

# ASHWIN SATHISH KUMAR

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## EDUCATION

### Birla Institute of Technology & Science, Pilani

Int. MSc.(Hons.) Mathematics and B.E.(Hons.) Electronics & Instrumentation

Rajasthan

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

High School Diploma: Mathematics, Computer Science

Chennai

2019 - 2020

## EXPERIENCE

### Visiting Student | Technische Universität 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' under Prof. Thomas Kürner.
- Currently performing literature study on **segmented RIS** for multiple-user scenarios to be implemented in **SiMoNe** (Simulator for Mobile Networks) at the Institute for Communications Technology.

### Visiting Student | Offenburg University of Applied Sciences

Offenburg | Jul - Dec 2024

- Implemented a Python **API framework** for virtualized 5G networks using **Open5GS** and **UERANSIM**. Integrated a containerized infrastructure with programmatic control over **network slice** configurations and automated **KPI monitoring**.
- Developed 3 concurrent use-cases: an **eMBB video streaming** service with dynamic quality adaptation, a **URLLC remote surgery** simulator achieving sub-millisecond latency requirements through Locust-based load testing, and an **mMTC sensor network** supporting multiple concurrent UE connections with differentiated QoS requirements.

### Teaching Assistant | Corporate Gurukul

Singapore (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**).

### Internship Trainee | CSIR - Central Scientific Instruments Organization

Chandigarh | May - Jul 2022

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

## CONFERENCES

- **Ashwin S.**, Sandeep J. "LiDAR-Enabled Spatial Awareness for Beamforming in IRS-Assisted Wireless Communication System", *IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS)*, 2024 [In press].
- **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., Debajani M., Pankaj A. (October 2024) "Numerical Modelling of a Highly Sensitive Surface Plasmon Sensor using Silicon and Platinum Diselenide Stacks," *International Conference on Advances in Optics and Photonics Instrumentation (OPTOIn)* [In press].

## SKILLS

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

## AWARDS & RECOGNITIONS

- 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.
- 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.
- 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.
- 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-PtSe<sub>2</sub> 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**, TiO<sub>2</sub>, and MoS<sub>2</sub> 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<sup>-1</sup>** 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

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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  $4.1\mu m^2$  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  $1.5\mu W$ .
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

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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.