MONASH University

MONASH ENGINEERING

Faculty of Engineering

ASPIRE Summer Research Program 2026-2027

Project Title: Low-carbon construction: lab-on-a-chip, deep learning and robotics.

Supervisor(s): Professor Wenhui Duan

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Objective

Offer a motivated student a summer research project at the interface of construction materials, structural engineering and construction. The student chooses ONE of four self-contained streams — matched to their interests and skills — and completes a focused 10-week study within Professor Duan's research group, supported by the group's ARC NetZero Hub and ARC Laureate Fellowship programs.

Project Details

The project bundles four research lines from the group; the student picks the one that best fits their interest and background. Each stream is a complete summer project on its own.

Stream 1 — Earthquake and structural dynamics, the inverse problem (OpenSeesPy): build a forward finite-element model of a simple frame under a recorded ground motion (e.g. El Centro), then recover its stiffness and damping from noisy response data by optimisation. Computational; underpins structural health monitoring.

Stream 2 — Lab on a chip for cement and biomaterial research: design, fabricate (PDMS soft lithography) and test a microfluidic device for one cement/biomaterial problem — additive screening, biopolymer-modified carbonation, or pore-solution ion transport — using optical microscopy and image analysis. Experimental.

Stream 3 — Physics-informed neural networks (PINN) for structural dynamics: train a neural network that enforces the equation of motion under earthquake excitation, for forward simulation and inverse identification of stiffness and damping. Computational / deep learning (PyTorch).

Stream 4 — Construction automation: robotics and structural dynamics: simulate a two-revolute (2R) robotic arm performing a placement task on a vibrating platform under ground motion, and design a control law that minimises the structural disturbance. Computational / robotics.

All streams sit within the group's active research and give the student access to its facilities, datasets and PhD researchers. The work is supported by the ARC NetZero Hub (IH240100006) and Professor Duan's ARC Australian Laureate Fellowship (FL250100198).

Project Timeline

TASK	1	2	3	4	5	6	7	8	9	10
Literature review + software / lab setup										
Define scope & method for the chosen stream										
Core build: model or device fabrication										
Run simulations or experiments										
Validation / benchmarking										
Analysis & interpretation										
Report & final presentation										

Prerequisites

Completed at least second-year undergraduate engineering or science. Python is used across all streams; a strong mathematical background (linear algebra, calculus, optimisation / ODEs) suits the computational streams, and an interest in laboratory experimentation suits the lab-on-a-chip stream. Prior exposure to PyTorch, OpenSeesPy or robotics tools is helpful but not required.

Student Placement Agreement

A student placement agreement must be signed by the project supervisor and the student prior to commencement of the ASPIRE program.

LV0554-72741 ASPIRE Program Co-Curricular-Student-Placement-Agreement-Short-term.docx

Additional Information

Applicants may be required to attend a short interview, where student and supervisor agree which of the four streams best fits the student's interests and background. The successful student joins Professor Duan's research group and is supported by current PhD researchers within the ARC NetZero Hub and Laureate Fellowship programs.