KATHOLIEKE UNIVERSITEIT LEUVEN

kulak

Wave Propagation and Signal Processing Research Group

Stochastic Response Surface Method for Studying Microphoning and Lorentz Detuning of Accelerator Cavities

J. Deryckere, Toon Roggen, B. Masschaele, H. De Gersem

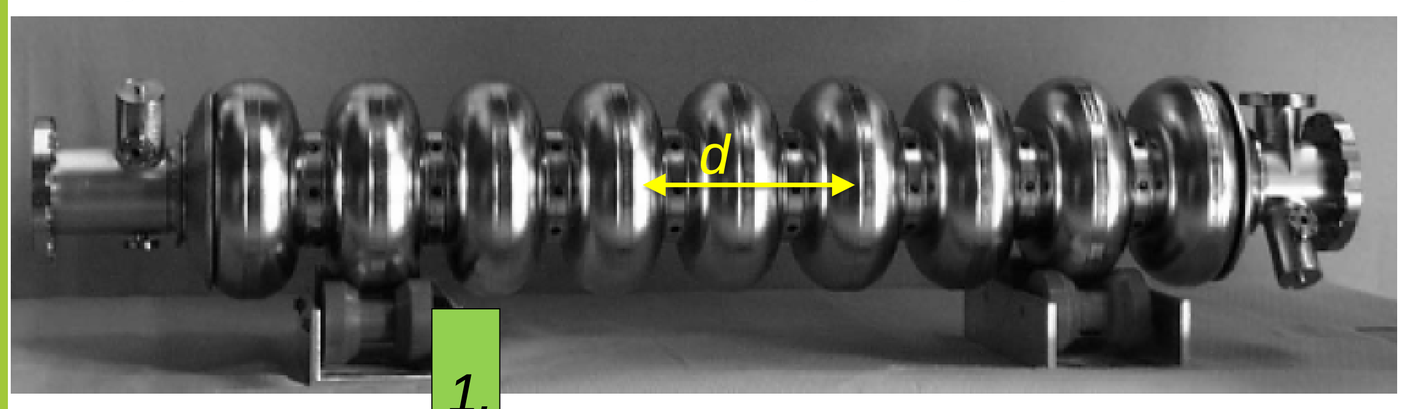
abstract

The dependence of the resonant frequency of an RF cavity on its geometry is represented by a stochastic response surface model, which is constructed on the basis of a few eigenmode solutions extended with sensitivity information. The response surface model is used for statistic analysis and for calculating the effect of Lorentz detuning.

problem statement

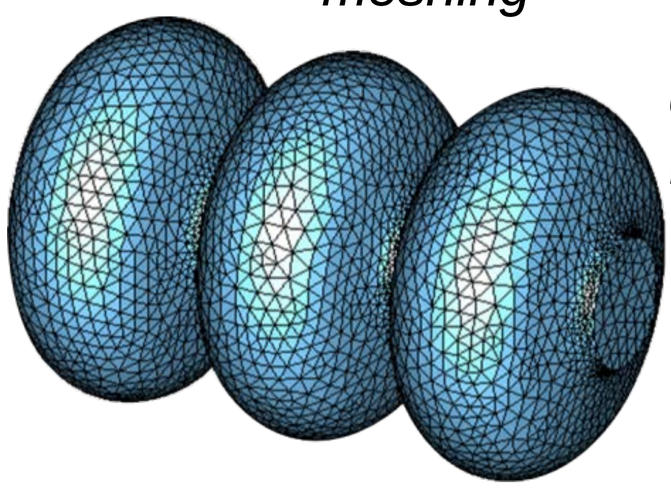
- cavity is tuned to the particle velocity
- resonance frequency is determined by the cavity geometry
- geometry influenced by
  1. production tolerances
  2. vibrations (microphoning)
  3. electromagnetic radiation (Lorentz detuning)
- high accuracies required (10^{-4})

cavity (resonator) for accelerating charged particles



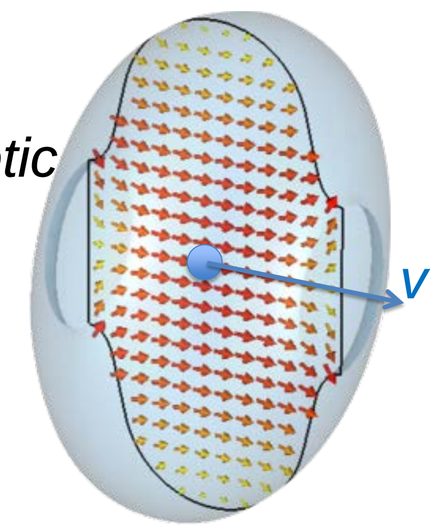
1. numerical model

meshing



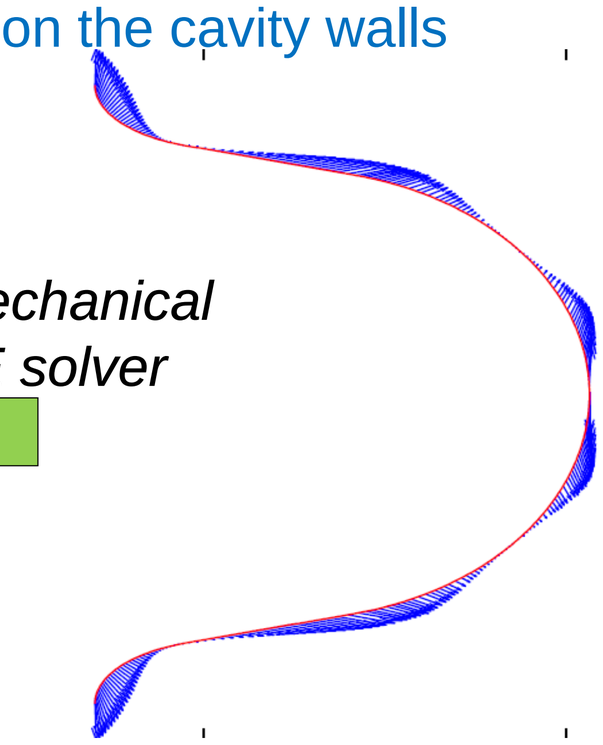
2. *electromagnetic FE solver*

accelerating eigenmode



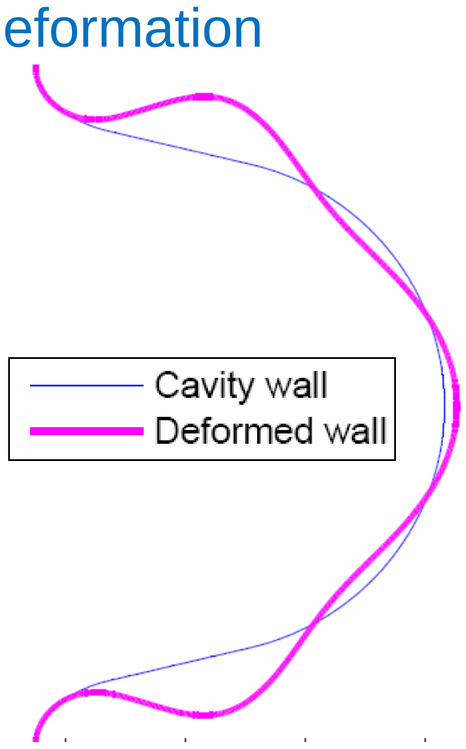
3. *post-processing*

electromagnetic pressure on the cavity walls



4. *mechanical FE solver*

mechanical deformation



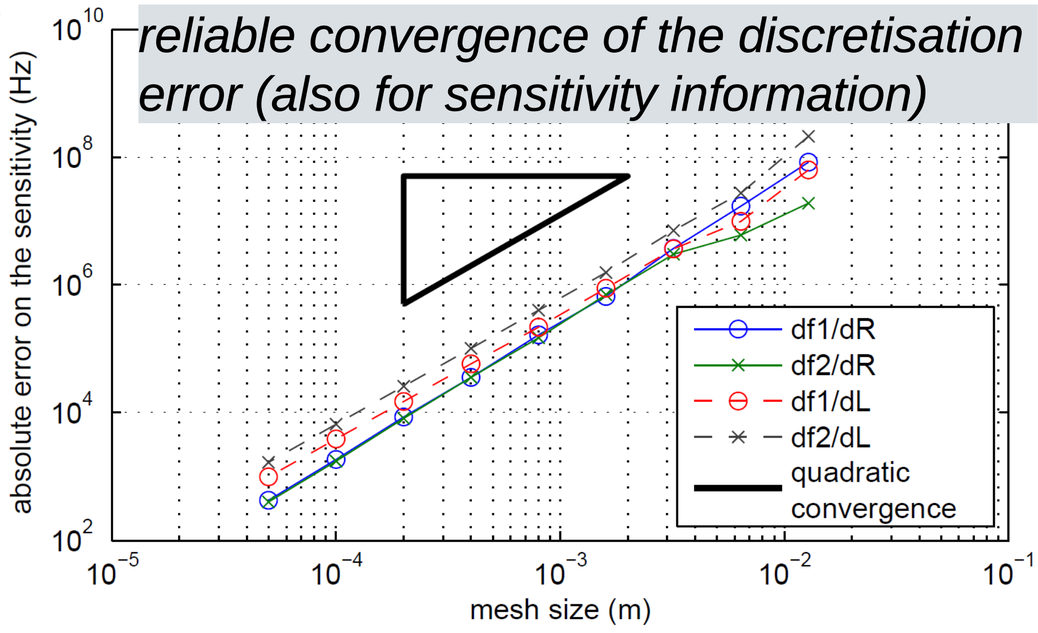
5. *geometry change*

deformation amplified by a factor 100

coupled finite-element analysis

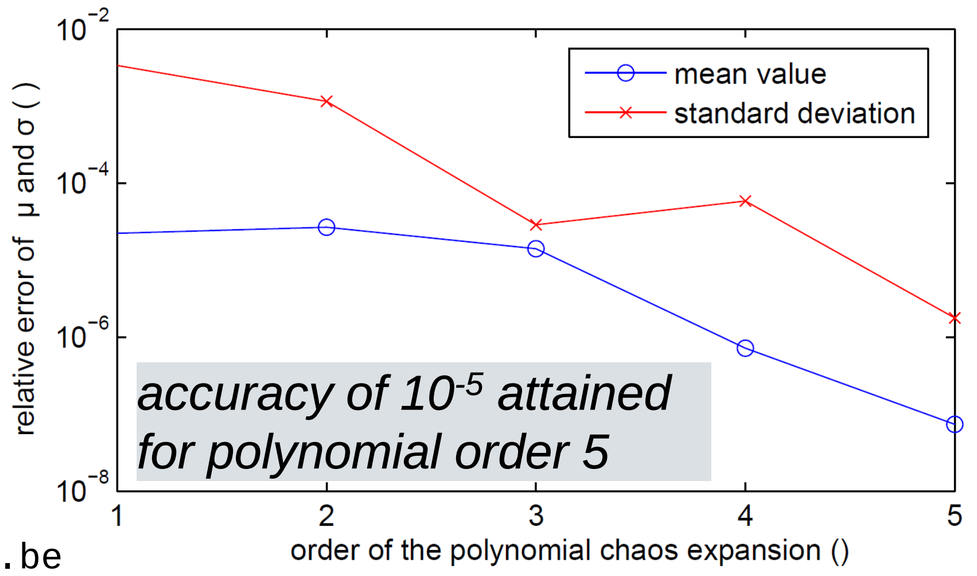
- electromagnetic eigenmodes
- mechanical deformation

reliable convergence of the discretisation error (also for sensitivity information)



stochastic analysis

Monte Carlo simulation on the stochastic response surface model



toon.roggen@kuleuven-kulak.be