

## Master thesis/Studienarbeit

### 3D-discretization of concrete microstructures

Computer Tomography (CT) is literary x-ray vision, letting us visualize the 3d-microstructure of a material. Concrete consists of aggregates (stones) embedded in mortar (cement and sand), which can be seen in the CT-scan in Figure 1. Additionally, there are large and small air voids. This structure on the microscale has a significant effect on the concrete strength and durability. At IAM, we are developing microstructure sensitive modeling techniques for concrete. With these models, we can understand causes for crack formation and guide the development of better concrete design. However, these models require a description of each phase as a finite element mesh.

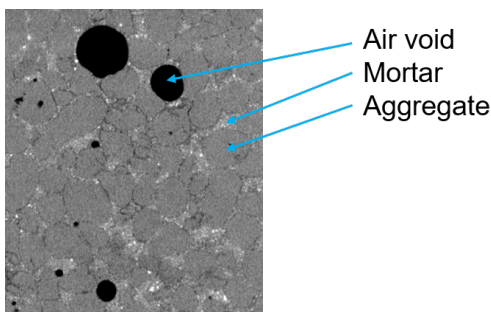


Fig. 1) 2d-slice from a CT-scan of concrete from IAM's scanner

To translate the grayscale voxel (3d pixel) data into an accurate and efficient mesh is the topic of this project. Based on previous work at IAM, CT-data with enhanced phase contrast difference [1] are available. You will be working with Avizo for the segmentation (separating the different constituents), and then Abaqus for creating the mesh. The goal is to automate the procedure, developing a workflow that enables analysis of many different samples.

Prerequisites: Linear Solid Mechanics, Independent problem solving skills

#### Tasks

- Literature study of different 3d-segmentation techniques
- Evaluating the segmentation techniques on concrete samples
- Evaluate different geometry smoothing techniques
- Meshing of the smoothed segmented geometry

#### References

[1] P. Carrara et al., "Improved mesoscale segmentation of concrete from 3D X-ray images using contrast enhancers," *Cem. Concr. Compos.*, vol. 93, no. June, pp. 30-42, 2018 <https://doi.org/10.1016/j.cemconcomp.2018.06.014>

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