

Project Title: AI-Driven Design of Architected Structures with Tailored Mechanical Properties for Pressure Sensing

Project Description

Pressure sensing is a key enabling technology for intelligent systems, supporting applications in soft robotics, wearable healthcare, human-machine interfaces, industrial automation, and smart manufacturing. The performance of a pressure sensor is strongly influenced by the mechanical response of its internal structure. By carefully designing architected structures with tailored mechanical properties, it is possible to achieve enhanced sensitivity, a wider sensing range, improved durability, and application-specific performance that are difficult to realise using conventional sensor designs.

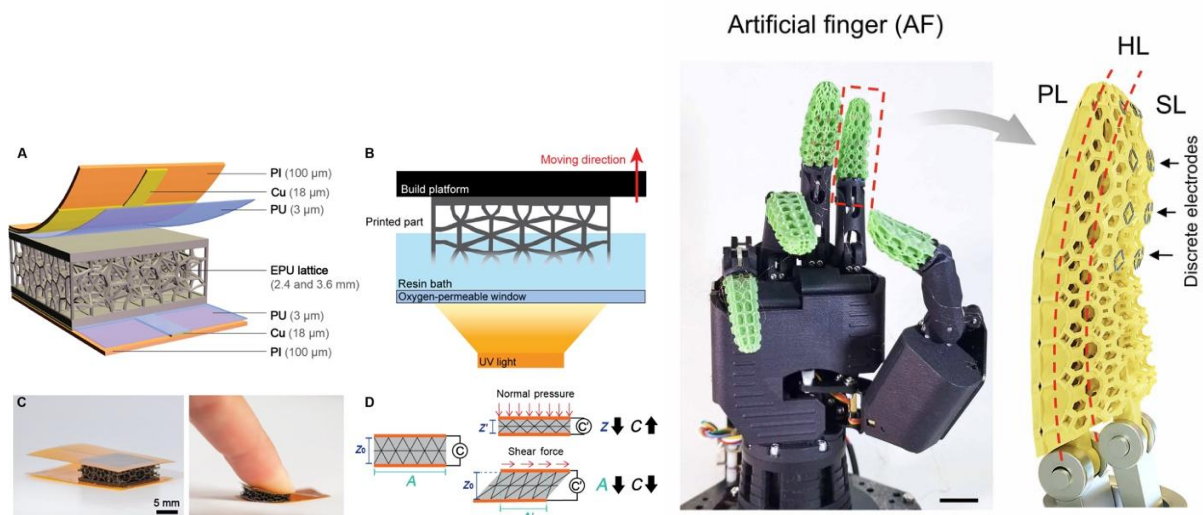


Fig 1 Example of Sensing Architected Structures (A. Berman et al, Science Advances 2024 Vol 10 No 40, F. Yang et al, Science 2026)

This project aims to develop an **AI-driven conceptual design framework** for architected structures with tailored mechanical properties for pressure sensing. The project focuses on the **digital design stage**, where artificial intelligence is used to automatically generate, evaluate, and optimise architected structures before fabrication. Rather than developing or manufacturing physical sensors, the project will investigate how AI can efficiently explore the large design space of architected structures and identify geometries that exhibit desirable mechanical behaviour for pressure sensing applications.

The project will integrate **generative AI, machine learning, topology optimisation, and finite element modelling** into a computational design workflow. AI models will be trained to predict the relationships between structural architecture, mechanical response, and sensing performance, enabling rapid inverse design of architected structures with targeted mechanical characteristics while considering additive manufacturing constraints.

The primary outcome of this project will be a library of optimised conceptual designs and an AI-assisted design methodology that can accelerate the development of next-generation pressure sensors. The proposed structures will be evaluated through numerical simulations to assess their mechanical performance and sensing potential.

Although **fabrication and experimental validation are beyond the scope of this project**, the optimised designs will provide a strong foundation for future research. Students undertaking this project will have the opportunity to extend their work by fabricating and experimentally testing the proposed pressure sensors using additive manufacturing technologies in subsequent honours, master's, or PhD research projects. This creates a clear pathway from AI-assisted conceptual design to physical prototyping and real-world applications.

The developed design framework has broad potential applications in tactile sensing for soft robotics, wearable electronics, electronic skin, intelligent human–machine interfaces, and smart manufacturing, while also establishing a general methodology for designing architected structures with application-specific mechanical properties.