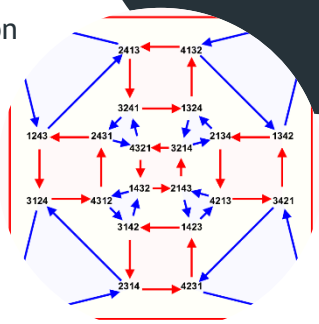
University of Stuttgart
Germany
Department for Stochastic Simulation
and Safety Research for Hydrosystems (LS^3)

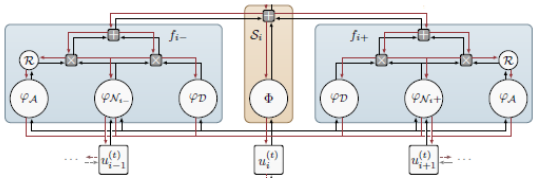
Project / B.Sc / M.Sc. Topic

FINN and Symmetries

The Finite Volume Neural network (FINN) adopts the numerical structure of the well-known Finite Volume Method for handling partial differential equations. This is a new way of combining the learning abilities of artificial neural networks with structural knowledge from mechanistic simulations. In previous works FINN is successfully applied to learning tasks in contamination-diffusion problems.

The goal of this thesis is to explore the possibility of improving the network by making use of the inherent symmetries of the setting. For instance, a mirrored input should lead to a mirrored output. In this manner, the symmetries of the contamination-diffusion problem can possibly be exploited in data augmentation, in the network architecture or in the formulation of the loss-function. Further, the redundancies caused by symmetries in the network architecture can be investigated. The results of these considerations should be implemented and tested in the existing FINN code in PyTorch.





Prospective Tasks

- Literature review on symmetries in neural networks
- Familiarization with FINN
- Design of numerical experiments
- Visualization of results and discussion

General Information

- Advisor: Nils Wildt, Tim Brünnette (LS3)
- Examiner: Prof. Wolfgang Nowak (LS3)

Desirable Skills

- Experience in Python is an advantage
- Knowledge (or a strong interest) in neural networks
- Knowledge (or a strong interest) in PDEs and the Finite Volume method

Apply now!
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