Thariq Shanavas

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Education

2019 – Present PhD Candidate in Physics, University of Colorado, Boulder, USA

2015 – 2019 Undergraduate, Indian Institute of Technology – Bombay, India
Major in Electrical Engineering, Minor in Physics. *CPI – 9.00/10*

Publications

Farsinezhad, S., **Shanavas, T.**, Mahdi, N., Askar, A. M., Kar, P., Sharma, H., Shankar, K. (2018). Nanotechnology, *Core–shell titanium dioxide–titanium nitride nanotube arrays with near-infrared plasmon resonances.* http://doi.org/10.1088/1361-6528/aaad58

Honors and Fellowships

- **Kishore Vygyanik Protsahan Yojana** (**KVPY**) *2015*
  Financial award by the Department of Science and Technology, India, for promotion of basic Sciences among high school students to approx. 1500 students in the country among 40,000 candidates.
- **National Talent Search Examination** (**NTSE**) *2013*
  Awarded by the National Council for Educational Research and Training as support for secondary education to approx. 1000 students in the country among 900,000 candidates.
- **Joint Entrance Examination** *2015*
  Ranked 69 among 1.35 million candidates for admission to IIT Bombay, the premier technical university in India.

Key Research Experience

- **Undergraduate Thesis – IIT Bombay** *July 2018 – November 2018*
  Magnetometry using Nitrogen-Vacancies in Diamond *Advisors: Dr Pradeep Sarin, Dr Kasturi Saha*
  - Involved in designing the experimental setup for sensing weak magnetic fields at micron-scale resolution using nitrogen-vacancy centers in diamond.
  - Using a microwave antenna, provided a uniform RF excitation to the diamond sample for magnetometry using optically detected magnetic resonance.
  - Improvements in the microwave field delivery system led to 57 percent increase in usable nitrogen-vacancies as compared to the setup previously used in the group, corresponding to an expected shot-noise limited sensitivity improvement of 21 percent. Report

- **Tyndall National Institute, Ireland** *May 2018 – July 2018*
  Demonstration of 20Gbps communication over 10G-class optics enabled by machine learning
  Advisors: Dr Cleitus Antony, Dr Paul Townsend
  - Explored the use of neural networks for equalisation at the receiver end and pre-compensation at the transmitter end to compensate non-linear effects of the channel
  - Integrated recurrent, convolutional and decision-feedback neural networks to a simulation testbed and real time experimental setup.
  - Demonstrated 20Gbps data transfer over 10G-class optics using a convolutional neural network at the receiver, within the acceptable error rates for Forward Error Correction. Report

- **KEK, High Energy Accelerator Research Organisation, Japan** *Nov 2017 – Dec 2017*
  FPGA based controller for self-triggered hybrid pixel detector *Advisors: Dr Manobu Tanaka, Dr Tetsuichi Kishishita*
  - Developed the FPGA framework for a hybrid pixel detector.
  - Characterised the field response of the analog front end ASIC chip, with test signals using the developed framework.
  - Examined proposed changes to the amplification stages of the ASIC chip, recommended the design with the least equivalent noise charge using Cadence.
    Report

- **University of Alberta, Canada** *May 2017 – July 2017*
  Modelling of Photonic nanotubes exhibiting near-infrared plasmon resonance
  Advisor: Dr Karthik Shankar
  - Analytically modelled and numerically simulated the optical properties of titanium dioxide nanotubes coated with Titanium Nitride.
  - Analytical predictions made by modifying Gans theory for a composite nanostructure led to accurate predictions of the plasmon excitation, results agreed with experimental result.
  - Set up and documented a finite element modelling testbed on the University of Alberta Supercomputing cluster using Comsol to support future work on plasmon resonance.

Other Research Experience

- **Particle discrimination using machine learning and matched filtering** *Mar 2018*
  Course Project, EE338: Digital Signal Processing
  Prof. V M Gadre, Department of Electrical Engineering, IIT Bombay
  - Used logistic regression and matched filtering to discriminate pions and electrons in the signal from a scintillation detector.
  - Analytically modelled the detector output to compare against incoming signal for matched filtering, used the same model to generate training dataset for the ML classifier.
  - Achieved over 98 percent accuracy for both techniques under reasonable noise conditions.
    Poster

- **Calibration of readout electronics for Silicon detectors** *Jan 2017 – Apr 2017*
  Prof. Pradeep Sarin, Department of Physics, IIT Bombay
  - Designed a portable GHz level pulse generator for the purpose of calibrating the electronic readout of Silicon and Diamond particle detectors.
  - Implemented a low noise transconductance amplifier circuit followed by an attenuator block to convert a voltage pulse into a micro ampere current pulse.

- **Design of multicycle RISC Processor – Course Project, EE309: Microprocessors** *Oct 2017*
  Prof. Virendra Singh, Department of Electrical Engineering, IIT Bombay
  - Designed and simulated a multicycle RISC processor optimised for performance.
  - Implemented a Von Neumann architecture, used a shared data and instruction memory.
  - Implemented and verified the design on an FPGA.
    Report

- **Image classification using Spiking Neural Networks** *Nov 2017*
  Prof. Udayan Ganguly, Department of Electrical Engineering, IIT Bombay
  - Demonstrated Spike Timing dependent plasticity using a GLM model of probabilistic SNNs.
  - Implemented First-to-Spike decoding rule - the SNN can perform an early classification decision once a spike firing is detected at an output neuron.
  - Observed a massive speed up in training and execution using first to spike decoding as opposed to conventional rate decoding.
    Poster. Report

- **Matsya, Autonomous Underwater Vehicle | AUV-IITB** *Oct 2015-Oct 2016*
  International RoboSub, AUVSI & US Office of Naval Research
  - Part of a 30 member team aimed at developing unmanned AUVs. The team came second in the world at the international Robosub competition 2016, San Diego, California.
  - Developed the DC-DC boost converter, motor drivers, battery hot-swapping capability and water seepage detection modules.

- **Simulation of Spiral RF inductors** *Apr 2016 - June 2016*
  Prof. Dipankar Saha, Department of Electrical Engineering, IIT Bombay
  - Studied and simulated Spiral RF inductors in the micron scale using finite element techniques.
  - Extracted the S-parameters as a function of the frequency of operation.

- **Coverage Control of multi-agent robotic systems** *Nov 2016 – Feb 2017*
  Prof. Sukumar Srikant, Systems and Control Engineering, IIT Bombay
  - Proposed a decentralised controller for autonomous mobile robots, drawing inspiration from patterns observed in the seed distribution of a sunflower.
  - Proposed a Lyapunov-type proof for the stability and convergence of the designed controller.
  - Numerical simulations carried out for the proposed controller. Results found to agree very well with coverage objective. Report

Leadership and Organisation

- **Manager**, **Maths and Physics Club**, IIT Bombay *2017 – 2018*
  - As a junior undergraduate, I led a team of six sophomores to foster enthusiasm in mathematics and physics, tending to a community of 400 – 500 in campus.
  - Organised institute-wide quizzes, talks, group discussions and mentoring activities to promote interest in the fundamental sciences.
  - Introduced Scientific Computing Championship to promote interest in Numerical methods for scientific research, first ever conducted to this scale in campus.
  - Oversaw five times improvement in year-to-year participation in Summer of Science initiative, where the club matches senior students to mentor enthusiasts in an area of their interest. Work Report

Technical Skills

Programming Languages : C++, MATLAB

CAD and Scientific Packages : Eagle, Altium, SolidWorks, Cadence, Comsol, CST Microwave Studio

Other software : Atmel studio, Arduino, HTML, CSS, Latex, gnuradio, VHDL, Xilinx ISE

Extracurricular Activities

- Popular Talks-
  - *Control loops and PID algorithm* - Robotics club, IIT Bombay. Slides.
  - Particle Physics: *Small detectors, Big questions* - Maths and Physics Club. Slides.
- Completed a year-long course on playing the Keyboard.
- Participated in the Summer of Science initiative under an experienced senior mentor, on Cosmology under the Maths and Physics Club. Report
- Secured first prize in Electric Jhatka General Championship by the Electronics club, an institute-wide circuit design competition.

References

1. Prof. Pradeep Sarin
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   Indian Institute of Technology, Bombay
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2. Prof. Karthik Shankar
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   Postdoctoral Researcher
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4. Prof. Manobu Tanaka
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