

# TEYMOOR ALI

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🌐 Teymoor-Ali

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📍 Edinburgh

## EDUCATION

Master of Engineering in Software Engineering

Heriot-Watt University

Doctor of Philosophy in Computing Science

University of Stirling

- Domain-Specific Optimisations for Image Processing Algorithms on Heterogeneous Architectures.

## WORK EXPERIENCE

Research Associate

University of Strathclyde, Glasgow [📄](#)

🔗 C/C++ Python Pytorch HyperSpectral FPGA Edge Computing

📅 Sep 2024 – Current

- **Research Aim:** To develop a novel HSI image processing algorithms for various industrial projects.
- **Objective 1:** The acquisition and analysis of HSI data covering a diverse range of applications.
- **Objective 2:** To research and develop novel algorithms and methods for the processing and analysis of spectral data, mainly HSI but also including conventional spectroscopy (e.g., LIBS, Raman) as well as regular image and video data.
- **Objective 3:** The development of tailored software tools in which novel data processing algorithms and methods will be embedded, to facilitate their deployment and evaluation by industrial partners.

Research Associate (Collaborative Proj.)

Newcastle University, Newcastle [📄](#)

🔗 C/C++ Python Pytorch TinyML Object Detection Classification

📅 Mar 2024 – Jul 2024

- **Research Aim:** To develop a novel AI-enabled pest surveillance system using computer vision on an embedded device. (Collaborative KTP: Spotta)
- **Objective 1:** Development of novel object detection and segmentation algorithms to identify a particular set of insects affecting vegetation.
- **Objective 2:** Design and deployment of algorithms on low power/resource micro-controllers (STM32 & RpiZero 2W). In addition, applying optimisations to decrease runtime and energy consumption
- **Objective 3:** Presented results and prototype to various stakeholders within the project.

PhD Research Scientist

STMicroelectronics, Edinburgh [📄](#)

🔗 C/C++ Python VHDL/Verilog CUDA MATLAB Pytorch Simulink

📅 Oct 2019 – Feb 2024

- Image-Signal Processing Pipeline:
  - Performance modelling, workload analysis of real-time image processing / Machine Learning algorithms on Xilinx FPGAs/CPU/GPU/TPU.
  - Developing optimisations techniques (e.g., quantization, pruning, downsampling) to understand the trade-offs in image/classification accuracy, energy, and run-time.
  - Benchmarking and analysing performance bottlenecks for AI/ML algorithms on various hardware architectures for training and inference.
- Image Sensor Characterisation: Development of CMOS image sensor characterisation algorithms (E.g. Sum-Squared, Median Replacement) on FPGAs.
- Heterogeneous Platform Design:
  - Design and Development of a low/high power heterogeneous platforms consisting of [CPU/GPU/FPGA] via PCIe DMA for the aim of power/latency efficient edge-AI computation.
  - Exploring and developing imaging algorithms using Xilinx HLS / MATLAB SIMULINK to target FPGAs
  - Developed imaging systems using various acquisition protocols, MIPI CSI-2, USB, FMC Camera.
  - Heterogeneous Algorithms: Designed of various HW/SW computer vision algorithms (MobilenetV2 & Resnet18), by partitioning each layer on the best performing accelerator (CPU/GPU/FPGA).

Research Associate

Newcastle University, Newcastle [📄](#)

🔗 C/C++ CUDA Python Vitis HLS Pytorch OpenMPI OpenCL

📅 Aug 2022 – Jan 2023

- **Research Aim:** To investigate whether the use of heterogeneous architecture in high performance computing systems can significantly reduce energy consumption in UKRI HPC digital research infrastructures, and to identify best practices for monitoring and comparing energy usage across architectures.
- **Objective 1:** Conducted a thorough analysis of algorithms executed on HPCs and Berkeley Dwarves to capture a pattern of computations and communication. Algorithms include: S-DGEMM, FFT, CNN's, STREAM
- **Objective 2:** Ported and executed selected algorithms on heterogeneous platforms (CPU, GPU, Embedded Systems & FPGA), including the development of a new framework and tools for energy measurement. Tools: Energy analyser/data-logger

- **Objective 3:** Presented findings at a conference workshop and disseminate results to stakeholders, including users, vendors, and policymakers, with recommendations for best practices in energy monitoring and comparable metrics across systems.

### Research Scientist (Short Proj.)

PicoJar, Stirling 

 Python Pytorch Tensorflow OpenCV NLTK

 Feb 2021 – Apr 2021

- **Project Background:** Picojar is a mobile application that allows users to capture, and organise screenshots of interest and automatically converts them into text. The aim is to produce a prototype that would extract meaningful text and data using CV and NLP algorithms to enable the user to organise screenshots into defined groups.
- **Prototype Development:** A topic model (LDA) is trained using data obtained from publicly available freetext datasets. A lexicon-based approach was used to analyse the sentiment present in the text. A score of positive and negative words is obtained and then normalised based on the word-count of the text analysed in each screenshot. A template matching approach is used to identify icons present in a screenshot. This information is then used to classify which social media platform is most likely present within the screenshot.

### Software Engineer

KAL ATM Software, Edinburgh 

 C# .NET C++ MongoDB TCP/IP SQL AR/VR Unity

 May 2016 – May 2019

- **Simulation Modelling:** Developed simulation software, for hardware components (E.g. Security Modules) inside ATM'S to test protocols, encryption and responses. Additionally, developed simulations to stress-test ATM software to measure network performance.
- **Product Component Database:** Developed of parts retrieval system, which enables users to scan a QR code found within a product and display all the components integrated within the system.
- **Augmented Reality:** Developed augmented reality software to aid engineers to identify various components found within an ATM machine.

## PROJECTS

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### ESPRC Rathlin Project

Image Processing

 CAL C

 orcc/orc-apps

Implemented various low-high level image processing algorithms using RVC-CAL domain-specific language (data-flow paradigm).

### Silicon Wafer Defect Detection

STMicroelectronics

 Python Clustering Pytorch Pandas Numpy sklearn Matplotlib

Integrated computer vision pipeline to automatically detect defects such as holes, scratches or marks found on silicon wafers using CNN/Clustering methods, compared to manually inspecting data.

## TEACHING

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[Undergraduate] Systems/Computer Architecture: Teaching Assistant

[Postgraduate] Deep Learning for Vision and NLP: Teaching Assistant

## ADDITIONAL SKILLS / TRAINING

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SPAD / Time of Flight Sensors

CMOS Image Sensor Characterisation

## PUBLICATIONS

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- Ali, T., Rainey, J., Lau, S., E. Gheorghiu, P. Maier, K. Appiah & Bhowmik, D. An FPGA-based neuromorphic vision system accelerator, SPIE: SPIE Sensors + Imaging (2024)
- Ali, T., Paul, G., Nicol, R. & Bhowmik, D. "Scheduling algorithms on heterogeneous architecture for efficient vision systems", Proc. SPIE 13137, Applications of Digital Image Processing XLVII, 131370F; <https://doi.org/10.1117/12.3031278>
- Kumar, H., Ali, T., Holder, C., McGough, S. & Bhowmik, D. Remote Sensing Classification using Quantum Image Processing, SPIE: Photonics for Quantum (2024)
- Ali, T., Bhowmik, D. & Nicol, R. Domain-Specific Optimisations for Image Processing on FPGAs. J Sign Process Syst 95, 1167–1179 (2023). <https://doi.org/10.1007/s11265-023-01888-2>
- Bane, M., Brown, O., Ali, T., Bhowmik, D., Quinn, J. and Stansby, D. (2023) ENERGETIC: Final Report v1.1. <https://doi.org/10.23634/MMU.00631226>
- Ali, T. et al., "Energy Aware CNN Deployment on Heterogeneous Architectures." in IEEE Transactions on Circuits and Systems for Video Technology (2024) [Revisions In Progress]

## REFERENCES

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Available on request