Ashwin Sathish Kumar

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Education

Birla Institute of Technology & Science, Pilani — Rajasthan
Int. MSc.(Hons.) Mathematics and B.E.(Hons.) Electronics & Instrumentation — 2020 - 2025

- Bachelor's Thesis: *Conceptualization and Implementation of 5G Use-cases in a Virtual Network*
  Advisors: Prof. Axel Sikora (Hochschule Offenburg), Prof. Sandeep Joshi (BITS Pilani)

Chettinad Vidyashram — Chennai
High School Diploma: Mathematics, Computer Science — 2019 - 2020

Work Experience

Visiting Student | IfN, Technical University Braunschweig — Brunswick | **Jan 2025 - Present**

- Working on my **Master's thesis** titled - 'Development and Implementation of a Simulation Concept for Multi-User RIS-aided Communication' (Prof. Thomas Kürner) at the Institute for Communications Technology (IfN).
- Currently developing optimization techniques for **multi-user beamforming** at **THz** frequencies, using channel measurements obtained from the institute's ray tracer and system-level simulator - **SiMoNe**

Visiting Student | ivESK, Offenburg University of Applied Sciences — Offenburg | **Jul - Dec 2024**

- Developed a **REST API** framework at the Institute of Reliable Embedded Systems (ivESK) for virtual **5G** networks, implementing a containerized **testbed** to demonstrate eMBB, URLLC, and mMTC use-cases.

Teaching Assistant | Corporate Gurukul — Remote | **Jun - Sep 2022**

- Mentored a cohort of 40 participants for the **Artificial Intelligence for Young Achievers** program, in collaboration with **NTU Singapore** and Hewlett Packard Education **(HPE)**.

Research Intern | CSIR - Central Scientific Instruments Organization — Chandigarh | **May - Jul 2022**

- Interned at the Centre of Excellence for Intelligent Sensors & Systems (ISenS), working on **non-Euclidean geometry** and **graph embeddings**.
- Developed a hyperbolic geometry-based **recommendation algorithm** for a bookstore dataset.

Internship Trainee | Hewlett Packard Enterprises — Remote | **Jan - Apr 2022**

- Completed training in **Azure** Fundamentals and Applied Deep Learning, with focus on **NLP and computer vision**. Implemented an email spam detection algorithm using **transfer learning** models.

Conferences

- **A. S. Kumar** and S. Joshi, "LiDAR-Enabled Spatial Awareness for Beamforming in IRS-Assisted Wireless Communication System," *IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS)*, Guwahati, India, 2024, pp. 1-6, doi: 10.1109/ANTS63515.2024.10898544
- **A. Sathish Kumar**, D. Mahanta, P. Arora, "High-resolution aluminum-based plasmonic devices using metamaterials for cancer cell detection," Proc. SPIE PC12990, Metamaterials XIV (6 June 2024); https://doi.org/10.1117/12.3021474
- Muskan D., Ashwin S., Debajni M., Pankaj A. (October 2024) "Numerical Modelling of a Highly Sensitive Surface Plasmon Sensor using Silicon and Platinum Diselenide Stacks," **(Poster presentation)** *International Conference on Advances in Optics and Photonics Instrumentation (OPTOIn).*

Skills

Languages:	MATLAB, Python, C, C++, HTML/CSS, Verilog, Javascript
Frameworks:	Flask, Docker, Tensorflow, Scikit-learn
Softwares:	Microwind, LTspice, Simulink, Wireshark, COMSOL

Awards & Recognitions

1. **Baden-Württemberg Stipendium** | *BW Stiftung* **August 2024**

   Awarded a scholarship of €4,750 by the Baden-Württemberg state to conduct my bachelor's thesis in Germany; distinguished among 1,500 students worldwide.

2. **SSD Surge Hackathon Winner** | *Micron Technology, Hyderabad* **March 2024**

   Selected among 10 participants from BITS Pilani for the Memory Makers Workshop conducted at Micron Hyderabad and won the SSD Surge Hackathon.

3. **DADB Scholarship** | *German Academy of Digital Education (DADB)* **Jan 2024**

   Selected for a full scholarship to attend the winter university program at Offenburg University of Applied Sciences, Germany.

4. **INSPIRE Scholarship** | *Department of Science & Technology, India* **June 2021**

   Awarded an annual scholarship by the Government of India for ranking in the top 1% of CBSE Board examinations and top 6% in JEE Advanced.

Projects

Aerial IRS-assisted Wireless Communications
Jan - Jun 2024 | Dr. Sandeep Joshi (Dept. of EEE, BITS Pilani) | *UAV Communications*

- Implemented **Monte Carlo simulations** for aerial IRS-assisted system with Nakagami-m fading and Inverse Gamma shadowing, deriving closed-form **outage probability** expressions using moment matching and Gauss-Laguerre quadrature
- Optimized IRS phase shifts and analyzed system performance through outage probability comparison between random and optimized configurations across varying **SNR** and **spectral efficiency** thresholds

Photonic Crystal-based Biosensors using Si-PtSe2 Stacks
Jan-May 2024 | Dr. Pankaj Arora (Dept. of EEE, BITS Pilani) | *Optoelectronics*

- Designed a photonic crystal-based **surface plasmon resonance** sensor using silicon and platinum diselenide stacks, with Aluminium as the plasmonic metal for enhanced sensitivity and cost-effective fabrication. Simulated the multilayer structure using the **Fourier Modal Method** in MATLAB.
- Optimized layer thicknesses and stack count, achieving a sensitivity of **101.1°/RIU** and a Quality Factor of **1094.79** for angle interrogation in the **near-IR** spectrum (1550nm).

Intelligent Reflecting Surfaces with LiDAR-enabled Spatial Awareness for Beamforming
Jun-Dec 2023 | Dr. Sandeep Joshi (Dept. of EEE, BITS Pilani) | *5G Smart Environments*

- Developed a spatially-aware beamforming framework integrating **LiDAR** data with IRS systems, achieving a **10.5%** improvement in achievable rates through dynamic phase shift optimization in urban vehicular networks. Conducted IRS element **grouping strategy analysis** for 8×8 and 16×16 arrays, demonstrating superior performance over full-CSI models.
- Designed a novel phase shift optimization algorithm leveraging vectorized computation, resulting in **10x accelerated convergence** compared to benchmark studies.

Aluminum-based Plasmonic Sensor with Metamaterials for Cancer-cell Detection
Aug-Dec 2023 | Dr. Pankaj Arora (Dept. of EEE, BITS Pilani) | *Plasmonics & Biosensing*

- Engineered an Aluminum-based SPR sensor with a metal-dielectric-metal (MDM) configuration, incorporating BTO, **metamaterials**, TiO2, and MoS2 layers for enhanced cancer cell detection in the near-IR spectrum (1550nm).
- Simulated multilayer structures using FMM and transfer matrix methods in MATLAB, optimizing sensor performance and achieving sensitivity of **101.2°/RIU** and a figure of merit of **5060 RIU^{-1}** for detecting cervical, blood, adrenal, and breast cancer cells.

FDTD Modelling for Non-destructive Testing
Jan-May 2023 | Dr. Praveen Kumar AV (Dept. of EEE, BITS Pilani) | *Computational Electromagnetics*

- Conducted FDTD simulations on a 3D concrete-rebar structure, applying **staircase approximations** and **Mur's 2nd order** boundary conditions, and utilized **Fourier analysis** to study waveform delays and changes in magnitude and phase shifts for corrosion level analysis.

Hyperbolic Book Recommender System
May-Jul 2022 | Dr. Ritesh Kumar (Center for ISenS, CSIR-CSIO) | *Geometric Deep Learning*

- Implemented a recommender system using **Poincaré and graph factorization** embeddings on Library of Congress data, utilizing **TF-IDF** vectors of book descriptions for similarity scoring and genre hierarchies for edge creation
- Performed comparative analysis between 2D and 10D embeddings by training both genre-only and genre+description models, visualizing results using **t-SNE** dimensionality reduction

Course-level Projects

1. **Fuzzy Logic Controller for Automatic Voltage Regulator System** | *Control engineering*
   Designed and compared a fuzzy logic controller with conventional PID using Simulink to study performance improvements in an automatic voltage regulator system.

2. **Compressive Image Fusion** | *Signal Processing*
   Utilized the L1-magic toolbox on MATLAB to design and execute fusion in the compressive domain for infrared and visible images, achieving convergence on various sampling patterns (star, double star, and star-circle) at a M/N ratio of 0.52 with high reconstruction quality (log(PSNR) value of 3.8).

3. **Asynchronous Counter** | *Digital circuit design*
   Designed a 3-bit DFF ripple counter using static CMOS logic on Microwind. Used TSMC 180nm technology, achieving a layout area of $4.1um^2$ and power dissipation of 0.3mW.

4. **Sequence Detector Circuit** | *Digital logic design*
   Designed a sequential circuit using Verilog that detects the sequence '1110'. Also integrated overlapping sequence detection.

5. **Difference Amplifier using Telescopic Op-amps** | *Analog circuit design*
   Designed a telescopic opamp-based low power difference amplifier using LTspice. Optimized aspect ratios of each MOSFET, achieving a DC gain of 100dB, unity gain bandwidth (UGB) of 6.15MHz, and power consumption of 1.5μW.

6. **Email Spam Detection** | *Natural Language Processing*
   Implemented and deployed an end-to-end spam detection system on Azure, comparing Naive Bayes, BERT-based transfer learning, and a DNN; showcasing an accuracy of 98.44% with transfer learning.

Certifications

1. **Industrial IoT & 5G** (5 ECTS credits) – Issued by Hochschule Offenburg, January 2024
2. **5G Technology** – Issued by German Academy of Digital Education (DADB), October 2023
3. **Applied Deep Learning** – Issued by Hewlett Packard Education (HPE), April 2022.