

GAN: Generating synthetic training data for fiber-reinforced materials

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Scientific question

Previous work has shown that artificial neural networks (ANNs) represent a promising approach to evaluate the quality of fibre-reinforced composite materials based on image data. However, ANNs usually require large amounts of data to learn such tasks. Moreover, a human has to label the data, i.e. manually tag which images show defective and which show faultless components, to enable the ANN to learn what a quality deviation looks like. In practice, however, collecting and especially labelling large amounts of training data is very time-consuming. Thus, there is a significant need for data-efficient solutions, to create and label training data. One possible solution is to augment the dataset by using Generative Adversarial Networks (GAN) to artificially generate synthetic data. Typically, GANs consist of two ANNs, which compete against each other in a contest, where one ANN tries to fool the other ANN by generating synthetic data samples. Recently, GANs demonstrated astonishing results by creating hyper-realistic images of faces (c.f. <https://thispersondoesnotexist.com/>). Thus, this thesis aims to investigate the applicability of GANs for generating synthetic training data for fibre-reinforced materials.

Scientific methodology

- Comprehensive research in the field of textile-engineering, machine learning and especially image processing and GANs
- Investigation of the given dataset and application of data preprocessing
- Selection and adjustment of a suitable GAN based concept for the given use case
- Prototypical implementation of the concept
- Verification and validation of the concept through a comparative study

Objective and expected results

This thesis aims to investigate whether a GAN based approach for generating synthetic data is applicable for the special use case of detecting quality deviations of fibre-reinforced composite materials based on image data. The expected result is on one hand the realisation of a GAN based approach for generating synthetic data and on the other hand the examination of the applicability and the added value of the generated data for training ANNs in the context of the industrial use case.