GeoDict: ITWM & M2M

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What is GeoDict?

- A graphical user interface to 15 years of project work at ITWM
- A 500,000 lines software engineering project
- A 1,000 page Users Guide
- 50+ publications and presentations
- The livelihood of Math2Market GmbH
- *The virtual material laboratory for analysis & synthesis of materials*
The Virtual Material Lab Approach: Computer Aided Material Engineering

Properties are:
- pore size distribution
- permeability, filter efficiency, …
- diffusivity, conductivity, …
- capillary pressure curve
- effective stiffness
- …

Experiment / Lab

Porous / Composite Material

measure

Properties

Computer

Model

generate / synthesize

Voxel Mesh

calculate / analyze

Properties

try next set of parameters

manufacture
next material
Validation - Step 1: Analysis or Property Computations

- Porous / Composite Material
- CT Image
- Voxel Mesh
- Properties

image → filter & segment → compare → compute
Validation - Step 2: Synthesis or Material Models

- CT Image
  - filter & segment
  - Voxel Mesh
    - compute
    - Properties

- Model
  - generate
  - Voxel Mesh
    - compute
    - Properties

compare
The Virtual Material Lab Approach: Computer Aided Material Engineering

- Porous / Composite Material
- 3d image
- CT Image
- filter & segment
- generate / synthesize
- Voxel Mesh
- compute / analyze
- Properties
- Lab
The two paths to realism...

Two parallel strategies in Fraunhofer ITWM’s SMS department: Aim at complex processes in complex geometries via

- **“Classic”:** complex process models in simple geometries
  - a. Focus on understanding mechanisms
  - b. Focus on projects and publications

- **“GeoDict”:** simpler process models in complex geometries
  - a. Geometry available through SEM and μCT
  - b. Computational power available through 64 bit technology
  - c. Requires Math, Physics, CS / HPC, process knowledge
  - d. Focus on product and customers
The Situation of ITWM and M2M

**M2M pays license fees to ITWM in order to**

- own, market & sell GeoDict
- add modules & features to GeoDict
- provide consulting services based on GeoDict

**ITWM collaborates with M2M by**

- training and educating personnel
- developing models and algorithms
- mutual customer recommendations
- supplying and supporting codes (FeelMath, …)
- using GeoDict for public & industrial R&D projects
FLOW AND MATERIAL SIMULATION
Fraunhofer ITWM – Industrial Mathematics

• Founded in November 1995 by Prof. Dr. Helmut Neunzert
• Fraunhofer Institute since 2001 (the first one with focus on mathematics)
• Departments
  - Transport Processes
  - Flow and Material Simulation
  - Image Processing
  - System Analysis, Prognosis and Control
  - Mathematical Methods for Dynamics and Durability
  - Optimization
  - Financial Mathematics
  - Competence Center »High Performance Computing«

• 260 employees and PhD students as well as around 200 research assistants
• Located in Kaiserslautern
Flow and Material Simulation

Groups:
- Hydrodynamics and CFD
- Complex Fluids
- Micro-structure simulation and virtual material design
- Mechanics of Materials

Research:
- Modeling complex physics
- Multi-scale simulation
- Efficient numerics for large complex systems

User specific software solutions
Application areas

- Porous material design (tech. Tex., Paper, …)
- Composite material design (CFK, GFK, MMC)
- Filtration (media design, filter housing)
- Fuel cell and battery performance
- Separation of suspensions, fractionation
- Injection moulding (PIM, RTM, concrete)
- Granular material processing: Silo, Mixer, Mills
- Production of paper/flake/plaster board, insulation material, ….
FLOW AND MATERIAL SIMULATION

"We do things, which might be available in commercial software tools in ten years"

“Together with M2M we will be much faster !!!”
ITWM collaborates with M2M by

- Common research and development projects
  - Direct assignment by M2M
  - Common partners in public projects

- Training and educating personnel
  - Talk by Sven Linden

- Developing models and algorithms
  - Talks by Liping Cheng, Jürgen Becker, Erik Glatt

- Mutual customer recommendation
  - Talks by industrial & research partners

- Supplying and supporting codes (FeelMath, …)
  - Talk by Matthias Kabel

- Using GeoDict for public & industrial R&D projects
  - Talk by Zahra Lakdawala
Announcements

- Program is found at the back of the booklet
- WLAN access data are available at the back of the booklet
- If you do not know how to get to the dinner – talk to Cornelia
- If you want to offer a ride to the dinner – talk to Cornelia

- … and enjoy the meeting together with the M2M* team