The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5 – 9 June 2022, Oslo, Norway

A Neural Network-enhanced Reproducing Kernel Approximation for Modeling Strain Localization

J. S. Chen[1], Jonghyuk Baek [2] and Kristen Susuki[3]

[1] University of California San Diego, Department of Structural Engineering, La Jolla, CA 92093, USA, js-chen@ucsd.edu
http://jacobsschool.ucsd.edu/faculty/faculty_bios/index.sfe?fmp_recid=363
[2] University of California San Diego, Department of Structural Engineering, La Jolla, CA 92093, USA, job011@eng.ucsd.edu
[3] University of California San Diego, Department of Structural Engineering, La Jolla, CA 92093, USA, ksusuki@ucsd.edu

Key Words: *physics-informed neural network, reproducing kernel approximation, localization, damage.*

The localized intensive deformation in the damaged solids requires highly refined discretization for accurate prediction, which significantly increases the computational cost. While adaptive model refinement can be employed for enhanced effectiveness, it is cumbersome for the traditional mesh-based methods to perform adaptive model refinement in modeling the evolving localizations. In this work, neural network-enhanced reproducing kernel (RK) approximation is proposed, where the location, orientation, and the shape of the solution transition near localization is automatically captured by the NN approximation via the minimization of total potential energy. The standard RK approximation is then utilized to approximate the smooth part of the solution to permit a much coarser discretization than the high-resolution discretization needed to capture sharp solution transition with the conventional methods. The proposed neural network approximation is regularized by introducing a length scale related to the objective dissipation energy. The effectiveness of the proposed NN-RK is verified by a series of numerical examples.