Ashwin Sathish Kumar

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EDUCATION

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
Integrated M.Sc Mathematics + B.E. Electronics & Instrumentation
August 2020 - June 2025 (Exp.)

THESES

1. Development and Implementation of a Simulation Concept for Multi-User RIS-aided Communication | Master's Thesis [Ongoing]
   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

VIRTUAL 5G TESTBEDS | Flask, Docker

- Developed a containerized 5G testbed using Open5GS and UERANSIM with a REST API for slice configuration control. Demonstrated eMBB streaming, URLLC remote surgery, and mMTC sensor network applications.

LIDAR-ENABLED IRS SYSTEMS | Python

- Developed a novel spatially-aware beamforming model integrating LiDAR data with IRS systems, achieving a 10.5% improvement in signal rates. Demonstrated superior 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-$PtSe_2$ 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_2, and MoS_2 layers for cancer detection, achieving 101.2°/RIU sensitivity and 5060 RIU^{-1} figure of merit in the near-IR spectrum (1550nm).

FDTD MODELLING FOR CORROSION ANALYSIS | MATLAB

- Implemented 3D FDTD simulation 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.

HYPERBOLIC BOOK RECOMMENDER SYSTEM | Python

- Developed a recommender system using Poincaré embeddings and TF-IDF vectors on Library of Congress data, comparing 2D/10D embeddings with t-SNE visualization of genre hierarchies.

EXPERIENCE

VISITING STUDENT

TU Braunschweig Jan 2025 - Present

Conducting my master's thesis on multi-user beamforming optimization at THz frequencies for the SiMoNe ray tracer (C#, MATLAB).

VISITING STUDENT

Hochschule Offenburg Jul - Dec 2024

Conducted bachelor's thesis research on software defined networking (SDN) for virtual 5G testbed development.

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

Trained in non-Euclidean geometry 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 • COMSOL • Simulink • Verilog • LTspice • Microwind • TensorFlow • C# • C/C++ • 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.

ULTRASONIC RADAR SYSTEM | Embedded Systems

- Designed a radar system using ultrasonic sensors, a DC servo motor, and an **Arduino** microcontroller for object detection and spatial mapping. Implemented precise angular positioning for the sweeping mechanism and a Processing-based GUI for visualization.

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 $4.1\mu m^2$ and power dissipation of 0.3mW.

SEQUENCE DETECTOR CIRCUIT | Digital Design

- Designed a sequential circuit using **Verilog** that detects the sequence '1110'. Also integrated overlapping sequence detection.

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 $1.5\mu W$.

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 my 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 Enterprises

RELEVANT COURSES

Applied Statistical Methods	GPA: 10/10
Digital Signal Processing	GPA: 10/10
Engineering Graphics	GPA: 10/10
Instrumentation Technology	GPA: 10/10
Statistical Inference & Applications	GPA: 9/10
Numerical Analysis	GPA: 9/10
Game Theory & its Applications	GPA: 9/10

LANGUAGES

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