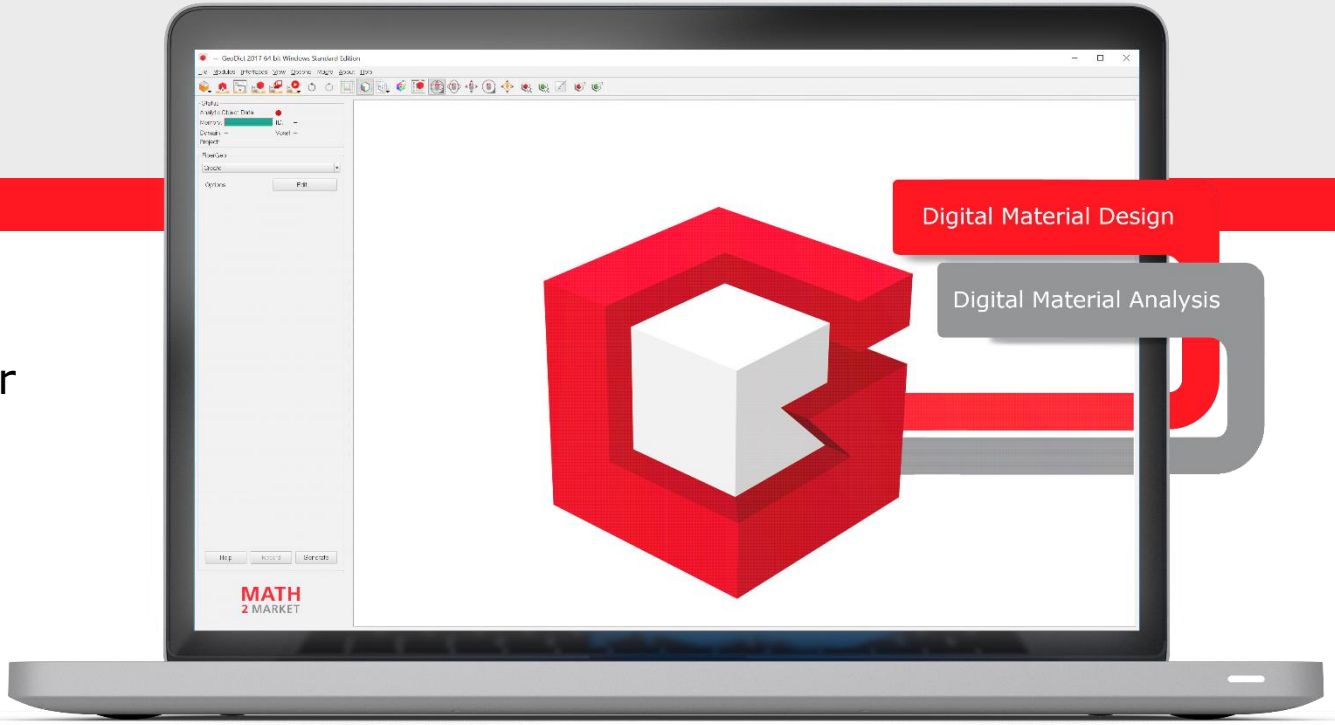
Object Identification on Micro-CT Scans with GeoDict

- Andreas Grießer
- Dr. Christian Wagner

Math2Market GmbH



Development of materials by Digital Material Design

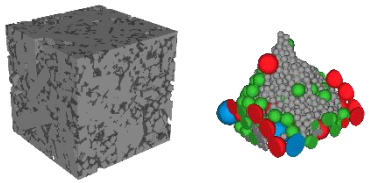
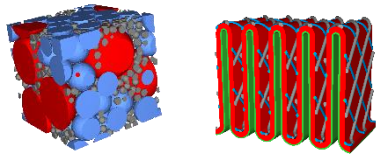
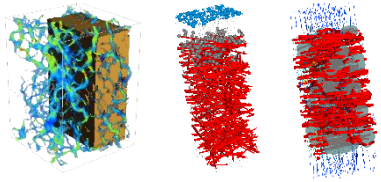


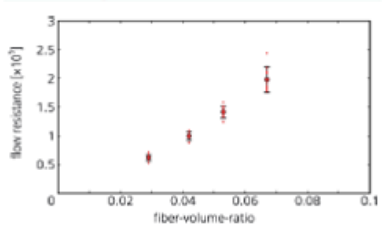
Image Analysis



Models of Microstructures



Microstructure Simulation



Macroscopic Material Parameters

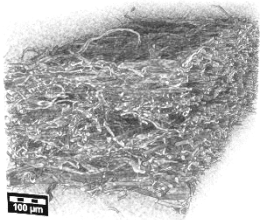
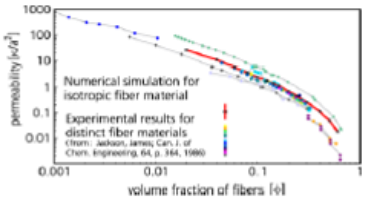


Image Acquisition

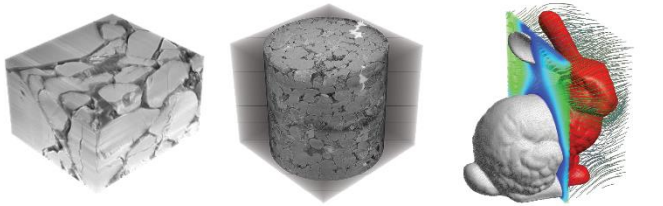
Change Geometry

Material Property

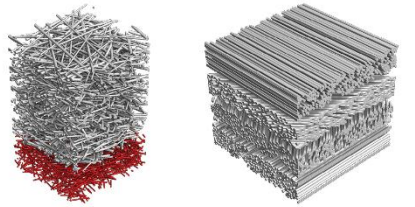


Experimental Verification

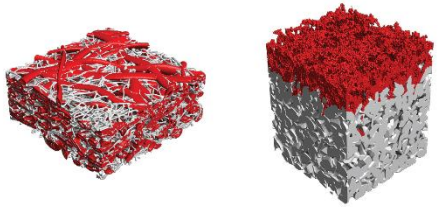
Development of Materials



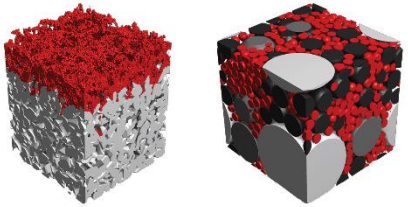
ImportGeo



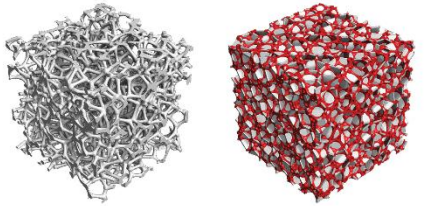
FiberGeo



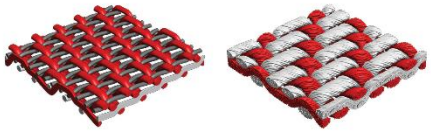
PaperGeo



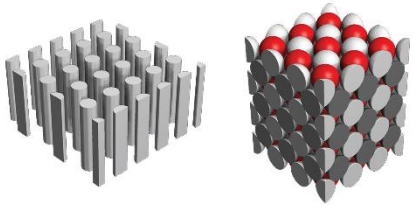
GrainGeo



FoamGeo

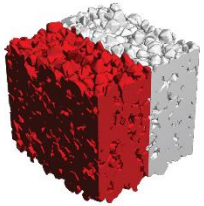


WeaveGeo

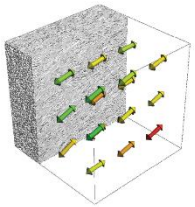


GridGeo

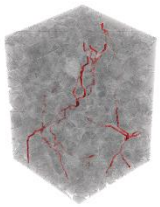
PleatGeo



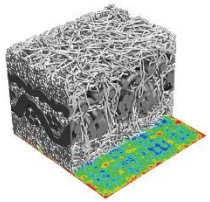
ExportGeo



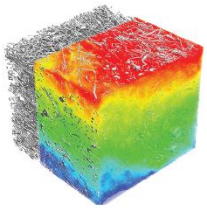
FiberGuess



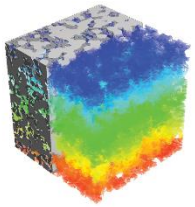
PoroDict



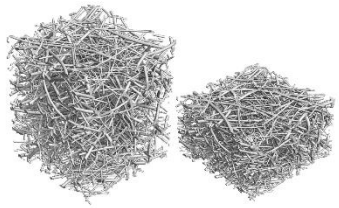
MatDict



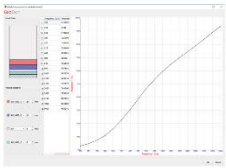
ConductoDict



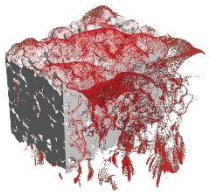
DiffuDict



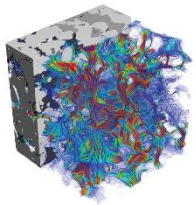
ElastoDict

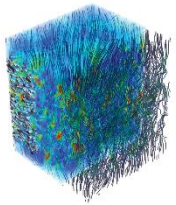


AcoustoDict

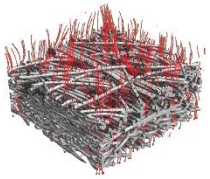


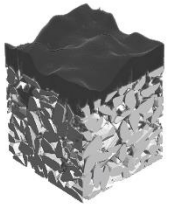
AddiDict



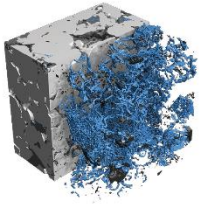


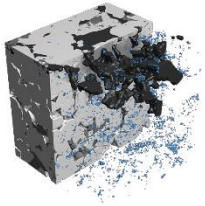
FlowDict





FilterDict



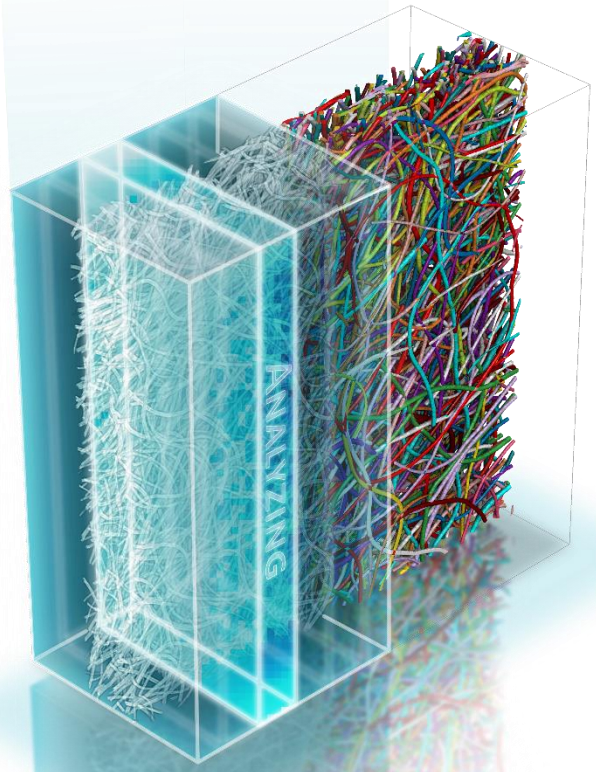


SatuDict

Machine Learning based Micro-CT analysis

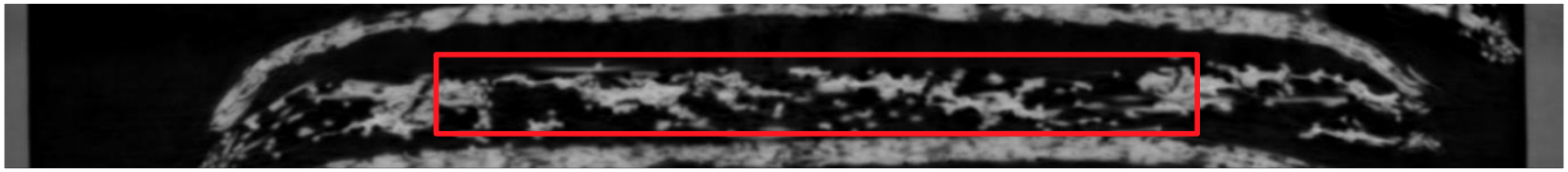
GeoDict for geometric analysis:

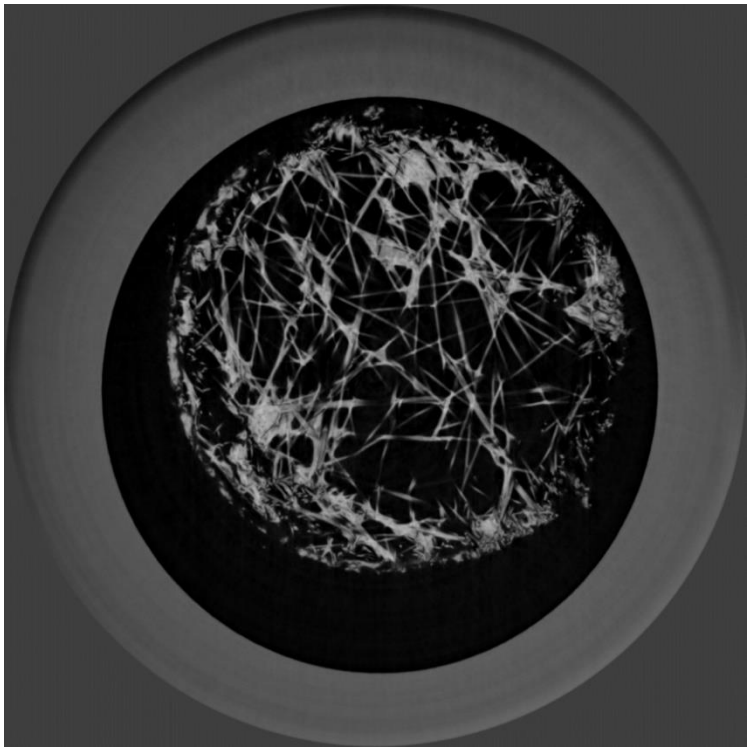
- Existing methods to measure
  - Fiber diameter
  - Fiber orientation
  - Pore size distributions
  - …



- New approach:
  - Machine Learning based geometric analysis to obtain more measurements out of complex micro structures

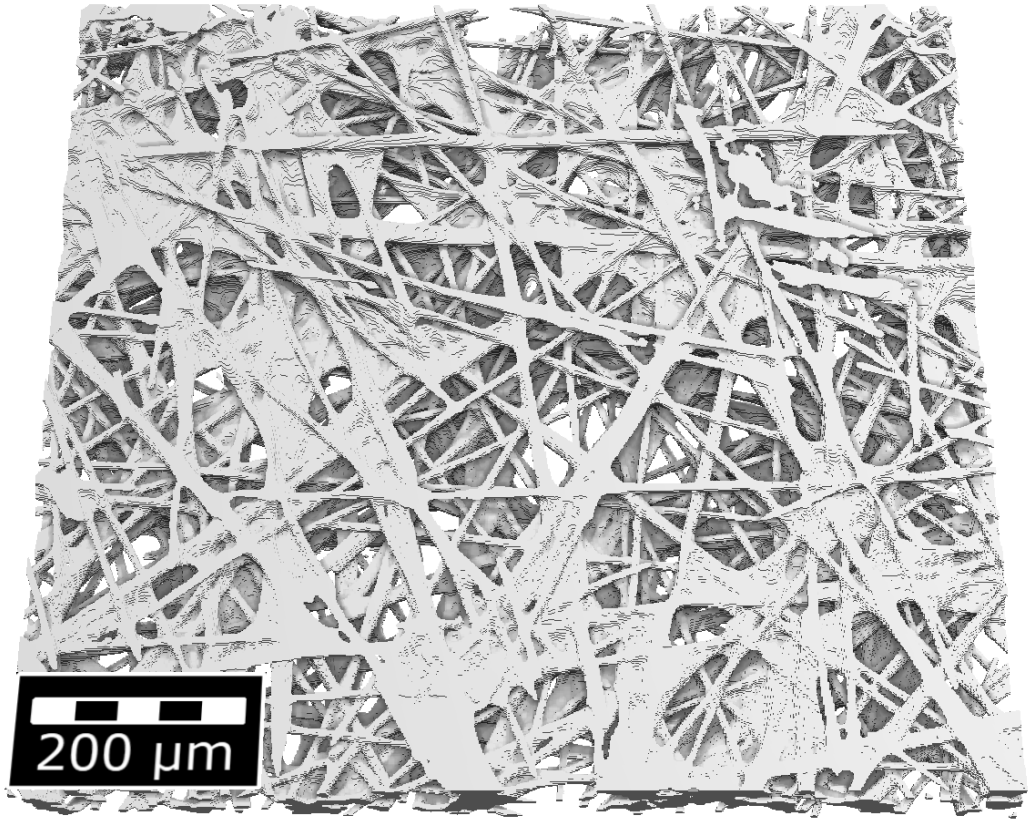
Micro CT-Scan of Gas Diffusion Layer



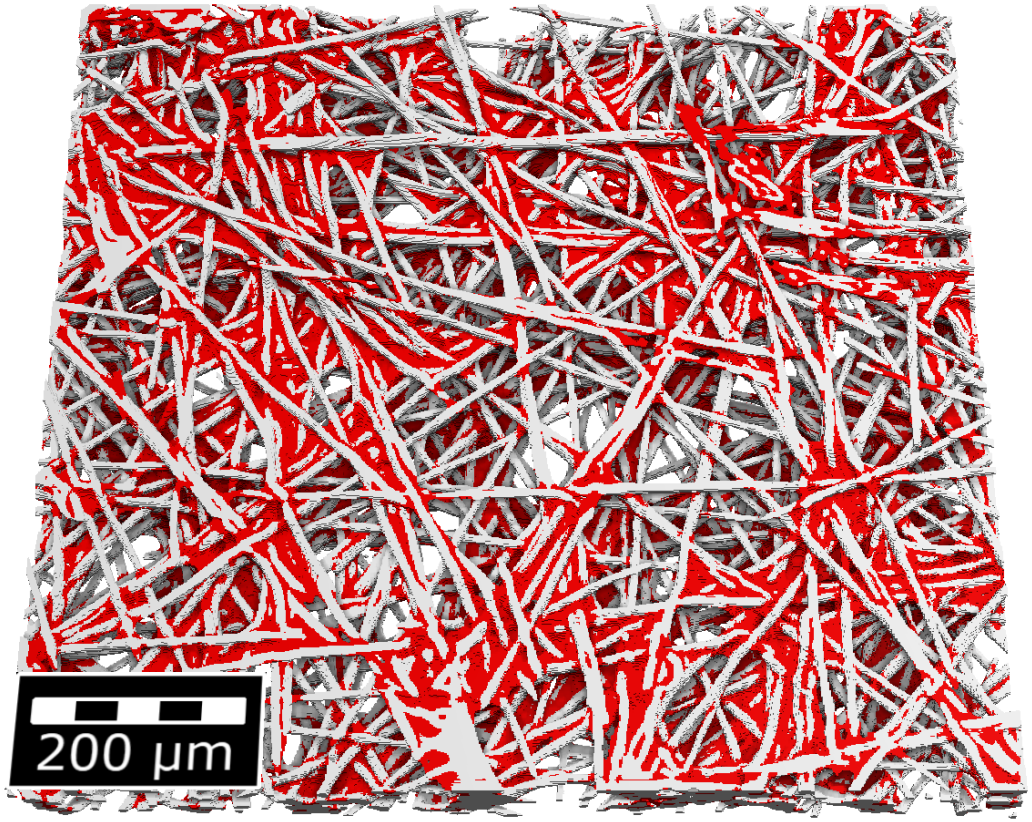


- Micro CT-Scan of a Gas Diffusion Layer
- 1.3µm voxel resolution
- Binder and fibers can not be directly segmented

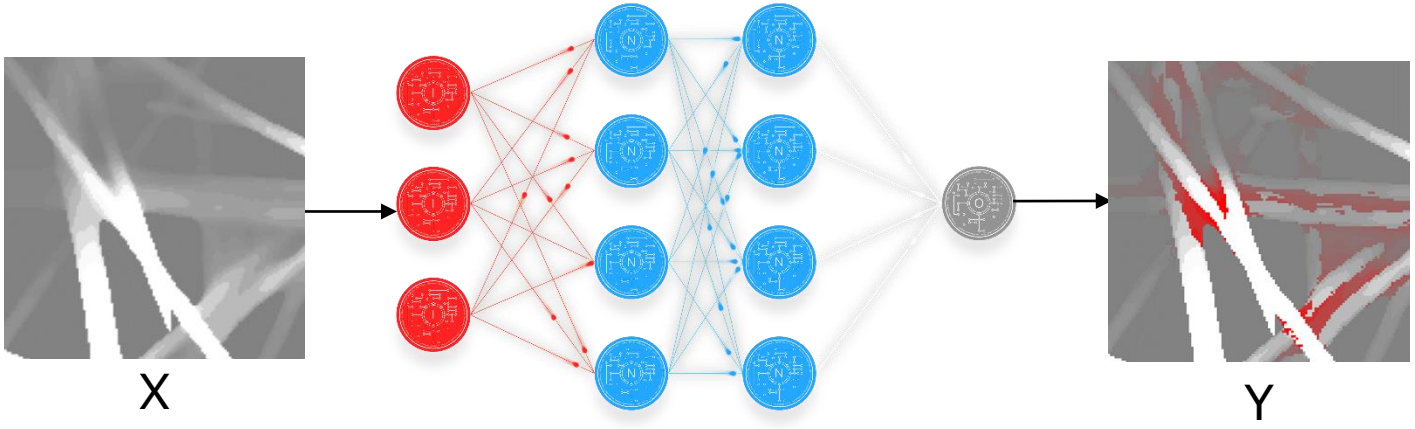
Binder identification in Gas Diffusion Layer



Binder identification in Gas Diffusion Layer

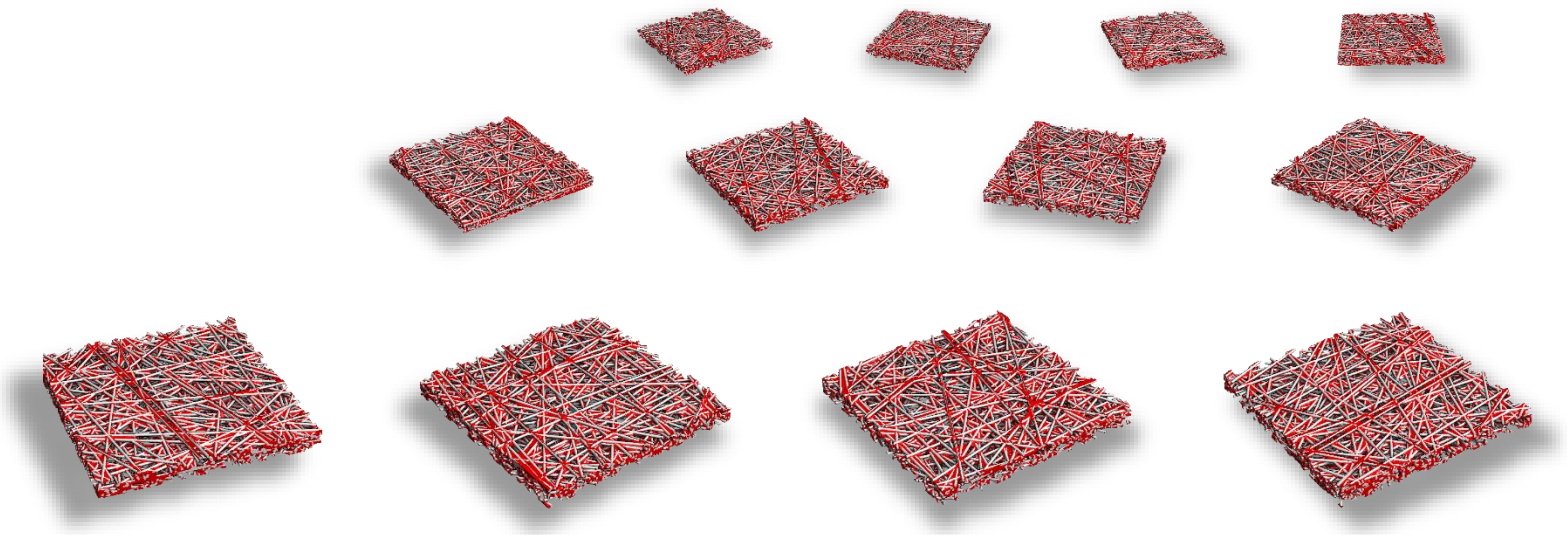


Overview: Supervised Deep Learning



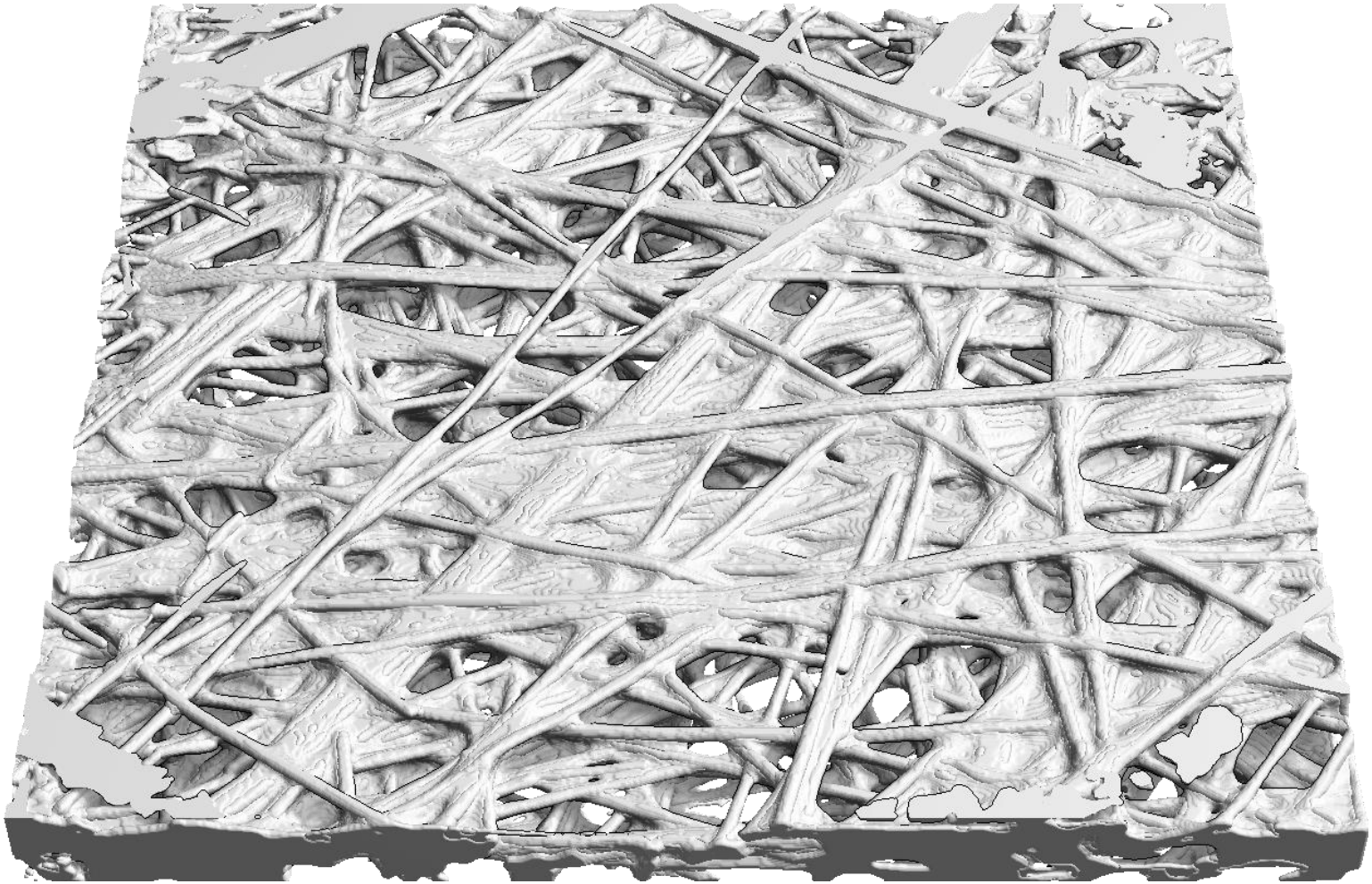
- Neural network: Network of artificial neurons
- Input X, Output Y
  - X and Y be anything: values, vectors, images…
- **Supervised** learning means we give many (X,Y) examples
  - The network then learns to predict Y from X
  - Problem: It needs **a lot** of training examples (> 100000)

Generating training data



- Solution: Use GeoDict's material modelling capabilties to generate training data
  - For training we generated 18 structures
  - Varying porosity and binder volume fraction
  - This corresponds to ~800 million training data points

Binder identification in Gas Diffusion Layer

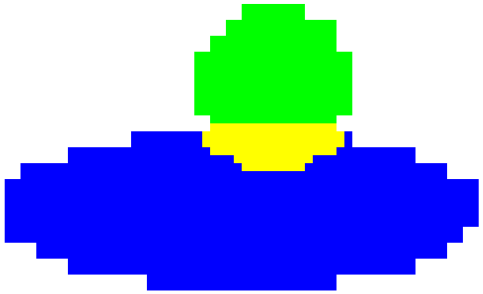


Binder identification in Gas Diffusion Layer

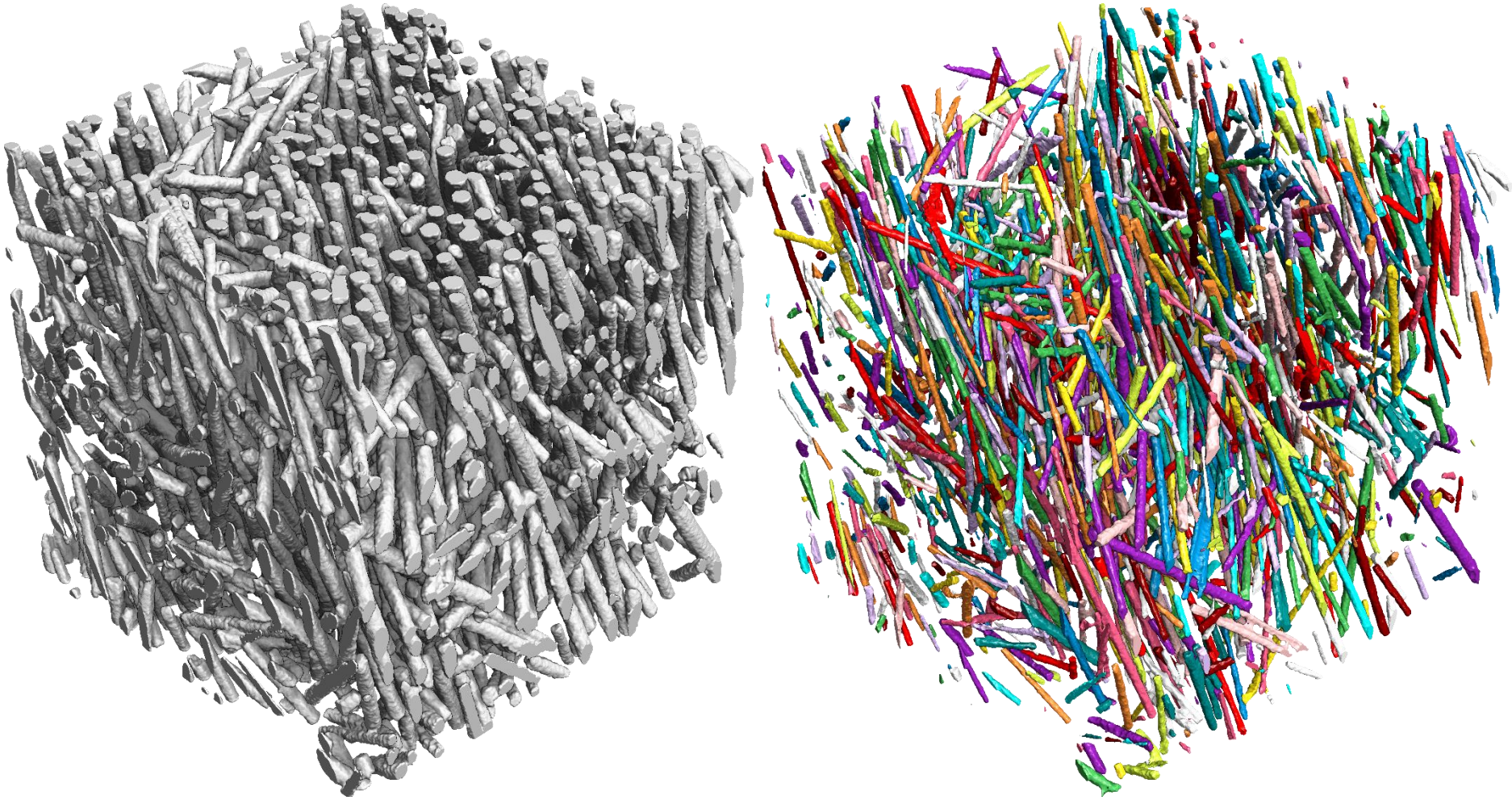
Fibers: 17%
Binder: 28%

Machine Learning to detect contact Voxels

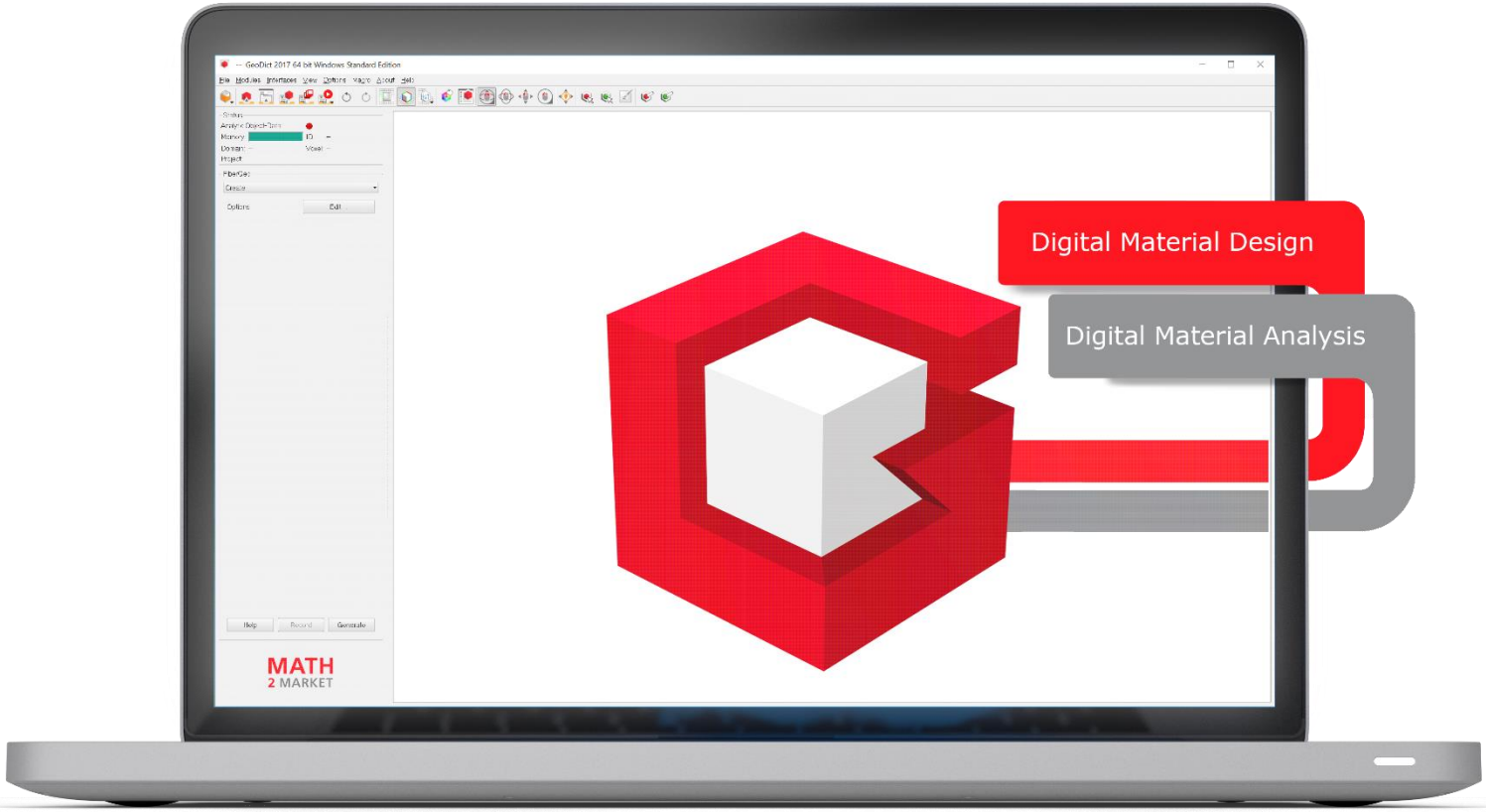
- Seperating individual fibers allows to get more precise statistics out of micro-CT images
  - Fiber length
  - Fiber curvature
  - Fiber shape
- We deploy the same technic as before to identify fiber contact points



Fiber identification in a GFRP



Thank You!



Visit us @ our booth on the ground floor and @ www.geodict.com