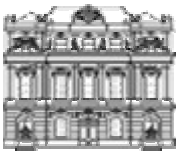

ÖAW - RICAM

Johann Radon Institute for Computational and Applied Mathematics

der

Österreichischen Akademie der Wissenschaften

Group Seminar

Group: Computational Methods for Direct Field Problems

Dirk Langemann

University of Rostock – Insitute for Mathematics

"Numerical simulation of the deformation and the motion of a water droplet in an electric field"

Water droplets on outdoor insulators of high-voltage equipment influence strongly the aging process and thus the insulating and hydrophobic properties of the material. The investigation of the behaviour of a single water droplet in a strong electric field leads to a coupled problem. The mechanical deformation of the droplet depends on the ponderomotoric force density acting on the droplet surface and vice versa. We get a free boundary value problem for the electric potential with the free droplet surface. This surface is described by a boundary value problem itself. The feedback loop is numerically decoupled by an iteration over both the sub-problems.
Modelling the deformation of the droplet and its interaction with the electric field is an essential part of the work. Particular questions are the dependency of the contact angle and of the growth of the ponderomotoric force density near the triple line on the electric field.
We use dissipative pseudo-transient processes for solving the non-linear mechanical sub-problem as well as for discussing the convergence of the iteration mentioned above.
The electric sub-problem consists in a 3d elliptic problem with material interfaces. After a restriction to a bounded domain, it is solved by finite elements on an adapted triangular mesh designed for the needs of the coupled problem.
We present 2d and 3d results of the deformation of dielectric and conductive droplets. Finally, it is shown that the total ponderomotoric force acting on an uncharged body is not vanishing in general. A method to approximate the motion of uncharged droplets in an electric field is given. We show a sample droplet moving on the surface of an insulator. Such droplets leave dry bands and water films which further the development of undesired electric currents or flash-overs.

Montag, 14. März 2005, 15:30
Hochschulfondsgebäude, Raumnr. 136