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F O R S C H U N G S P R A X I S
for
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Development of a user interface using one-class classification methods to predict manufacturability in vehicle tire designs

Problem description:

During the design process of complex systems like a vehicle, optimization methods are needed in order to cope with high-dimensional parameter interdependencies and to generate new designs of the vehicle parameter. The optimizer searches for a design that maximizes the objective function. Unfortunately in many industrial applications the optimal design given by the optimizer can't be manufactured, since the manufacturable design is only a set of the whole design space.

In this Forschungspraxis we use machine learning methods which are able to estimate the set of manufacturable designs. Typically the training dataset collected from manufacturers contains only manufacturable designs (positive class). In this case we apply one-class classification methods in the absence of negative training data to address this problem [1]. We compare simple one-class classification methods like convex hull and one-class support vector machine (SVM) [2] as well as the more advanced methods kernel PCA and diffusion nets [3] in order to predict manufacturability. The performance of different classifiers will also be compared based on two evaluation criteria: test accuracy and relative volume estimation. The approach is applied to a design problem with respect to vehicle driving dynamics for a tire.

Work schedule:

- Literature research on one-class classification methods
- prepare and pre-processing the training dataset
- implement different one-class classification methods
- evaluate the performance of different classifiers
- implement a GUI in Matlab for the application on tire design

Bibliography:

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- [3] R. R. Coifman, I. G. Kevrekidis, S. Lafon, M. Maggioni, and B. Nadler. Diffusion Maps, Reduction Coordinates, and Low Dimensional Representation of Stochastic Systems. In *Multiscale Modeling Simulation* 7.2, 2008

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