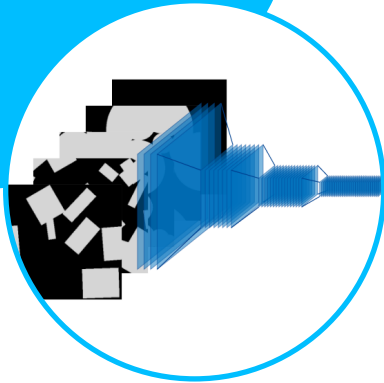


**Unsupervised  
feature engineering  
for microstructures  
in homogenization**



Composite materials are essential in engineering due to their enhanced mechanical properties. Homogenization determines the macroscopic properties based on given microstructures. Since classical simulations are too expensive for this task, machine learning methods can be used that operate on microstructure features. Traditional surrogate models often rely on supervised learning, limited by data availability and complexity.

This thesis explores unsupervised machine learning techniques, specifically autoencoders, to identify representative geometrical features of microstructures for homogenization. Autoencoders can automatically extract essential characteristics without extensive labeled datasets.

The extracted features will be used as inputs for existing physics-augmented machine learning methods, aiming to build accurate and efficient surrogate models for various homogenization problems. This approach enhances the adaptability and generalization of surrogate models in composite material analysis.

### Tasks

The thesis/project would include following tasks:

- Get familiar with the concept of unsupervised machine learning and esp. autoencoders
- Literature study for existing autoencoder-based approaches
- Implementation of suitable machine learning models in Python
- Use of the identified features in various scenarios and evaluation

### Requirements

- Interest in machine learning, preferably basic knowledge (e.g. Deep Learning or Machine Learning lecture)
- Programming knowledge in Python



### Contact

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