Deep learning enhancements of numerical methods

ABSTRACT:
Numerical methods are used to approximate solutions of mathematical models, especially when explicit expressions are unavailable. Despite the development of robust and accurate techniques, many of them suffer from bottlenecks which may manifest themselves in the form of computationally expensive subcomponents, or problem-dependent parameters that require empirical tuning.

In this talk, I will present a new data-driven approach to overcome such bottlenecks. In particular, I will demonstrate how artificial neural networks (ANNs) can be trained to assist and improve numerical methods. This includes the detection and control of spurious Gibbs oscillations encountered while using high-order methods to approximate solutions with low-regularity, interpolation of rough functions and approximation of parameter-to-output maps needed for designing robust reduced order models or uncertainty quantification.