# Project descriptions

## WiSh3

## Project I: Shape optimization combined with stochastic modelling

### Supervised by Laura Bittner[1] and Kathrin Welker[2]

Shape optimization problems arise in technological processes and are often modelled under partial differential equality constraints. A lot of real world accidents show that stochastic aspects should be included in the modelling process. For example, a recent accident occurred on a flight with Southwest Airlines in April 18, 2018. An engine on the plane broke apart shortly after takeoff even though it was inspected two days before.[3]

In this project, we formulate a specific stochastic shape optimization model and investigate it under analytical and computational aspects in view of a suitable simulation. Background material will be sent for reading before the workshop.

## Project II: Exploring feature representations for 3D shape segmentation using deep learning

### Supervised by Ilke Demir[4]

Although deep learning approaches become popular solutions for semantic segmentation and recognition tasks in several 2D domains, the lack of uniform representations in 3D domains slows down the development of such methods for 3D shape segmentation. In this working group, we would like to explore (i) several representations (multi-view, volumetric, point-based, surface-based) and 3D formats, for segmentation of models in (ii) different domains (face, body, architecture, nature), and (iii) their feasibility for different deep learning models (hierarchical, graph-based, convolutional, capsule-based). The topic will be narrowed down based on the experience and interest of the participants. Group members are expected to have familiarity with deep learning and 3D geometry processing. Reading material will also be sent before the workshop as a background setup.

## Project III: Modelling with splines skeletons

### Supervised by Géraldine Morin[5]

In this group, we propose to model considering skeleton representations of higher continuity. Skeleton based representation offer a intuitive model of 2D and 3D shapes. Moreover, this representation provides a model of lower dimension. Most skeleton approximations consider piecewise linear representation, and we shall consider here medial axis curves (or surfaces in 3D) of higher order, modelled in particular by spline functions. To be able to model circular shapes, more general splines (like circular splines) will be considered. We will consider shapes in 2D to start with, and then in 3D where we will try to tackle the curve and the surface setting.

References will be sent out for reading before the workshop.

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[2]Universität Trier, Germany, E-Mail: `welker@uni-trier.de`

[3]https://www.nytimes.com/2018/04/18/business/southwest-plane-engine-failure.html

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