

FILTER ELEMENT SIMULATION TOOLBOX

The **F**ilter **E**lement **S**imulation **T**oolbox (FiltEST) is a collection of software modules developed to assist the designers/manufacturers of filter elements in the developmental process. Experience has shown that specialized CFD tools can reduce the time for the creation and optimization of filter element designs significantly. It comes with a Graphical User Interface (GUI) to guide the user through the different stages of a simulation project and thus facilitate the work.

Available commercial CFD software packages do not provide the possibility of an adequate modeling or efficient simulation of the respective problems, which is why the development of specialized algorithms and software is necessary. The mathematical models and the developed algorithms are specialized for the requirements of filtration simulation.

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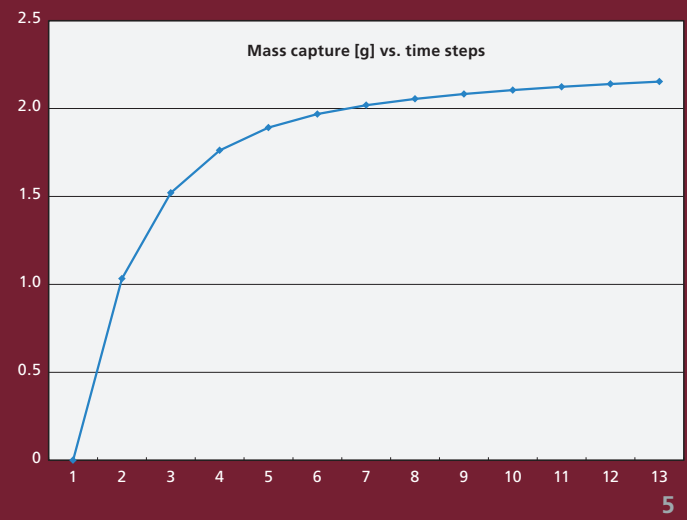
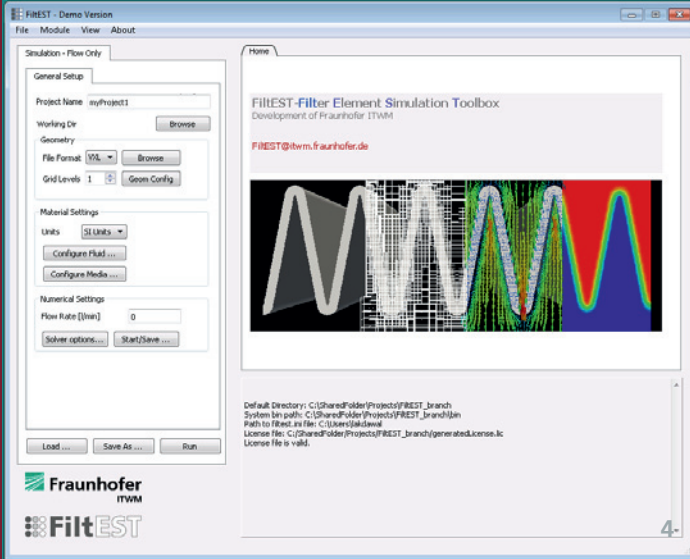
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Potential capabilities of FiltEST simulation modules

The Voxel Grid module converts CAD data (STL format input) for the housing, filter medium, inlet and outlet are transformed into a 3d image data format which become the numerical simulation domain.



1 Cylindrical housing with round pleated filter medium, side inlet (red) and central outlet at the bottom (green)

2 Numerical simulation of the flow through the filter element: Streamline representation of the fluid flow speed

3 Efficiency simulation: Visualization of the local particle concentration

4 FiltEST-Filter Element Simulation Toolbox: Graphical User Interface

5 Sample result of an efficiency simulation run

The numerical simulation is for Newtonian incompressible laminar and inviscid flows. Porous media with isotropic permeability is considered. The simulation includes the following:

- steady state or transient flows using unsteady Navier-Stokes-Brinkman system of equations
- transport of particle concentrations (several sizes) uniformly mixed in the fluid using unsteady convection diffusion equations
- deposition/absorption for particle capturing inside the filtering media
- permeability update models for pressure increase over time.

The models and simulations are aimed towards handling application specific needs for design and assessment of the filter elements. In order to improve computational efficiency and speed up, FiltEST is equipped with special features, such as local refinement of the computational grid, high performance linear solvers, various efficiency test settings and a variety of filtration models.

Additional optional features include filtration parameter estimator, and the FiltEST team also offers support and consultancy for incorporating alternative physical models related to flow in porous media. In addition, future versions will offer a module to generate boundary adapted grids that are especially suitable for pleated filters.

Output and Visualization

FiltEST offers a lot of flexibility by storing the solution (pressure, flow fields, concentration, permeability field, captured mass etc.) in VTK (Visual Toolkit) format. The developed solver provides detailed information about velocity and pressure distribution in the filter (in particular, in the filter medium), thus assisting engineers in the design of more efficient filters.

FiltEST also offers the possibility to export efficiency simulation results for further data analysis in a file which can be directly imported into an Microsoft Excel worksheet.

Trial version available online

The latest information about FiltEST and a free trial version can be found on our web site: www.itwm.fraunhofer.de/en/filttest