

Ullas Shivaprakash

 +44 7442625595 | +91 9538610574

 ellas30101996@gmail.com

 <https://www.linkedin.com/in/ullas-shivaprakash>,  <https://scholar.google.com/citations?hl=en&user=G-8QMRYAAAAJ>,  <https://orcid.org/0000-0002-9000-3234>.

Visa Status: Citizen of India, residing currently in the UK on a Student (Tier 4) visa and transitioning to Global Talent Visa (without need of employer assistance). **No sponsorship required in the UK and India.**

Professional Summary

Academic Research Data Scientist and Machine Learning Engineer with a strong **interdisciplinary focus** on developing first-of-its-kind, end-to-end data pipelines and interpretable machine-learning models for complex, interconnected systems. Developed machine-learning-based predictive models for coupled buried infrastructure (pavements–soils–pipelines), enabling stakeholders to forecast failure, plan proactive maintenance, and reduce lifecycle maintenance costs under **data-scarce conditions**. Brings 3+ years of industrial experience as a Software Engineer in the automotive sector, delivering **safety-critical diagnostic and communication software**, CI/CD pipelines, and production-grade embedded system solutions. Experienced in **synthetic data generation**, feature engineering, prompt engineering, and machine-learning model development, and leverages large language models (LLMs) to optimise coding, debugging, and implementation. Motivated to solve real-world, interdisciplinary forecasting and prediction problems where data is limited.

Skills Summary

- 1. Machine Learning & Computational Modelling:** Scikit-learn, XG Boost, TensorFlow, Deep Neural Networks (DNNs), Supervised Learning, Feature Engineering, Exploratory Data Analysis (EDA), Monte Carlo Simulation, Synthetic Data Generation (**Synthetic Data Vault – SDV**), NumPy, Pandas, SciPy
 - 2. Programming & Scripting Languages:** Python, MATLAB, SQL, Embedded C, C, CAPL
 - 3. Data Visualisation & Analytics:** Matplotlib, Seaborn, Power BI, Tableau
 - 4. Data Pipelines, MLOps & DevOps:** End-to-End Data Pipeline Development, Modular ML Pipelines, Experiment Tracking, Reproducible ML Workflows, Jenkins (CI/CD), GitHub, Google Cloud Platform (GCP)
 - 5. AI-Assisted Development:** Prompt Engineering, LLM-Assisted Code Optimisation, Debugging, Refactoring, Rapid Prototyping
 - 6. Embedded Systems & Hardware Platforms:** LabVIEW, Arduino, Raspberry Pi, ARM Cortex, MSP430, FPGA, Off-the-Shelf Sensor Integration
 - 7. Automotive & Communication Protocols:** Classic AUTOSAR, CAN, CAN FD, FlexRay, OBD, UDS
 - 8. Testing, Validation & Debugging:** HIL, SIL, JTAG, CAPL, LabVIEW, DSMSIM, Manual & Automated Testing, Simulation Environments
 - 9. Requirements & Project Management Tools:** IBM Rational DOORS, Agile, ALM
 - 10. Operating Systems:** Windows, Linux
 - 11. Soft Skills:** Research & Analytical Thinking, Teaching & Mentoring, Technical Communication, Stakeholder Collaboration, Project & Workflow Management, Cross-Disciplinary Collaboration, Problem Solving, Decision Support & Advisory
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Professional Experience

- **Postgraduate Researcher – Machine Learning and Data Science for Infrastructure Monitoring (Full-Time) | National Buried Infrastructure Facility, University of Birmingham, UK | May 2022 – Present**
- Identified critical research gaps caused by siloed modelling of pavements, subgrade soils, and buried pipelines, leading to the development of an integrated system-of-systems infrastructure framework.
 - Designed a **physics-guided, diagnostic-first, prediction-second methodology** that balances predictive accuracy with engineering interpretability for safety-critical infrastructure assessment.
 - Defined controlled comparative case studies (clayey vs sandy subgrades) with identical pavement structure, pipeline properties, traffic loading, and environmental conditions to isolate soil-driven system behaviour.
 - Selected physically meaningful, literature-supported parameters spanning pavement deterioration, soil hydro-mechanical response, pipeline stresses, and external environmental loading, and mapped them to consistent performance states (Ideal, Serviceable, Failed).

- **Designed and implemented an end-to-end data pipeline** covering literature ingestion, parameter curation, evidence-driven synthetic data generation, state encoding, exploratory analysis, modelling, and explainability.
- Generated large-scale **evidence-based synthetic datasets** using **Synthetic Data Vault (SDV)** and literature-constrained Monte Carlo simulation, preserving realistic distributions, cross-parameter dependencies, and physical constraints.
- Implemented progressive coupling regimes, from independent subsystems to feedback-driven interaction collapse, explicitly encoding causal and feedback mechanisms between pavement, soil, and pipeline systems.
- **Performed exploratory data analysis and feature engineering jointly**, including numerical validation, physical bounds checking, descriptive statistics, correlation analysis, multicollinearity assessment (VIF), and diagnostic PCA to understand variance organisation and interaction regimes while retaining interpretability.
- Engineered subsystem- and system-level features using conservative maximum-rule aggregation, with a weighted-sum alternative introduced as a sensitivity analysis to test robustness under serviceability-oriented assumptions.
- **Developed, trained, and evaluated machine-learning models** using widely adopted algorithms (Random Forest, XGBoost), applying Recursive Feature Elimination (RFE) and VIF screening to derive compact, physics-informed feature sets.
- Built imbalance-aware predictive models with strict separation of training, tuning, and testing datasets, evaluating performance using balanced accuracy, macro F1-score, and failure recall to prioritise safety-critical degradation detection.
- Applied SHAP-based explainability, benchmarking, sensitivity analysis, and subsystem ablation to confirm physically consistent decision logic and dependence on system-level integration rather than isolated features.
- Leveraged **large language models (LLMs)** to accelerate research software development, including code optimisation, debugging, refactoring, and documentation, enabling faster and more reliable implementation of complex simulation-to-ML workflows.
- Managed **version-controlled data and ML pipelines using GitHub**, applying MLOps practices such as modular pipeline design, experiment tracking, configuration control, and reproducible model training and evaluation.
- Delivered a **fully integrated, interpretable, and defensible ML framework** for coupled pavement–soil–pipeline infrastructure assessment under realistic uncertainty and class imbalance.
- Disseminated research outcomes through publications in peer-reviewed, high-quality journals and international conferences, contributing to academic knowledge and industry-relevant best practices.

Impact: *This research delivered a first-of-its-kind integrated predictive decision-support framework that jointly models pavements, subgrade soils, and buried pipelines as a coupled infrastructure system rather than isolated assets. The framework enables infrastructure owners and asset-management organisations to understand cross-asset failure mechanisms, forecast degradation earlier, and plan coordinated preventative and proactive maintenance interventions. By shifting decision-making from reactive, single-asset repairs to system-level risk-informed planning, the approach demonstrates strong potential to reduce unplanned maintenance and emergency repair costs significantly, while improving service reliability, resilience, and long-term infrastructure performance.*

➤ **Postgraduate Teaching Assistant – School of Engineering (Part-Time) | University of Birmingham, UK | May 2022 – Present**

- Delivered tutorials, lab sessions, and technical guidance across 6+ engineering modules, including IoT, Fluid Mechanics and Energy Transfer, Engineering Maths 1 and Digital Electronics, and Embedded C Programming.
- Mentored undergraduate and master's students in engineering design, technical writing, and research communication.
- Supported hands-on learning by aligning practical labs with core theory in embedded systems, electronics, and IoT applications.
- Promoted inclusive, interdisciplinary learning by contextualizing engineering concepts within smart infrastructure and environmental monitoring use cases.
- **Recognized as an inclusive educator with a HEFi (Higher Education Futures Institute) teaching award** from the University of Birmingham.
- Contributed to assessment design, grading, and feedback, improving academic performance and student engagement.
- Collaborated with academic staff to enhance module content and delivery through reflective teaching practices and peer feedback.
- Encouraged student-led innovation and provided ongoing academic and career mentorship across diverse student groups.

Impact: *Enhanced inclusive student understanding, engagement, and technical confidence by connecting theory with practical, real-world engineering applications, contributing to improved learning outcomes and stronger preparation for industry and research careers.*

➤ **Software Engineer – Diagnostic Event Management for Active Safety ECUs (Full-Time) | Bosch Global Software Solutions Pvt. Ltd, Bangalore, India | September 2020 – April 2022**

- Worked on customer-specific Suzuki projects for Active Vehicle Safety (ABS, ESP) and Hybrid Electric Vehicles (HevX), focusing on diagnostics and event management in safety-critical ECUs.
- Specialized in **OBD (On-Board Diagnostics)** and **UDS (Unified Diagnostic Services)** protocol development and validation within Classic AUTOSAR architecture.
- Configured and tested Diagnostic Communication Manager (DCM) modules using Embedded C, defining DTCs, fault memory handling, and failure message mapping.
- Led software development across the full SDLC – Requirements, Design, Coding, Testing (RDCT) – ensuring compliance with Bosch's CMMI Level 5 quality standards.
- Conducted HIL (Hardware-in-the-Loop) and SIL (Software-in-the-Loop) testing across various automotive ECUs, improving software robustness in real-world conditions.
- Performed JTAG-based debugging and testing to validate signal behaviour and track faults at the hardware-software interface level.
- Automated ECU test benches using CAPL and LabVIEW; implemented CI/CD pipelines with Jenkins, reducing regression testing time by 40%.
- Programmed and validated automotive communication protocols including CAN, CAN FD, and Flex Ray, ensuring reliable and secure in-vehicle networking.
- Queried, managed, and analysed structured diagnostic datasets using SQL** to support debugging, event logging, and system validation.
- Interpreted and implemented OEM-specific requirements, ensuring system integration and compliance with diagnostics and safety standards.
- Coordinated with cross-functional teams and OEM stakeholders for debugging, requirement clarifications, and feature implementation.

Impact: Improved robustness, reliability, and validation efficiency of safety-critical automotive ECUs, reducing testing cycles and enabling timely delivery of compliant diagnostic software for production vehicles.

➤ **Project Trainee – CAN bus configuration management for Active Safety ECUs (Full-Time) | Robert Bosch Engineering and Business Solutions Pvt. Ltd, India | July 2019 – May 2020**

- Contributed to Suzuki projects focused on Active Safety Systems (ABS, ESP) and Hybrid Electric Vehicles (HevX) for a leading Japanese OEM.
- Configured **CAN, CAN FD, and Flex Ray communication layers** compliant with **Classic AUTOSAR standards**, ensuring robust in-vehicle communication.
- Worked on **customer-specific implementations** of the **COM** and **SCL** layers of the CAN protocol stack, enabling seamless diagnostic and control messaging between ECUs.
- Participated across the Software Development Life Cycle (SDLC – RDCT), covering requirement analysis, software design, coding, and validation.
- Performed manual, **HIL, SIL**, and simulation-based testing to validate ECU behaviour under realistic vehicle scenarios.
- Developed **CAPL** and **LabVIEW** scripts to automate testing workflows and monitor signal integrity across communication stacks.
- Verified signal routing and diagnostics across **AUTOSAR** layers, improving consistency and compliance with OEM specifications.
- Delivered key test and communication optimizations that improved diagnostic accuracy and reduced development cycle time by 15%.

Impact: Contributed to improved communication reliability and diagnostic consistency in active safety ECUs, reducing validation effort and supporting smoother system integration.

➤ **Project Intern – Combat & Engine Systems Modelling (Full-Time) | Mission and Combat System Research and Development Centre (MCSRDC), Hindustan Aeronautics Limited (HAL), Bengaluru, India | January 2017**

- Gained practical exposure to advanced aerospace systems including aircraft combat and engine controls in a mission-critical R&D environment.
- Programmed and simulated embedded components related to fuel regulation and combat systems, engaging with real-world electro-mechanical interface scenarios.
- Acquired working knowledge of control systems architecture used in aircraft, contributing to a deeper understanding of complex integrated defence technologies.

Impact: Built early expertise in high reliability embedded and control systems, forming a strong foundation for later work in automotive safety and infrastructure monitoring.

Education

1. **PhD in Machine Learning and Data Science for Infrastructure Monitoring** | National Buried Infrastructure Facility, University of Birmingham, UK | May 2022 – Present
 2. **M. Tech in VLSI Design & Embedded Systems** | Visvesvaraya Technological University, India | October 2018 – August 2020 | GPA: 4.0
 3. **B.E. in Electronics & Communication Engineering** | Visvesvaraya Technological University, India | September 2014 – June 2018 | GPA: 3.7
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Volunteering Experience

- **Postgraduate Researchers' Representative** | School of Engineering, University of Birmingham | September 2024 – Present
- Served as the **student voice for PhD and postgraduate researchers**, representing academic, research, and wellbeing concerns to the School of Engineering.
 - Supported communication between researchers and school leadership and helped organise interdisciplinary research events and symposiums.
- **Workshop Coordinator – Communication & Leadership in Volunteering** | University of Birmingham | June 2025
- Designed and delivered an interactive workshop on communication, leadership, and professional development for undergraduate and master's students.
 - Coordinated with academic staff and industry speakers to promote technical outreach, volunteering, and inclusive STEM participation.
 - Mentored students on career development and effective engagement in volunteering activities.
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Mini Projects

Smart Water Irrigation System | Undergraduate Final Year Project | VTU | 2018

- Built an IoT-enabled irrigation system with leak detection, soil moisture sensors, and a cloud-based dashboard using ESP8266 and Raspberry Pi.
 - Enabled real-time monitoring and automated control of water distribution, reducing wastage and promoting sustainable agriculture practices.
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Achievements

- **Best Poster Award** – IEEE UK & Ireland Symposium (2023)
 - **Second Rank** – M. Tech VLSI & Embedded Systems (2020)
 - **Second Prize** – Smart Water Irrigation System (UG Final Year Project)
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Publications

1. Ghosh, R., Pragathi, R., **Ullas, S.** and Borra, S., 2017. *Intelligent Transport System*. In: Proceedings of the Second International Conference on Circuits, Controls, and Communications (IEEE). [online] IEEE. **Citations:** 18.
2. **Ullas, S.** and Kumari, N., 2020. CAN configuration management for electric vehicles using AUTOSAR and OEM-architectures. *International Journal of Creative Research Thoughts (IJCRT)*, Volume 8, Issue 7, July 2020 | ISSN: 2320-2882.
3. Shreyas, R.Y., **Ullas, S.**, Pragathi, R. and Ghosh, R., 2018. Embedded IoT based water supply distribution system for suburban area: A survey. *International Journal of Latest Engineering and Management Research (IJLEMR)*, Volume 03, Issue 03, PP. 42-47
4. **Ullas, S.**, Ghosh, R., Shreyas, R.Y. and Pragathi, R., 2018. Real-time accident and breakdown alerting systems: A survey. *International Journal of Latest Engineering and Management Research (IJLEMR)*, Volume 03, Issue 03, PP. 48-55