hydrodynamics with anomalous global charges had **non-local** effective actions in the literature which made computations difficult.
    - I constructed for the first time the effective action for anomalous hydrodynamics that is purely **local**, thereby opening the door for better understanding of the off-shell dynamics of parity breaking fluids.

- **Modular flow of excited states**
    - Quantum information quantities like relative entropy, in continuum systems, are computed in terms of so-called modular operators and modular automorphisms/modular flows.
    - Before this work, modular flows were known explicitly only for specific geometries and quantum states in the literature.
    - I constructed modular flows in quantum field theories (QFTs) for excited states for the very first time.

Ongoing Projects

- Recently, structured state space sequence (S4) models have emerged as a contender for the transformer architecture and are shown to have superior performance in many NLP tasks.
- I am working on modifying the state space to be in tensor product form for these models and studying new emergent structure on such tensorized models.

Publications

- Blind Signal Characterization: Transformers, Triplet Losses and Beyond. R.Mathuria, S. Rajagopal, D. Bharadia *, IEEE Dyspan, 2024 Washington D.C.*
- Fourier meets Gardner: Robust Blind Waveform Characterization, R. Mathuria, S. Rajagopal, D. Bharadia *IEEE Dyspan, 2024 Washington D.C.*
- Multirate signal processing for software radio architectures, F Harris, E Venosa, X Chen, R Bell, S Rajagopal, R Mathuria, D Bharadia, *Signal Processing and ML Theory, 403-494*
- Perturbation Theory for the logarithm of a positive operator**,** N. Lashkari, H. Liu and S.Rajagopal, *JHEP 2023, 97 (2023)*
- Modular Flow of Excited States, N. Lashkari, H. Liu, S. Rajagopal, *JHEP 2021, 166 (2021)*
- Global Anomalies, Discrete Symmetries and Hydrodynamic Effective Actions, P. Glorioso, H. Liu, S. Rajagopal, *JHEP 2019, 43 (2019)*
- Holographic Trace Anomaly and Local Renormalization Group, S. Rajagopal, A. Stergiou and Y. Zhu, *JHEP 2015, 216(2015)*