

# Joseph V. Azrak

<https://www.josephazrak.com>

## Education

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- **The University of Edinburgh and Heriot-Watt University** Edinburgh, UK  
PhD in Sensing, Processing, and AI Systems (industry partnership with STMicroelectronics R&D) 2024 – present
- **The University of Edinburgh** Edinburgh, UK  
Master's degree, Electrical & Electronic Engineering 2021 – 2025

## Research

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### ▪ PhD Research: ML Model Monitoring in Production Environments

Investigating techniques for monitoring CNN performance in semiconductor manufacturing where ground truth is unavailable and concept drift is inevitable. Core challenge: static models deployed in chaotic, evolving production environments. How do we detect failure modes, emerging defect classes, retraining needs without labelled data?

#### Current research directions include...

- Using mechanistic interpretability and representation theory to derive drift metrics from internal model activations
- Exploring statistical process control and changepoint detection on learned representations, developing watchdog architectures that co-evolve with the supervised model to better detect out-of-distribution data
- Investigating self-supervised learning techniques to produce features more amenable to production monitoring

## Industry Experience

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- **STMicroelectronics R&D** Edinburgh, UK  
Master's Thesis: CNN Performance Monitoring Summer 2024 – 2025  
  
Developed ML observability techniques for a computer vision based defect classifier in semiconductor manufacturing. Designed GAN-based out-of-distribution detection using internal activation patterns. Built validation framework using synthetic drift injection to quantify detection thresholds. This work identified the core research gap now driving my PhD.
- **Celestia Technologies Group** Edinburgh, UK  
Engineering Intern Summer 2023 – January 2024  
  
Developed real-time monitoring systems for phased-array antenna control. Built Python/Qt GUIs for production system observability. Programmed embedded firmware in C++ for ARM Cortex-M processors. Worked in interdisciplinary hardware/software team to ship production telemetry tools.

## Technical Leadership

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- **Endeavour Rockets** Edinburgh, UK  
Avionics Software Lead 2022 – 2024  
  
Led 5-person team developing flight computer software for supersonic sounding rocket. Designed real-time telemetry system with Grafana-based mission control. Shipped safety-critical C++ firmware for embedded Linux stack with GPS, IMU, and radio integration.

## Skills

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- **ML & Research:** Deep learning theory and implementation (PyTorch, JAX); interpretability techniques; statistical signal processing; large-scale data analysis (pandas, numpy, scipy)
- **Systems Engineering:** Embedded systems (C/C++, ARM); PCB design (Altium); FPGA/Verilog; communication protocols; real-time telemetry systems
- **Programming:** Python, C/C++, Verilog, SQL, web