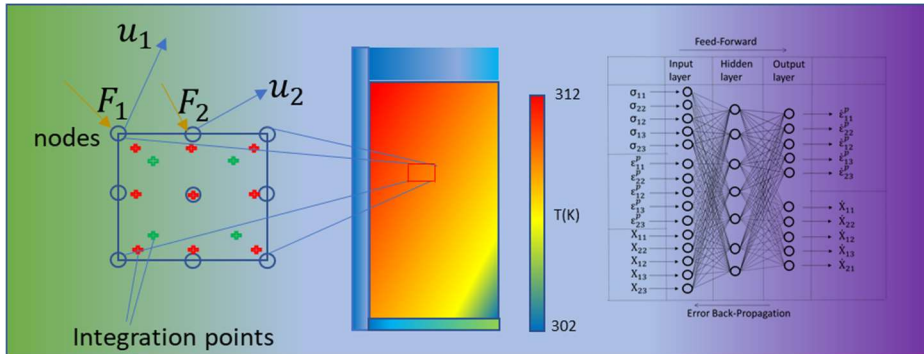


RWTH Technology Intelligent Finite Elements in Structural mechanics



Challenge

In structural mechanics, the Finite Element Method is used to simulate structural deformations and loads, e.g. for the design of components in mechanical or civil engineering. The more complex the structural deformations are, the longer simulation times associated with convergence problems can last. This is where the present invention comes in, by combining the classical Finite Element Method with artificial intelligence. This is the first method in the literature that significantly improves simulation times and convergence properties in this way.

Solution

Deep artificial neural networks are developed that can map the relationship between deformations and loadings in Finite Element models. After training on individual elements, the stiffness matrices and internal force vectors of the Finite Elements can be replaced by artificial intelligences. The trained intelligent elements are then applied to arbitrary boundary value problems and are able to shorten or skip iteration and integration procedures leading to a decreased simulation time and assuring convergence.

Advantages

- The simulation time is significantly reduced.
- Convergence of the nonlinear problem is ensured.
- The present method can model nonlinear behavior directly at the element level.
- Path-dependencies are taken into account.

Status

- Patents pending at the German Patent and Trademark Office and the WIPO. Not yet disclosed. No rights against third parties can be derived from the patent application not yet disclosed.
- Development status: Proof of concept, ongoing research and development

RWTH Aachen University offers a cooperation partner with many years of expertise in FE simulation and artificial intelligence and is looking for partners for patent exploitation and product development or research partners (industry or university) for development cooperation.

RWTH Innovation GmbH

RWTH Technology
#2539

Fields of application

Structural simulation, Crash, forming processes

Keywords

FEM; intelligent elements; artificial intelligence; Stiffness matrix replacement; Sobolev vector space.

Contact

RWTH Innovation
Campus-Boulevard 57
52074 Aachen
GERMANY

Tel.: +49 241 80-96610

info@rwth-innovation.de
www.rwth-innovation.de