Computational Mechanics Group
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www.compmech.ethz.ch

Topic proposal

Deep learning for accelerating phase field microstructure simulation

Solidification microstructure is widely seen in metal parts manufactured by casting and additive manufacturing. The understanding of microstructure evolution during the process helps to reveal the resultant mechanical response of the final product. However, the conventional methods for solidification microstructure modelling (e.g. phase field and cellular automata) are computationally expensive. Fortunately, deep learning methods provide a promising solution to reduce the computation cost for high-fidelity simulations. A recurrent convolutional neural network (RCNN) was developed in the group and successfully captured the spatial-temporal microstructure evolution under solidification conditions after training with the outcomes of cellular automata (CA) simulations. The resulting computations were proven to be orders of magnitude faster than with the conventional CA method.
The proposed project aims at further developing the RCNN architecture, training and testing it with phase field simulations in which more microstructure features (e.g. segregation and phase transition) can be involved compared with CA. Candidates with knowledge of Python and deep learning are preferred.

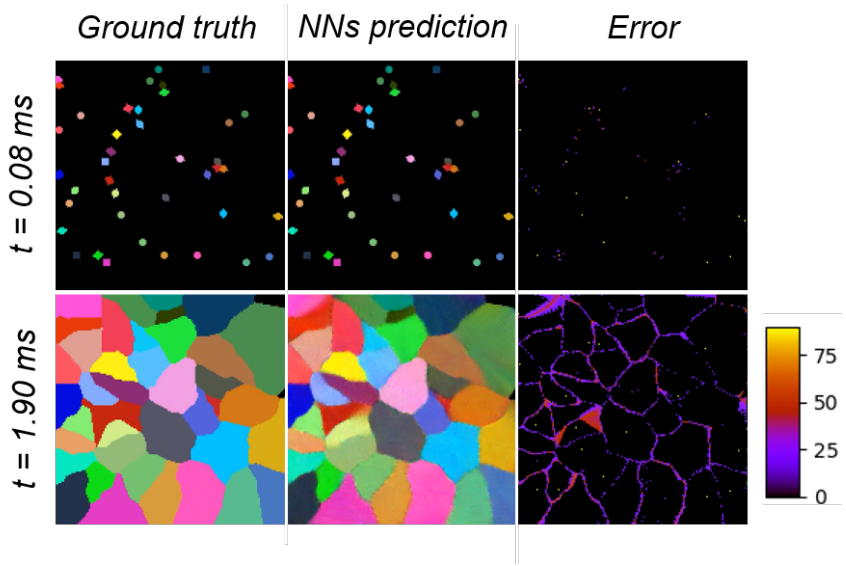

Figure*: Solidification microstructure evolution with multi-grain growth under isothermal conditions.

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