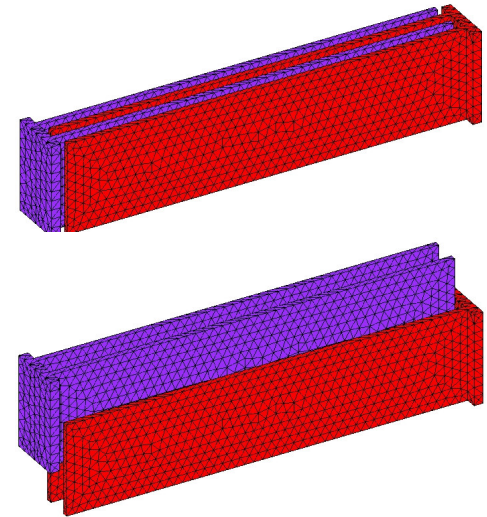
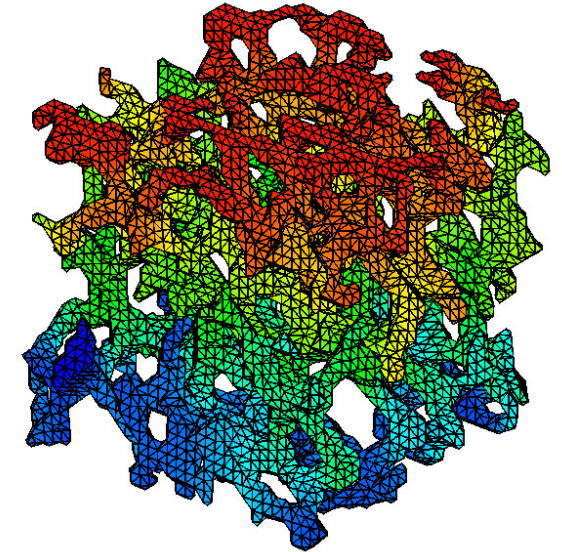
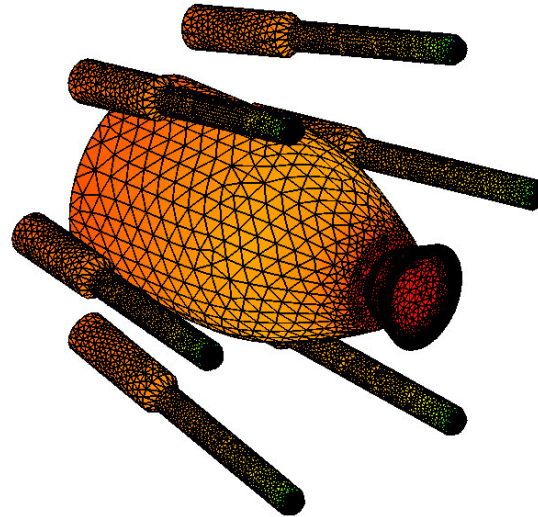
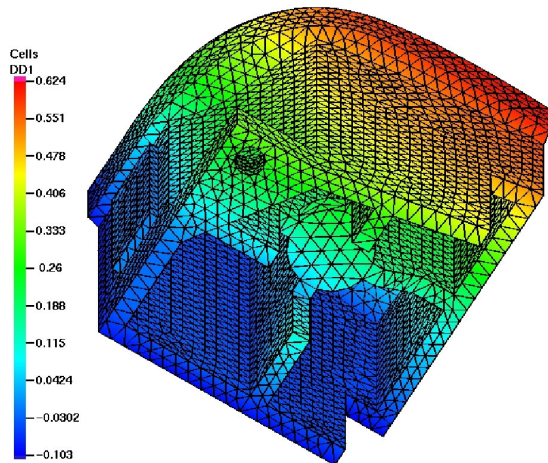


Fast Boundary Element Methods

- surface triangulation of complex structures
- exterior boundary value problems
- moving boundaries
- direct computation of the complete Cauchy data



Fast Boundary Element Methods

Indirect ansatz for the Dirichlet boundary value problem of the Laplacian:

$$u(x) = (Vw)(x) := \int_{\Gamma} \frac{1}{4\pi} \frac{1}{|x-y|} w(y) ds_y = g(x) \quad \text{for } x \in \Gamma = \partial\Omega.$$

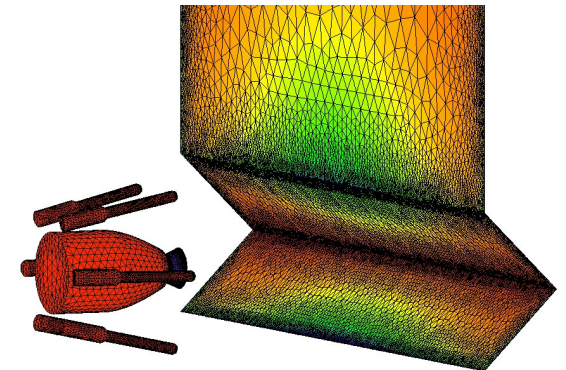
Fast Multipole Method: (related to Hierarchical Matrices)

- separation of variables for the kernel by spherical harmonics
- hierarchy provides fast application of matrix vector multiplication ($\mathcal{O}(N \log^2 N)$)

Preconditioning: BPX, AMG, boundary integral operator of opposite order

Applications:

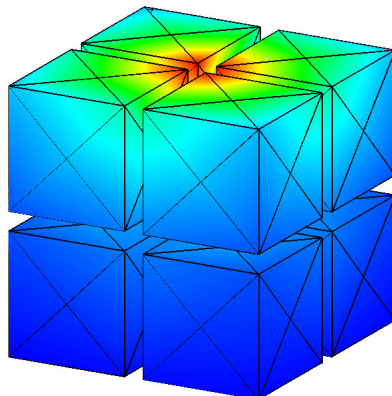
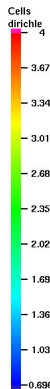
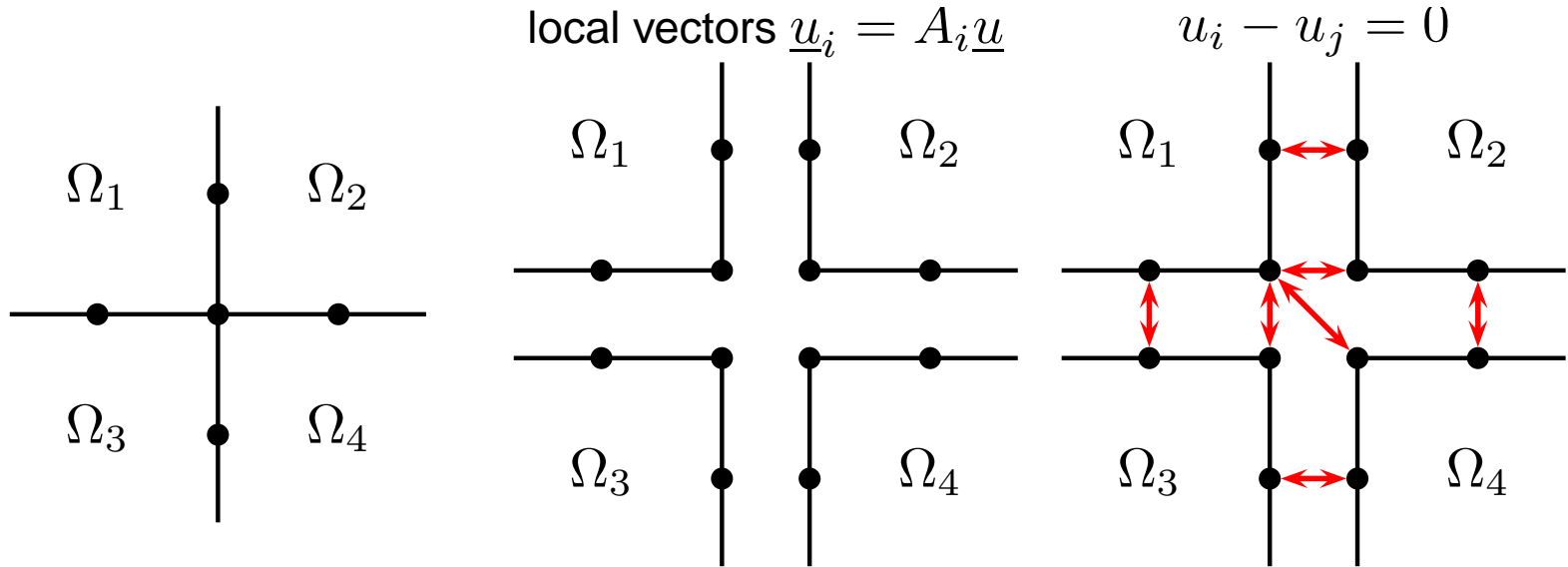
- | | |
|-----------------------|-----------------------------|
| • Laplace | • Collision detection |
| • Linear Elastostatic | • Electromagnetics (Breuer) |
| • Stokes system | • Acoustics (Fischer, Gaul) |



Domain Decomposition Methods

Boundary Element Tearing and Interconnecting method (BETI)

[Langer, Steinbach 2003] (FETI [Farhat, Roux 1991; Klawonn, Widlund 2001; . . .]):



Outlook:

- real life applications
- coupling with finite elements
- nearly incompressible materials

Cooperations:

- saddle point formulations
- AMG
- coupling
- inverse problems, optimization