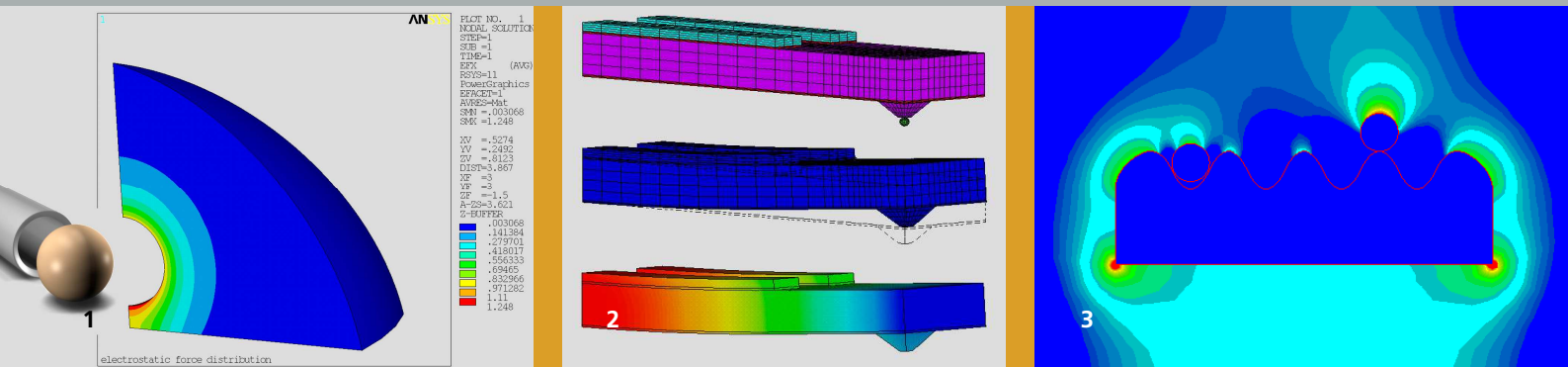




# Fraunhofer IBMT

FRAUNHOFER-INSTITUT FÜR BIOMEDIZINISCHE TECHNIK IBMT



- 1 Force simulation of a spherical electrostatic gripper system for micrometer sized objects.
- 2 Piezoelectrically activated cantilever with pyramidal hollow neede.
- 3 Electrostatic attraction of spherical objects and charged surface topology.

## STIMULATING YOUR DESIGN

### Situation

Biomedical applications like lab-on-chip devices, microsensors and microelectromechanical systems (MEMS) define a highly dynamic and competitive market. The rather complex combination of various physical effects on a small scale make trial-and-error in design and experimental prototyping a time and cost consuming approach.

Physical modelling and simulation mark a breakthrough in shortening time-to-market and reducing development costs for those devices. It supports the creative process from the first principles over simplified designs up to detailed optimization and evaluation of the final device.

We can import your detailed 3-D data from state of the art commercial CAD codes or build the model from scratch. Our simulations cover many industrial fields ranging from mechanical engineering to micro-system technology.

### Computational Methods

- computational fluid dynamics (CFD) simulation approach (ANSYS, FLOTRAN, CFX)
- additional physical effects (electrostatics, piezoelectrics) included by FEA (ANSYS Multiphysics)
- optimization routines as a supplement to commercial codes (genetic algorithms)
- acoustic wave propagation and beam-pattern simulation (tailored code for ultrasonic medical imaging)
- design studies on device geometries imported from 3-D CAD (ProEngineer, AutoCAD, SolidWorks)
- virtual prototyping and result review with 3-D visualization toolkit (3DStudio)
- analytical and semi-analytical approaches (Matlab, Mathematica, Fortran, C++)
- 3-D image reconstruction for experimental evaluation purposes (Amira)

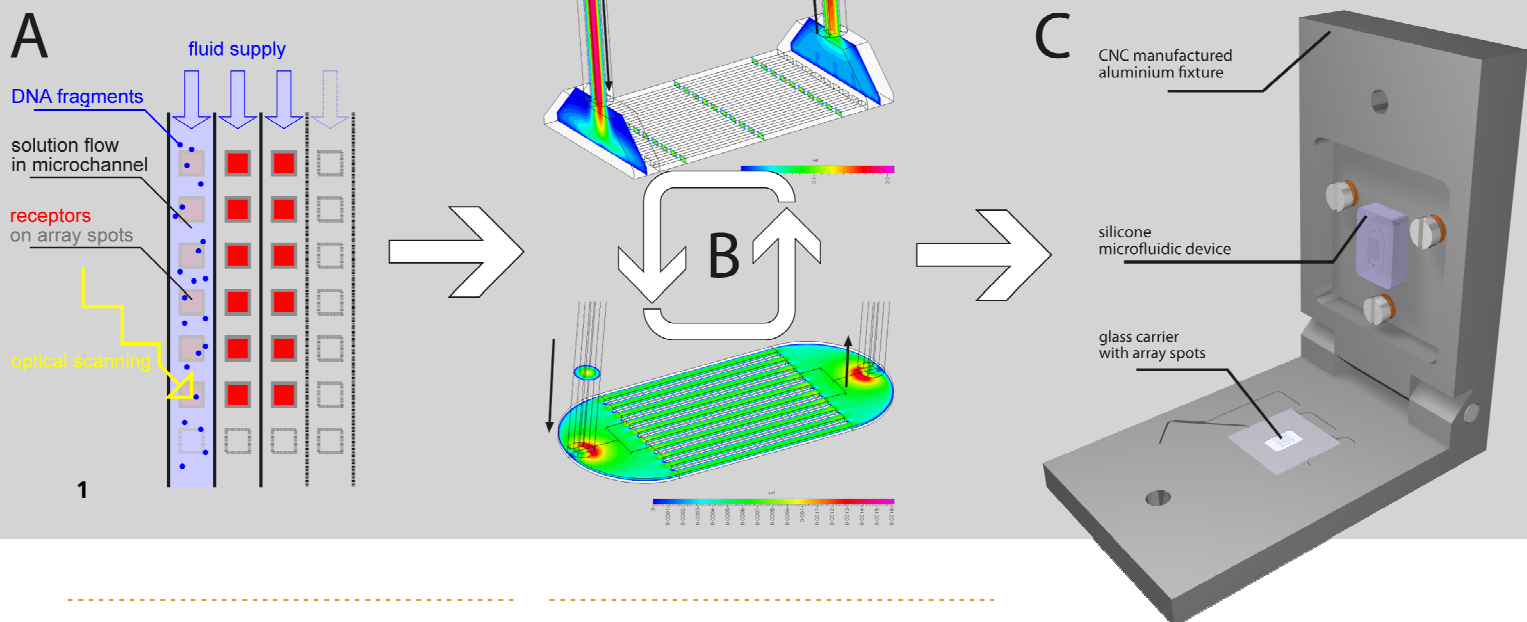
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## Fields of Application

- MEMS modelling (microactuators, micromotors)
- piezoelectric sensor and device design (medical ultrasonic transducers, piezoelectric actuators)
- microfluidic simulations (DNA sequencers, micromixers, microvalves)
- structural (nonlinear) simulations (mechanical engineering)
- thermal design of microstructures (microdispensers, microheaters)
- material property measurement and parameter extraction (piezoelectric ceramics and single crystals, acoustic waveguides)
- 3-D reconstruction and visualization in medical imaging (ultrasound, NMR, thermoimaging)

## Our Offer

Based on the custom specific requirements we can design, test and optimize microfluidic devices, miniaturized sensors and complete lab-on-chip systems by computational methods. Transferring three-dimensional models from CAD programs the complete development is performed in virtual environment fast and cost effective.

Our well trained staff utilizes state of the art commercial software to analyze and optimize your design proposals. If necessary we tailor special purpose code to your and our needs. The measurement systems developed and used at Fraunhofer IBMT ensure a permanent verification of the experimental as well as the simulation results.

This makes IBMT the perfect partner for

- evaluating your approaches
- troubleshooting your design
- outsourcing the complete development and prototyping process.

### **1** Example of a microfluidic device optimization:

*A complete development process for a DNA scanner system supplying a rectangular grid of immobilized receptors with a homogeneous flow of solution. From a first schematic (A) illustrating the basic principles, a design optimization loop of several CFD simulations based on different geometries (B) to a final design (C) realized as a 3-D CAD virtual prototype ready for transfer to a CNC process.*