Physics-Informed and Autoregressive AI for structures

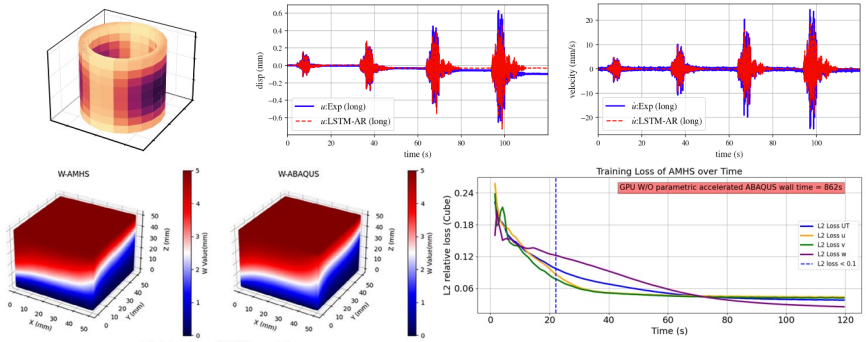
Kyoto University, Dept. of Civil and Earth Resources Eng., Chul-Woo Kim [kim.chulwoo.5u@kyoto-u.ac.jp]

Purpose Investigate PINN and autoregressive models for structural applications.

Outline The Multi-resolution Hash-encoding Solver (MHS) combines EPINNs, hash encoding (with an FEM-like formulation), and AutoML to solve static solid-mechanics problems in a 3D mesh-free framework. The autoregressive neural solver uses LSTM-based state updates to learn time-history data and sequentially predict displacement, velocity, and acceleration.

Result The MHS achieves a 10-fold speedup compared with ABAQUS for the hyper-elastic cube case with Dirichlet boundary conditions. The autoregressive neural solver demonstrates stable rollout under continuous large ground-motion input, despite being trained only on small ground-motion data.

Computing system:	SQUID General Purpose GPU nodes
node-hour	1,000 node-hour
memory used	100 GB
parallelize	2 nodes



Static and dynamic structural modeling using the autoregressive neural solver (top) and MHS (bottom)