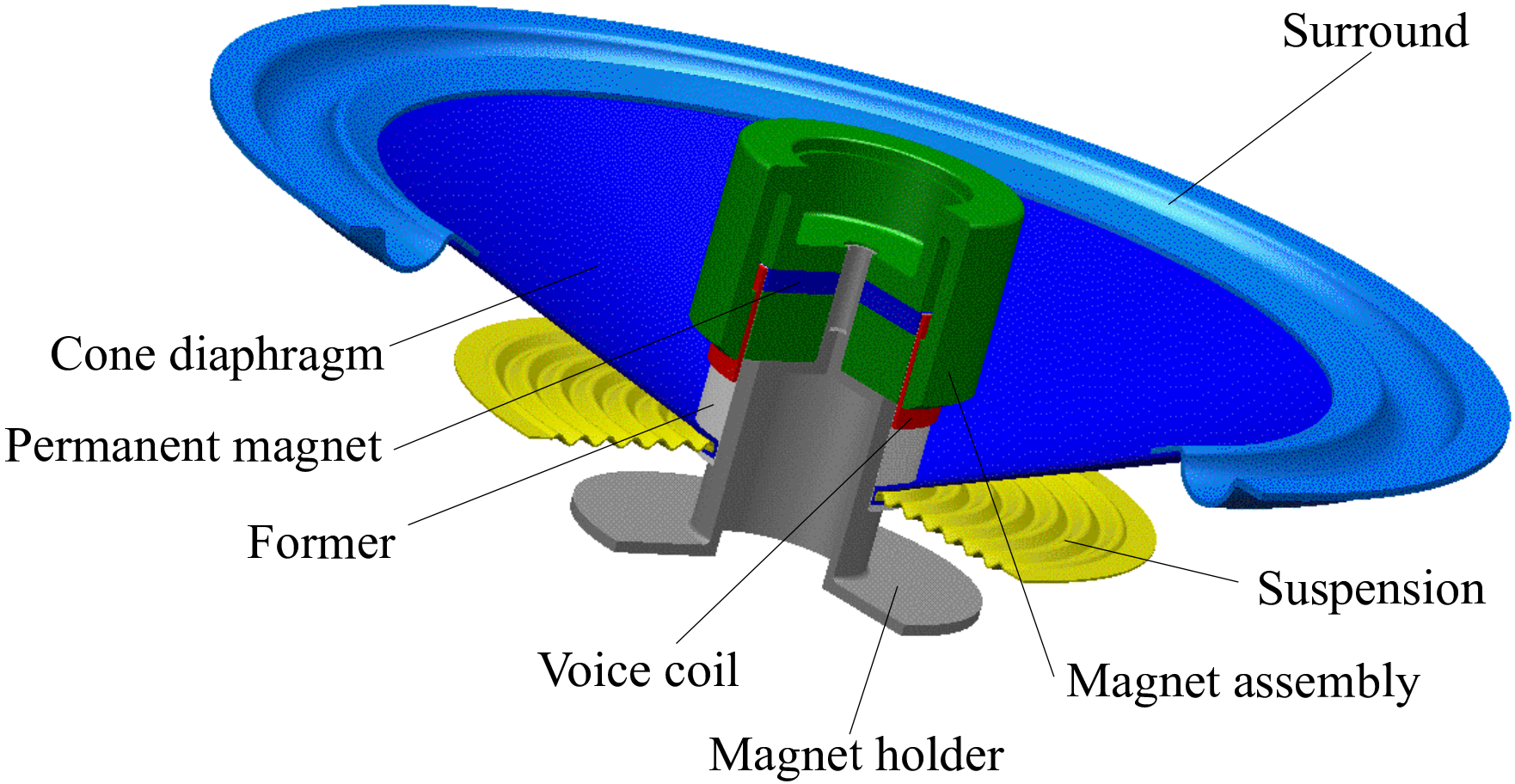
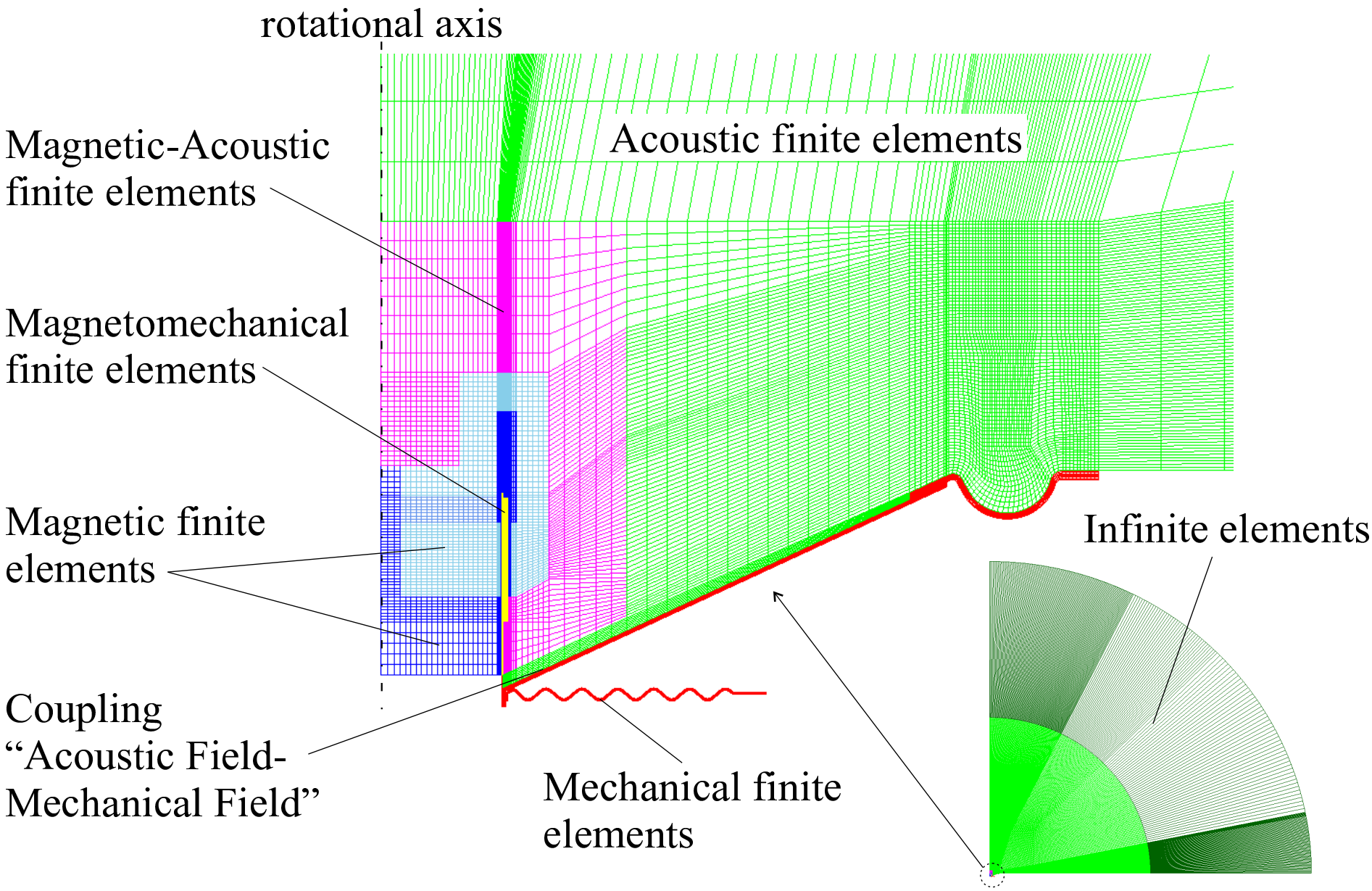
Schematic of an Electrodynamic Loudspeaker



FEM-Model of an Electrodynamic Loudspeaker



Problems in this simulation

I. Large number of unknowns (> 200.000) and time steps (> 10.000)

II. Moving parts cause mesh distortion

⇒ **Solution with our software**

ad I. Efficient algorithms and solvers

ad II. New modeling scheme for a voltage loaded moving coil

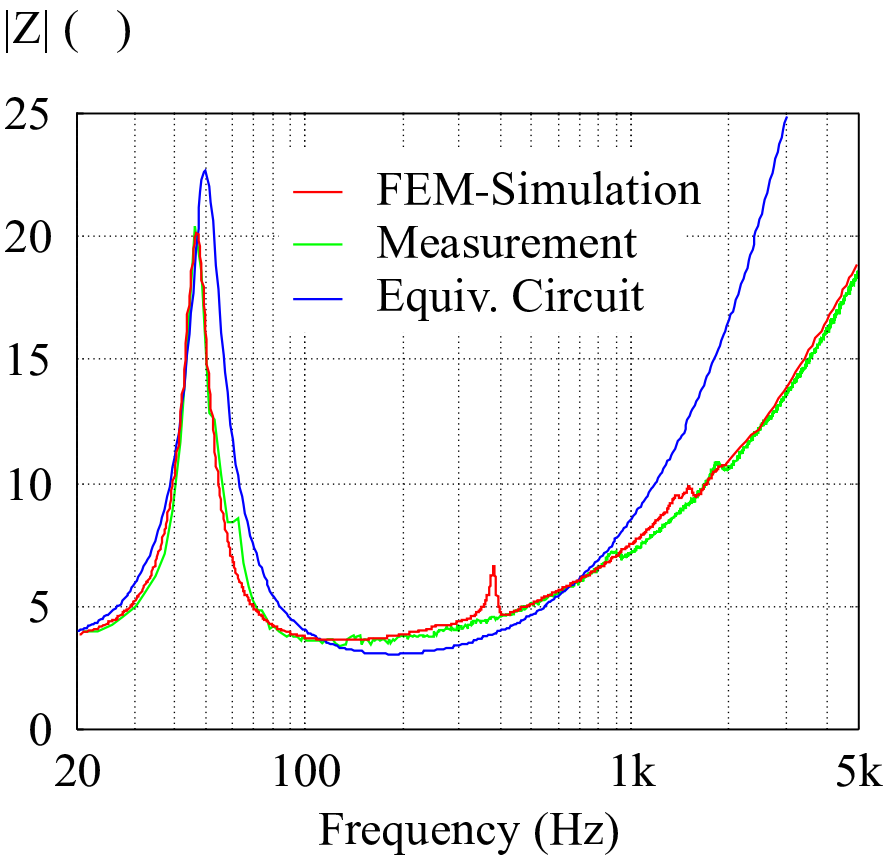
Current state of the art:

- Computer tools based on equivalent circuit representations
  - Do not show complex or wavelike properties
  - Circuit element parameters have to be determined empirically by measurements
- Commercially available BEM-packages
  - Work effectively only in the frequency domain

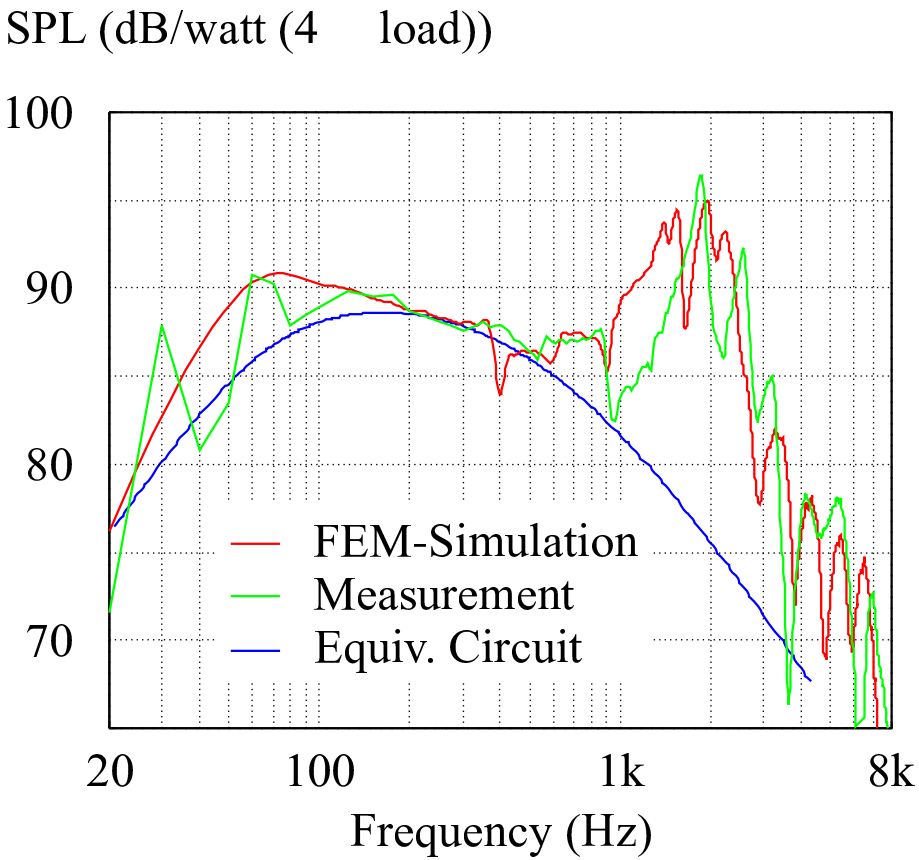
  ⇒ CPU-time will be enormous for the computation of frequency responses
- Commercially available FEM-packages
  - Standard iterative coupling scheme
  - Uneconomic algorithms and data structures in respect to such problems

Measurement vs. FEM vs. Classical analysis

Electrical input impedance



Axial pressure response at 1m
(Voltage clamping)



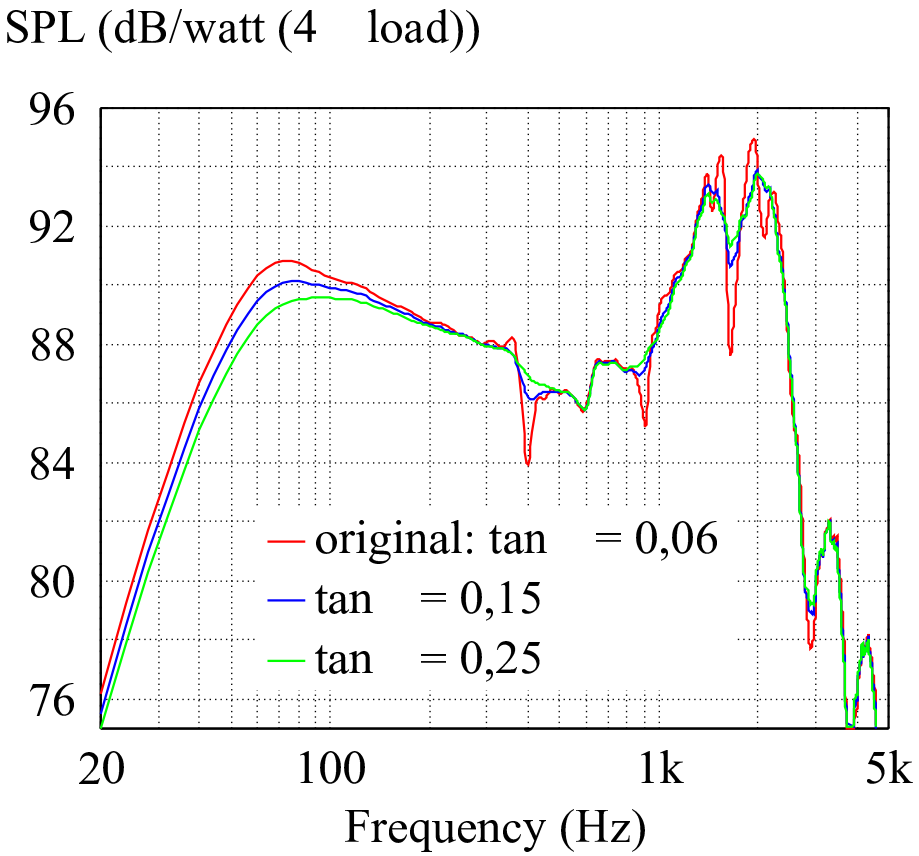
Advantage of our software-package:

- Efficient computation of the magnetic, mechanical and acoustic fields including their couplings in a **single** computer run
- Consideration of coupled nonlinear effects in mechanics and magnetics
- Sophisticated algorithms, solvers and data structures
- Possibility to choose location and type of output results
- Dedicated to the modeling of sensors and actuators

Optimization of loudspeaker-design parameters

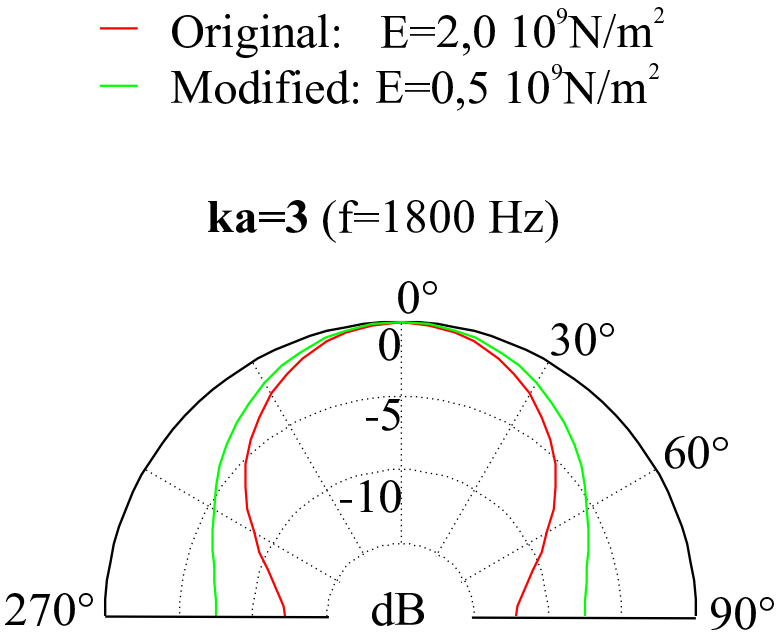
Elimination of response dips

by increased surround-loss factor



Improvement in directivity patterns

by decreased modulus of elasticity E of the diaphragm



Conclusion

- Numerical scheme for the computer modeling of electromagnetic actuators
- Investigation of complex interactions of magnetic, mechanical and acoustic fields
- Optimization of design parameters and limits