

Faculty of Engineering

ASPIRE Summer Research Program 2026-2027

Project Title: Physics-informed neural networks (PINN) for structural dynamics

Supervisor(s): Professor Wenhui Duan

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Objective

Develop a physics-informed neural network (PINN) that solves the equation of motion of a structure under earthquake excitation, for both forward simulation and inverse identification of stiffness and damping. The project introduces the student to deep learning constrained by physics, a fast-growing tool in computational mechanics.

Project Details

A PINN enforces a governing equation as part of the network’s loss, blending sparse data with physics. For structural dynamics the equation of motion is $\ddot{u} + c\dot{u} + ku = F(t)$; a PINN learns the displacement response $u(t)$ directly, with the equation imposed through automatic differentiation.

The student will build a PINN solver for single- and multi-degree-of-freedom structures under earthquake excitation, training on synthetic Newmark simulations and a recorded El Centro ground motion, and explore two case studies: a forward surrogate model, and inverse identification of stiffness and damping from partial measurements. Work is in Python on Anaconda using PyTorch (or TensorFlow) for the network and SciPy for the reference numerical methods. Materials covered are linear-elastic and inelastic (bilinear, hysteretic) models for steel and reinforced concrete.

Project Timeline

[illegible]

Hyper-parameter tuning + ablation										
Report & final presentation										

Prerequisites

Completed at least second-year undergraduate engineering or science. Python coding; a strong mathematical background (calculus, linear algebra); an interest in deep learning or structural dynamics. Prior PyTorch / TensorFlow exposure 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. The successful student will join Professor Duan's research group within the ARC NetZero Hub and be supported by current PhD researchers.