Rishi Nandha V

B.Tech in Electrical Engineering, IIT Madras

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Education

Indian Institute of Technology, Madras (IITM) — **Chennai, India**
B.Tech in Electrical Engineering (**8.72** CGPA) — Ongoing (Expected Graduation 2025)

Roles: R&D Associate at Indigenous 5G Test Bed | Social Innovation Club Head | Dpt. UG Council Representative

Coursework:

Multirate Digital Signal Processing	Fundamentals of Audio Engg"	Digital IC Design
Adaptive Signal Processing	RF IC Design	Analog IC Design
Convolution Neural Networks"	Analog Systems Lab	Digital Systems Lab

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Languages: C, Python, C++, MATLAB, Dart, AVR and ARM Assembly, Verilog
Libraries & Frameworks: Numpy, **Tensorflow 2, PyTorch,** Pandas, Scipy, OpenCV 2, Simulink, Wave, Serial
Softwares: Energia, **Electric VLSI, Cadence OrCAD, Virtuoso & Allegro, Ansys Electronics**, PUTTY, Fusion 360
Other Relevant Skills: Sound Synthesis, Audio Declipping & Noise Reduction, Machine Learning for Audio Processing

Professional Experiences

1. R&D Project Associate: Design of RF Clocking Structure for 5G-NR RRH — **Dec 2023 - Present**
Guide: Prof. Radhakrishna Ganti — *5G Test Bed, IIT Madras*

- Reviewed literature on modern RRHs to maximize future scope and expandability of Clocking for Advanced 5G / 6G Systems
- Analysed Encoding techniques and the required Clocking Structures for Protocols such as JESD204B and Synchronous Ethernet
- Designed Clock Structure for Synchronization with Global Clocks GPS/PPS/IEEE 1588 PTP using Dual-Reference DSPLLs
- Layout with Traces tuned up to ± 6.4ps and AC Terminations. Simulated the 128-Port System for Coupling and S-Parameters
- Attended the National Communications Conference 2024 on the latest happenings in Wireless and Optical Communications

2. Research Internship: Design & Testing of an RF Clock Evaluation Board — **May 2023 - Nov 2023**
Guide: Prof. Radhakrishna Ganti — *5G Test Bed, IIT Madras*

- Reviewed literature on Bode Noise Theorem, Quantization Noise, Noise-Shaping, Oversampling and Interference at High Speed
- Characterized the effect of Phase Noise in the Clocking of ADCs and reviewed literature on the usage of PPLs to filter jitter
- Fabricated a Clock Jitter Filtering Evaluation Board using PLLs with Impedance Matched and Delay Tuned Differential Traces
- Designed Regulator Blocks, Communication Protocol Blocks, Power Surge Protections, Thermal Pads and AC Terminations
- Simulated Electromagnetics of the Design and achieved -20 dB Return & -0.1 dB Insertion Loss for Frequencies up to ≈5GHz

Technical Projects

1. Design of a 0.13μm CMOS RF Analog Front End for 5GHz WLAN (802.11a) — **Feb 2024 - Present**
Guide: Prof. Sankaran Aniruddhan — *IIT Madras*

- Designed and Simulated a Cascoded Common Source Low-Noise Amplifier with S_{11} < -11dB, NF < 1.7dB & IIP_3 = -7dBm
- Designed a Differential Gilbert Mixer with an IIP_3 = -4dBm. Achieved Gain 34dB and NF 4.4dB for the LNA+Mixer Integration
- Sketched out the Complete Front-End including Voltage Controlled Oscillator & Power Amplifier, to be designed & simulated

2. Self Project: Vacuum Tube Triode Guitar Pre-Amplifier Pedal — **Dec 2023 - Present**

- Designed a 2-stage Class-A Amplifier using a 12AT7 Tube. Characterized and chose DC Points for Max Harmonic Distortion
- Manually Soldered into Circuit Boards, Verified Power Integrity, & Filtered Switching Converter Feedthrough with an LC Shunt
- Tested the Pedal with a Guitar and a Hi-Z Speaker. Tuned the Potentiometers and designed 3rd order passive filter for Tone

3. Layout & Simulation of a CMOS 22nm 8-bit Carry Save Multiplier — **Sep 2023 - Dec 2023**
Guide: Prof. Janakiraman Viraraghavan — *IIT Madras*

- Designed & Layouted a 22nm Technology 8-bit CSM to operate at 2.8 GHz Clock with a simulated parasitic delay of 0.32 ns
- Characterized Delay in the Critical Path, simulated delay in the complete CSM and optimized it by scaling the standard cells
- Designed Flipflops & Pipelined to improve the frequency by 67%. Made a Carry Select Vector Merge to reduce delay by 21%

4. SW-KRLS for Adaptive Filtering of Self Interference in MIMO 5G Transceivers — **Sep 2023 - Nov 2023**
Guide: Prof. Srikrishna Bashyam — *IIT Madras*

- Simulated Kernel-RLS for a Fully-Duplexed TX-ORX pair for Robust Filtering despite Time-Variant Self-Interference Profiles
- Demonstrated about 90% mitigation of Time-Variant Non-Linear Self-Interferences such as IMD2, IMD3, and TxH2 in O(n^2)
- Compared Resilience with Time-Variance of Interference Patterns against other Sparsification Techniques such as ALD and FW

5. Audio Compression, Recovery & Transmission Parallelization with Filter Banks — **Aug 2023 - Oct 2023**
Course Project: EE6311 - Multirate Digital Signal Processing — *IIT Madras*

- Implemented & Simulated Upsampling, Downsamping & Polyphase Filter Banks for Compression and Recovery of Digital Audio
- Investigated Methods to recover clipped Audio using Spline-based Techniques & for the removal of Power-Hum and white noise
- Designed filters and compared the resulting Spectrograms of fully recoverable and partially recoverable parallel transmissions

6. VASS.AI: Re-imagining Mobility for the Auditorily-Impaired **Apr 2023 - Jul 2023**
Sahaay - Social Innovation Club *CFI, IIT Madras*
- Implemented a CNN on Spectrograms and a Mel-Filter Bank for detecting Environmental Danger with Audio from a Mic-Array
- Assisted in implementing Beamforming principles to Localize the Danger in the surrounding using the multiple audio channels

7. Composite Audio System to Generate a Buzz and Play it on a Speaker **Jan 2023 - Apr 2023**
Course Project: EE2019 - Analog Systems Lab *IIT Madras*
- Built a System with a Schmidt Oscillator, Pulse-Width Modulator, Band-pass Filters, DC-DC Buck Converter, Peak Detector and BJT Class-D Amplifier from fundamental components such as Opamp ICs, Comparator ICs, Transistors, Rs, Ls and Cs
- Generated Non-Overlapping Clocks for Class-D Amplification using CMOS Inverter Buffers with Loading Capacitance. Stabilized the Closed-Loop System while taking parasitics of the breadboard into consideration. Compared results with Simulation Results

8. Project Vision: Re-imagining Mobility for the Visually-Impaired **Jun 2022 - Mar 2023**
Sahaay - Social Innovation Club *CFI, IIT Madras*
- Implemented Tiny YOLO v3 on a Jetson Nano to detect obstacles using a Stereo Camera's Depth Data and report it to user
- Established wireless communication from a Raspberry Pi to an ESP32 using the MQTT Protocol for transferring detected data
- Assisted in the design of a haptics-based Gripper attachment to the White-cane that communicates the depth map of obstacle

9. Automatic Waste Segregator: Fostering Waste Recyclability **May 2022 - Jul 2022**
Sahaay - Social Innovation Club *CFI, IIT Madras*
- Created a dataset of ≈3000 images of Solid Waste; trained variants of CNN Models on them such as ResNet & InceptionNet
- Deployed it on a development board. Augmented the Dataset with transforms & noise to increased base accuracy by 35%+
- Compared Class-wise Accuracies & F1 Scores; achieved 92.8% Validation Accuracy with Transfer Learning on MobileNetV2

Positions of Responsibility

1. Club Head, Sahaay - Social Innovation Club **May 2023 - Present**
Sahaay, CFI - Centre for Innovation *Co-Curricular Sphere, IIT Madras*
- Head of the Social Innovation Club of IIT Madras managing over 75 Members and a budget of about 2 lakhs INR (≈240$)
- Reformed the Club's Member Selection Process & Publicity Practices to achieve an increase upto 400% in the member-count
- Reformed the Club Structure, Member Accountability & Project Workflow Guidelines to achieve 100% success-rate in projects
- Collaborating with an Animal Welfare NGO to Deploy a Mobile App in our City to Reform Animal Distress Call Response
- Supervising six different projects for Social causes including Assistive Technology, Animal Welfare, Agri-tech & Waste Mgmt

2. Band Leader, Music Contingent **Jun 2023 - Present**
Music Club, Sangam *Culturals Sphere, IIT Madras*
- Led the Official University Rock Band of about 12 Members in College Fests & Semi-Professional Shows as their Bass Guitarist
- Used Technical Background to maximize the efficiency of the Band with Audio Equipment in Live-Settings and hence success-rate
- Pioneered Reform in Audition Process to encourage Sincere Musicians to improve and & re-audition by taking up menteeship

3. Coordinator, Sahaay - Social Innovation Club **Jun 2022 - Apr 2023**
Sahaay, CFI - Centre for Innovation *Co-Curricular Sphere, IIT Madras*
- Managed a 5-member interdisciplinary project. Pitched the USP, PoC & Segment Analysis at G20 Conference & CSR Summit
- Lectured a paid workshop program with over 100 registrations on Python, Numpy & CNN for Social Innovation Tech. Projects

4. Musical Events Coordinator **Jun 2022 - Apr 2023**
Music Club, Sangam *Culturals Sphere, IIT Madras*
- Organized Events at the IIT Madras College Fest including the Audio Equipment setup and invitation of participants & judges
- Transitioned 15+ music events into offline mode post-COVID with an attendance of over 500+, handling a budget of INR 2L+

Scholastic Achievements

1. Online Physics Brawl 2021 **Nov 2021**
Secured **7th** in O category out of 147 teams and an overall **13th** out of about 800 teams from all around the world as a **team of 5** under the team name "Laplace's Demon"

2. JEE Advanced 2021 **Oct 2021**
Secured an **All India Rank 332** among about **0.14 million** candidates

3. Online Physics Olympiad 2021 **Aug 2021**
Finished in **Gold Tier** and **secured 6th** rank out of about 600 teams from all around the world as a **team of 3** under the team name "Laplace's Demon"

Culturals Activities & Social Volunteering

- Guitarist & Bassist in Institute Band. Won/Earned over INR2L+ in over 7+ Fests and Semi-Professional Shows (2022-24)
- Part of the Student Volunteer Group that helped the academic restructuring of the Department B.Tech Semesters (2023)
- Part of Student Volunteer Group that led movement for preventive measures for Women's Safety on Campus (2022)
- Mixed, Composed & Mastered Music with Online Groups & Orchestras using professional Audio Tools and published (2021)
- Produced music for promotional video of the "Unity" Clinical Study about techniques against risks of COVID-19 (2020)

Declaration

I do hereby declare that all the details furnished above are true to the best of my knowledge and belief.

Place: Chennai, Tamil Nadu, India
Date: March 19, 2024

Rishi Nandha V