GEODICT

The Digital Material Laboratory

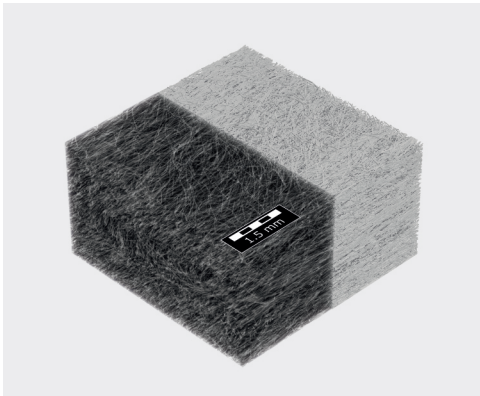## Analysis of a Long Fiber Reinforced Thermoplastic

- Analysis of a complex microstructure

- Evaluation of the manufacturing process-induced morphology and properties

- Variation of parameters to assess the impact of defects

- Computation of mechanical and physical properties run on the µCT scan and the digital twin
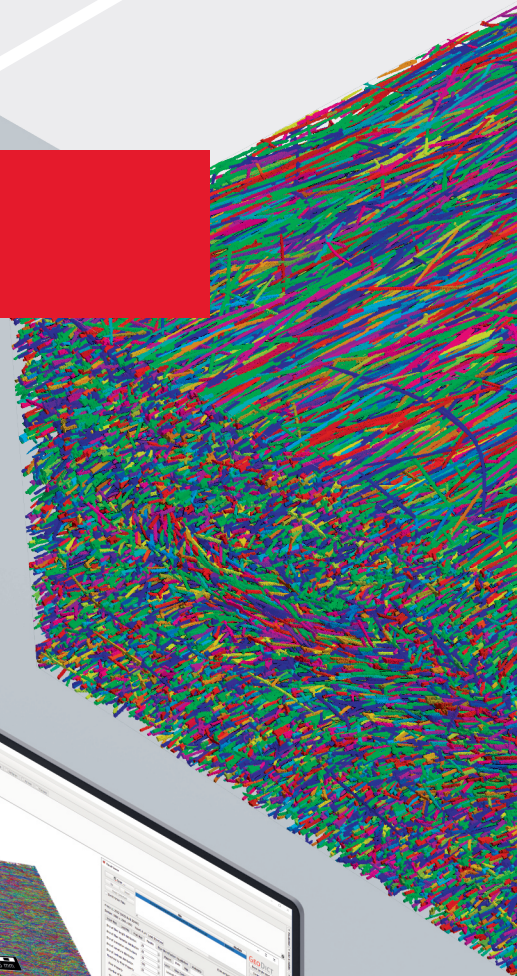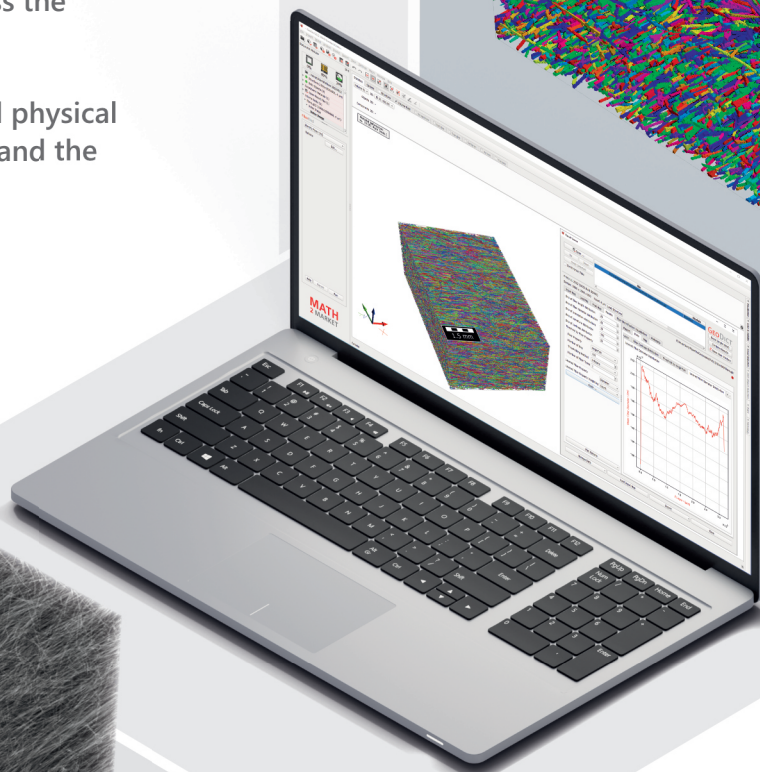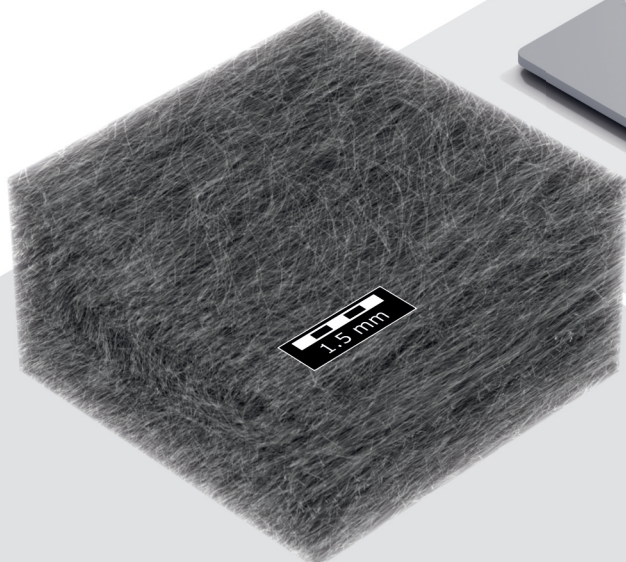
MATH
2 MARKET

1 — Import and segmentation

Import a µCt scan of the composite:

- Use GeoDict image processing tools to improve the scan's quality

- Segment the scan into 3 phases (fibers, polymer, pores) via
    - Manual thresholds
    - Automatic thresholds (OTSU, k-Means)
    - Multiphase threshold via watershed algorithm
    - AI-based segmentation

Result: Digital twin of the composite

2 — Fiber identification
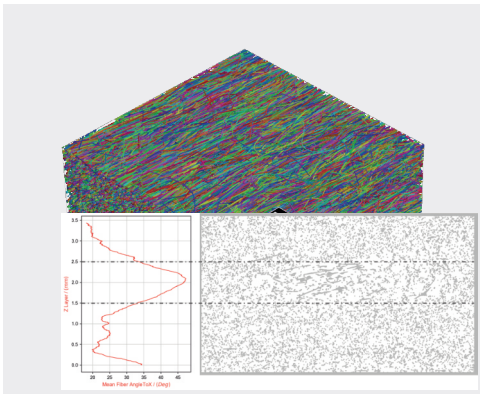
- Let FiberFind AI identify single fibers in the scan

- Evaluate fiber orientation, fiber diameters, fiber distribution, and a lot more in the composite material 3D-model

- Evaluate fiber orientation through the thickness of the material to assess process induced variations

- In this example, fibers are oriented differently within the inner layer due to the injection molding process

Result: Statistical description of fibers in composite

3 — Pore analysis
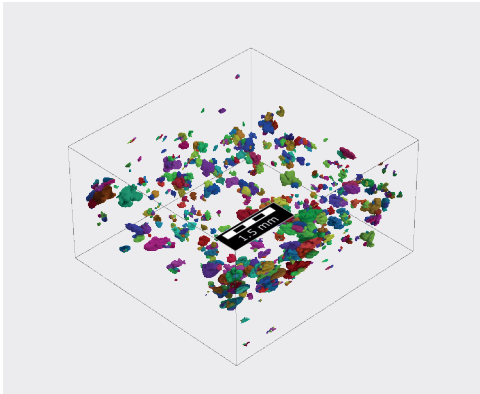
- Analyze the pore space with PoroDict
    - Pore size distribution
    - Pore shapes
    - Pore locations
- In this example,
    - voids are mainly located in the inner region in which the fibers are not aligned to the flow direction
    - mean diameter (diameter of volume-equivalent sphere) of 237.36 µm with a standard deviation of 97.46 µm.

Result: Extensive evaluation of pores

4 — Mechanical properties
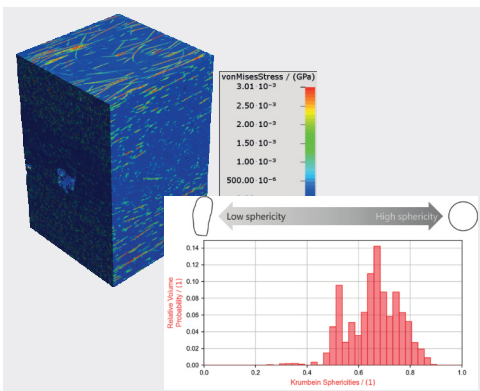
- Compute material properties:
    - Flow properties, such as permeability
    - Electrical and mechanical conductivity
    - Stiffness tensor
- Simulate large deformation such as tensile and bending tests
- Vary material morphology, such as pore content and pore sizes

Result: Validated model for mechanical properties