Master's Thesis

Investigation of the possibilities to solve partial differential equations using artificial neural networks

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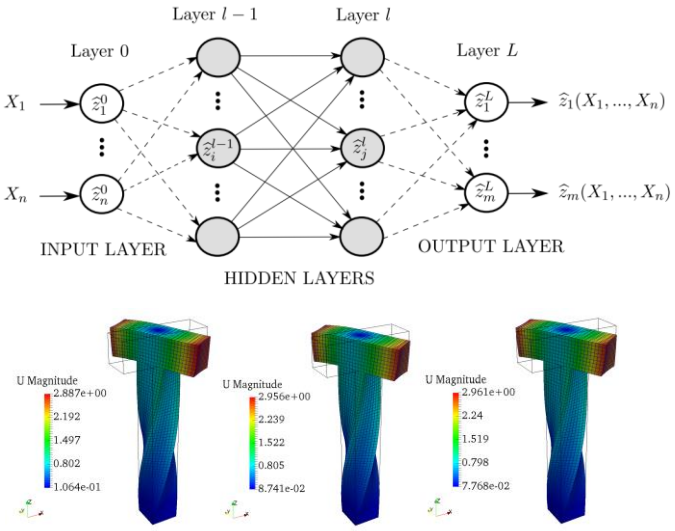
Background: Machine learning became an integral part of many everyday problems in recent years. This rapid development lead to new approaches using machine learning to solve existing engineering and mechanical problems more efficiently, e.g. multiscale problems, computational homogenization or constitutive modelling (Data-driven approaches). However, very recently innovative methods using neural networks were developed to solve partial differential equations (PDEs) directly. Feedforward neural networks were used as global ansatz function for PDEs in solid mechanics and even fluid dynamics, showing the potential of a promising method beside classical numerical methods.



[Nguyen-Thanh et al. (2020) A deep energy method for finite deformation hyperelasticity. Eur. J. Mech. A. Solids 80: 103874]

Task:

- Implementation of a suitable feedforward neural network for solving PDEs
- Application of the implemented model for solving PDEs (e.g. momentum equation for simple linear elastic problems and extension for dynamics or finite deformation)
- Investigation of typical benchmark problems using the developed model
- Critically reflecting the possibilities of the proposed method

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