

# Ashwin Sathish Kumar

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## EDUCATION

### BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

Integrated M.Sc Mathematics + B.E. Electronics & Instrumentation  
Aug 2020 - Jun 2025 (Exp.)

## THESES

1. **Development and Implementation of a Simulation Concept for Multi-User RIS-aided Communication** | Master's Thesis, May 2025  
Prof. Thomas Kürner (TU Braunschweig), Prof. Ashish Tiwari (BITS Pilani)
2. **Conceptualization and Implementation of 5G Use-cases in a Virtual Network** | Bachelor's Thesis, Dec 2024  
Prof. Axel Sikora (Hochschule Offenburg), Prof. Sandeep Joshi (BITS Pilani)

## RESEARCH

### MULTI-USER RIS OPTIMIZATION | MATLAB, C#

- Designed a 300 GHz multi-user RIS optimization framework in SiMoNe with constrained optimization to enhance directive gains. Implemented bilinear interpolation for estimating path gains using a codebook of directive gains for 65,341-point spatial locations. Achieved an angular resolution of 5° and support for 5 concurrent users, for computationally efficient performance in NLoS conditions.

### VIRTUAL 5G TESTBEDS | FLASK, DOCKER, WIRESHARK

- Developed a containerized 5G testbed using Open5GS and UERANSIM. Implemented a REST API for slice configuration control and a UE-UPF gateway for tunnel transmission. Demonstrated eMBB-based 4K streaming (Bitrate - 4.19 Mbps), URLLC-based remote surgery using Locust load testing (Avg latency - 9.32ms), and mMTC-based sensor network (6 UEs: Avg throughput - 165 Kbps).

### LIDAR-ENABLED RIS SYSTEMS | PYTHON

- Developed a novel spatially-aware beamforming model integrating LiDAR data with RIS systems, achieving ~ 10.5% improvement in signal rates. Demonstrated enhanced performance of grouped RIS arrays over full-CSI models and a phase shift optimization algorithm with 10x faster convergence than benchmarks.

### PHOTONIC CRYSTAL SPR SENSORS | MATLAB, COMSOL

- Designed Si-PtSe<sub>2</sub> stacked photonic crystal-based SPR sensor with Aluminium as the plasmonic metal; using Fourier Modal Method for simulations and COMSOL Wave Optics module for field confinement analysis. Achieved 101.1%/RIU sensitivity and 1094.79 Quality Factor, in the near-IR spectrum (1550nm).

### METAMATERIAL-ENHANCED BIOSENSORS | MATLAB

- Engineered an aluminum-based SPR sensor with MDM configuration using BTO, metamaterials, TiO<sub>2</sub>, and MoS<sub>2</sub> layers for cancer cell detection. Achieved 101.2%/RIU sensitivity and 5060 RIU<sup>-1</sup> figure of merit, exceeding benchmark results by a factor of 50 in the near-IR spectrum (1550 nm).

## EXPERIENCE

### VISITING STUDENT

TU Braunschweig

Jan - May 2025

Conducted my master's thesis on a multi-user RIS beamforming framework at THz frequencies, for the SiMoNe ray tracer.

### VISITING STUDENT

Hochschule Offenburg

Jul - Dec 2024

Conducted my bachelor's thesis on software defined networking (SDN) for virtual 5G testbed development using Open5GS and UERANSIM.

### TEACHING ASSISTANT

Corporate Gurukul

Jun - Sep 2022

Mentored a cohort of 40 participants for the 'AI for Young Achievers' program, in association with faculty from NTU Singapore.

### RESEARCH INTERN

CSIR-CSIO Chandigarh

May - Jul 2022

Worked on non-Euclidean models and developed hyperbolic geometry-based recommendation algorithms at the Centre for ISenS.

## CONFERENCES

1. **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

2. **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>

3. M. Deori, **A. Sathish Kumar**, D. Mahanta, P. Arora (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

MATLAB • Python • C# • COMSOL • Simulink  
• LTspice • Microwind • TensorFlow • C/C++ •  
HTML/CSS • JavaScript • AutoCAD

## PROJECTS

### AERIAL IRS SYSTEMS | TELECOMMUNICATIONS

- Derived closed-form outage probability expressions for an aerial IRS system simulated on **MATLAB**, with Nakagami-m fading and Inverse Gamma shadowing using moment matching and Gauss-Laguerre quadrature for optimized phase shifts.

### COMPRESSIVE IMAGE FUSION | IMAGE 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).

### FUZZY LOGIC CONTROLLER FOR AVR | CONTROL SYSTEMS

- Designed and compared a fuzzy logic controller with conventional PID, using **Simulink**, to study performance improvements in an automatic voltage regulator (AVR) system.

### FDTD MODELLING | COMPUTATIONAL ELECTROMAGNETICS

- Implemented 3D FDTD simulation on **MATLAB** with staircase approximations and Mur's 2nd order boundary conditions for concrete-rebar structures. Analyzed corrosion levels using UWB pulse excitation and Fourier-based propagation delay estimation.

### ASYNCHRONOUS COUNTER | VLSI DESIGN

- Designed a 3-bit DFF ripple counter using static CMOS logic on **Microwind**. Used TSMC 180nm technology, achieving a layout area of  $4.1\mu\text{m}^2$  and power dissipation of 0.3mW.

### DIFFERENCE AMPLIFIER | ANALOG 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  $1.5\mu\text{W}$ .

### HYPERBOLIC RECOMMENDER SYSTEM | GEOMETRIC DL

- Developed a book recommender system (**Python**) using Poincaré embeddings and TF-IDF vectors on Library of Congress data. Utilized t-SNE for dimensionality reduction to visualize genre hierarchies and compared genre-only vs. genre+description-based recommendations.

### EMAIL SPAM DETECTION | MACHINE LEARNING (NLP)

- Implemented a spam detection algorithm using **Python** and deployed it on **Azure**. Compared Naive Bayes, BERT-based transfer learning, and a deep neural network; showcasing an accuracy of 98.44% with the transfer learning model.

## AWARDS

### 1. Baden Württemberg Stipendium

BW-Stiftung, Germany

Aug 2024

Awarded €4,750 to conduct bachelor's thesis; distinguished among 1500 students worldwide.

### 2. SSD Surge Hackathon Winner

Micron Technology, Hyderabad

Mar 2024

Selected as one of 10 university participants for the Memory Makers Workshop and won the SSD Surge Hackathon.

### 3. DADB Scholarship

German Academy of Digital Education

Jan 2024

Full scholarship for the winter university program on IIoT & 5G at Hochschule Offenburg.

### 4. INSPIRE Scholarship

Dept. of Science & Technology, India

Jun 2021

Annual scholarship for ranking in top 1% of CBSE Class XII exams and top 6% in JEE Advanced.

## CERTIFICATIONS

### Industrial IoT & 5G (2024)

5 ECTS credits | Hochschule Offenburg

### 5G Technology (2023)

DADB (German Academy of Digital Education) & BITS Pilani

### Applied Deep Learning (2022)

Hewlett Packard Enterprise (HPE)

## RELEVANT COURSES

Digital Signal Processing	GPA: 10/10
Applied Statistical Methods	GPA: 10/10
Engineering Graphics	GPA: 10/10
Instrumentation Technology	GPA: 10/10
Transducers & Measurement Tech.	GPA: 9/10
Statistical Inference & Applications	GPA: 9/10
Numerical Analysis	GPA: 9/10
Game Theory & its Applications	GPA: 9/10
Mathematical Methods	GPA: 9/10
General Biology	GPA: 9/10

## LANGUAGES

English (Fluent) • Tamil (Fluent) • Hindi (Fluent)  
• Telugu (Conversational)