

GEO DICT

The Digital Material Laboratory

**SIMULATION OF
ELECTROSTATIC
FILTRATION
PROCESSES**



THE MOTIVATION

Leverage the power of electrostatic forces to capture even the finest particles. With GeoDict's advanced simulation tools, you can design and optimize filter media that outperform traditional solutions - reducing energy costs, improving air quality, and extending product lifetime. Turn innovation into measurable results and stay ahead in a competitive market.

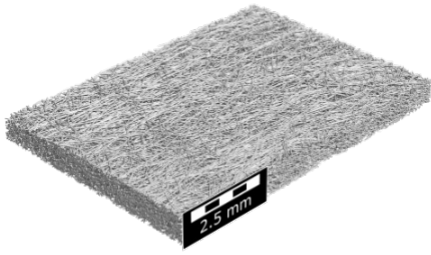
OUR SOLUTION

GeoDict empowers engineers to design, analyze, and optimize electrostatically charged filter media in a virtual environment before production begins. From 3D modeling of fiber structures to precise airflow and particle simulations, GeoDict delivers data-driven insights that cut development time and reduce prototyping costs. Achieve higher filtration efficiency and faster time-to-market - all in one powerful software platform.

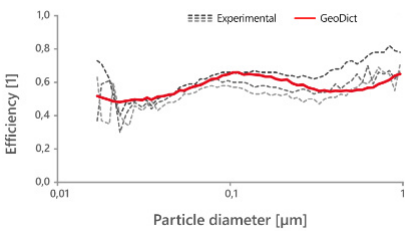
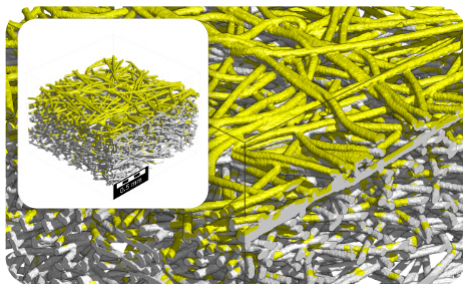
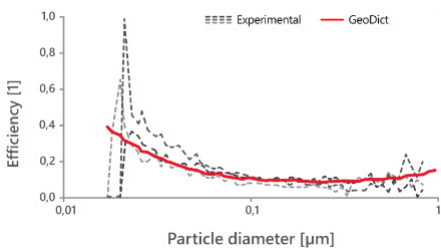
YOUR BENEFIT

With GeoDict you gain a decisive advantage: faster development cycles, lower material costs, and a clear understanding of how electrostatic effects boost filtration performance. Virtual testing replaces expensive trial-and-error, enabling you to fine-tune fiber geometry and charge distribution for maximum efficiency. The result is cleaner air, extended filter life, and a competitive edge that directly supports your business growth.

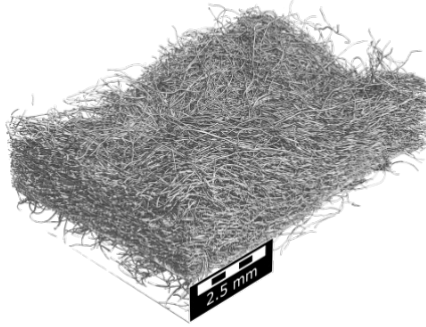
Filter Medium A



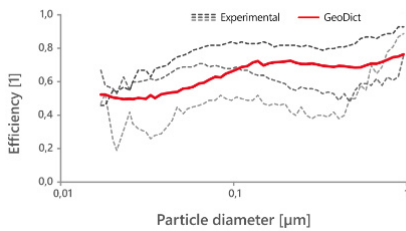
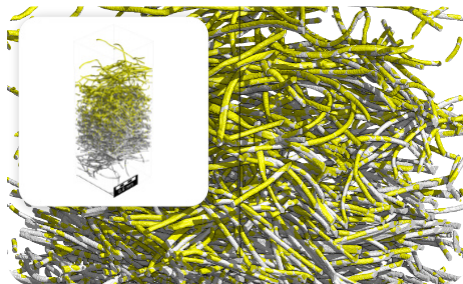
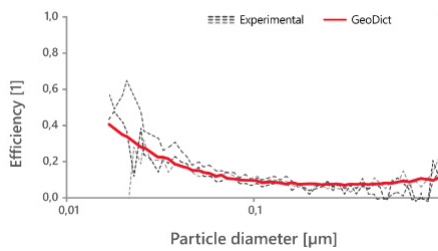
- Material: Polypropylene
- Segmentation: Random Forest (AI method)
- Dimension: 3416 x 2451 x 295 Voxel
- Voxel Length: 3µm



Filter Medium E



- Material: Polypropylene
- Segmentation: Random Forest (AI method)
- Dimension: 3264 x 2451 x 1429 Voxel
- Voxel Length: 3µm



SEGMENTATION

Convert 3D images of real filters, obtained via micro-CT or FIB-SEM analysis, into digital materials. The real filter structure provides the basis for all analyses and simulations. Different samples, each with unique shapes and morphologies are tested for simulation (filter media A–E).

The following modules were used:

- **IMPORTGEO**
- **FIBERGEO**
- **MATDICT**

MECHANICAL FILTRATION

Mechanical filtration relies on the geometric structure of fibers and pores to capture particles. Key factors include fiber diameter, packing density, and pore morphology.

The following modules were used:

- **FILTERDICT**
- **FLOWDICT**

ELECTROSTATIC FILTRATION

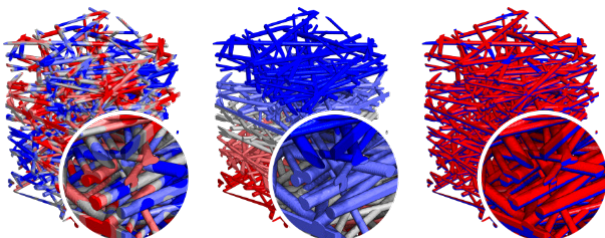
Electrostatic filtration enhances particle capture using electrostatic forces. Charged fibers attract and retain fine particles that would otherwise escape through the pore structure. In both mechanical and electrostatic simulations, the simulation time increases with the size of the selected sub-volume of the segment.

The following modules were used:

- **FILTERDICT**
- **FLOWDICT**

Additional feature related to Electrostatics:

- Digital testing of different electrical charge distributions
- Electrostatic decay



Different colors = different charges = different values for ξ_0



Development of an innovative extension for the simulation of electret filter media in the FilterDict module.
Funded by the Federal Ministry of Research, Technology and Space (BMFTR).
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ADDITIONAL INFO

To learn more about the validation of GeoDict's electrostatic feature or the details of the **ELEK SIM** project, please visit our website: <https://www.math2market.com>

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