EXTRAPOLATING PLATE DYNAMICS THROUGH NEURAL DIFFERENTIAL EQUATIONS

Taniya Kapoor[1], Anastasios Stamou[2*], Michalis Fragiadakis[2]

[1]Technical University Delft
5 Mekelweg, 2628 CD Delft
T.Kapoor@tudelft.nl

[2]National Technical University of Athens
9 Iroon Polytechniou 15780, Zografou Campus, Athens, Greece
{a stamou,mfrag}@mail.ntua.gr

ABSTRACT

Plates are key structural components, hence simulating their dynamic response under various loading conditions is important for a variety of applications, i.e. structural design and optimization. In this study, a deep learning-based Neural ODE recurrent architecture is proposed to accurately predict plate dynamics, particularly in out-of-training domains, a major challenge in machine learning. The proposed architecture leverages inherent causality and temporal sequencing to mitigate the problem of exploding and vanishing gradients. Several numerical experiments are conducted in order to validate the proposed approach, including Kirchhoff-Love plate dynamics with uncertain initial conditions. Confidence intervals for the plate deformation under different loading scenarios are also examined in an effort to quantify uncertainty. The results showcase that the proposed architecture improves the generalization capabilities of plate dynamics, enabling accurate prediction beyond the training data.