Advanced finite elements and neural networks for scaled models

ADVANCED FINITE ELEMENTS AND NEURAL NETWORKS FOR SCALED MODELS ANALYSIS

E. Carrera, P. Iannotti, A. Pagani, M. Petrolo

Mul2 Lab, Department of Mechanical and Aerospace Engineering
Politecnico di Torino

This work proposes a hybrid approach based on finite element analysis and deep learning for predicting static and dynamic response of scaled models. The finite element models are built by using the Carrera Unified Formulation (CUF), according to which high order theory of structures can be implemented by expanding the primary unknowns with arbitrary cross-section or thickness functions, in the case of beams and plates/shells respectively. Sampled models are used for training neural networks, which are ultimately able to predict natural frequencies as well as stress states of structures subjected to different loadings and boundary conditions. Several problems are considered, including composite structures, for which refined layer-wise kinematics is demanded for providing accurate failure indexes. It is demonstrate that the proposed machine learning algorithms are able to predict the expected results in a very efficient manner once the main characteristics of the structure and the scaling parameters are known.