Focus Session: Advanced Topics in Acoustics

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COMSOL CONFERENCE
2015 BOSTON

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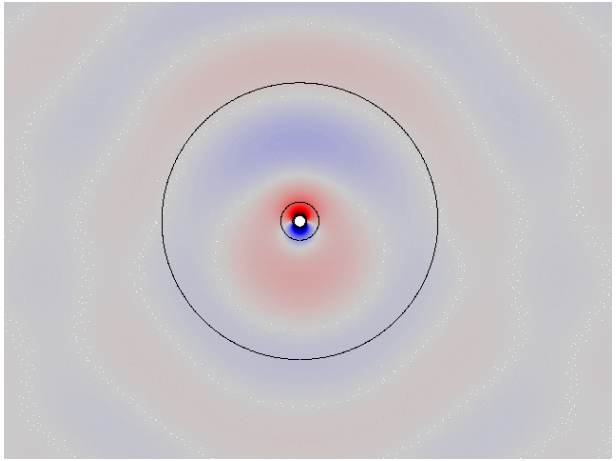
Schedule

- Examples of advanced acoustic applications
- The acoustics roadmap
- The invited presenters



Thermoviscous scattering off a small elastic particle modeled using thermoelasticity. See COMSOL Blog in October.

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Advanced Acoustic Applications

- Non out-of-the-box problems
  - Manual coupling of physics and/or spatial dimensions
  - User defined equations and expressions
- Optimization
- Models and features that drive the development of the Acoustics Module
  - Customer inputs and suggestions
  - Results form the academic world
- All this is possible in COMSOL Multiphysics!

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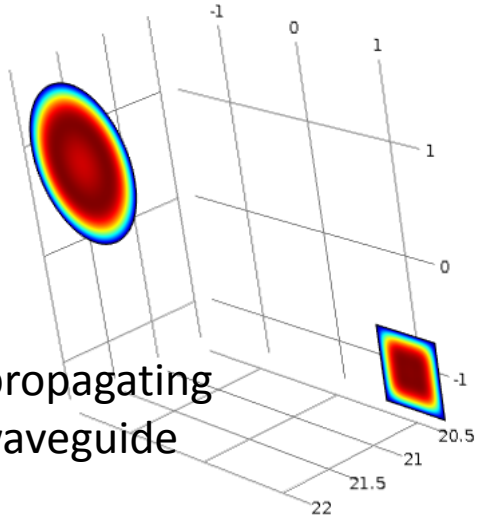
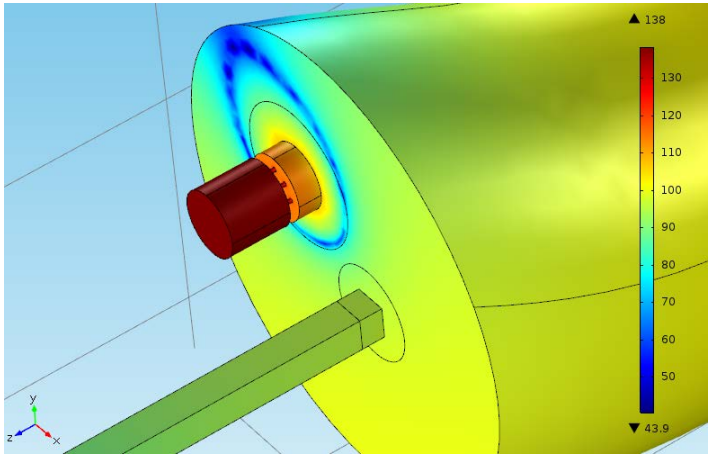
Advanced Acoustic Applications

- Port Conditions in Thermoacoustics



Solve for propagating mode in waveguide (p, $\boldsymbol{u}$, T)



Couple:

- Pressure Acoustics and Thermoacoustics
- End impedance
- Lumped speaker model

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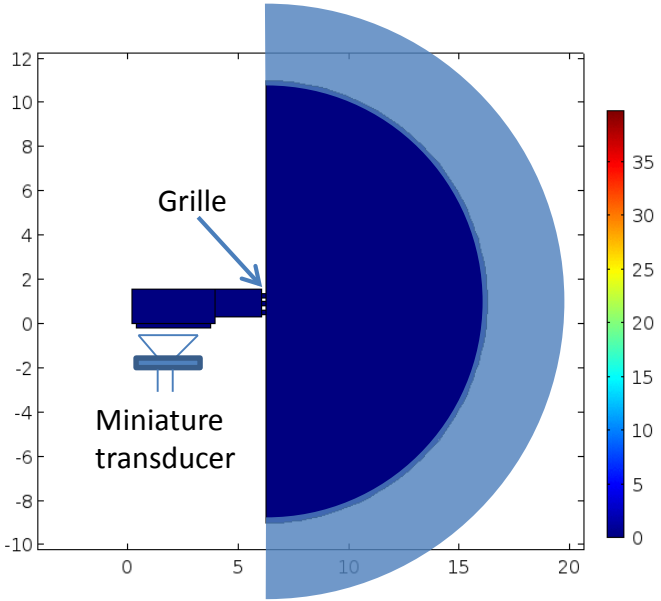
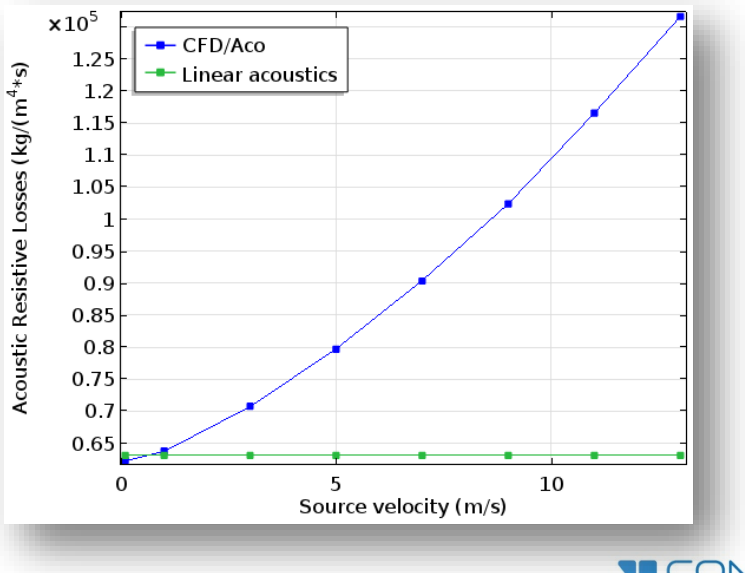
Advanced Acoustic Applications

- Non-linear Losses in Fluid





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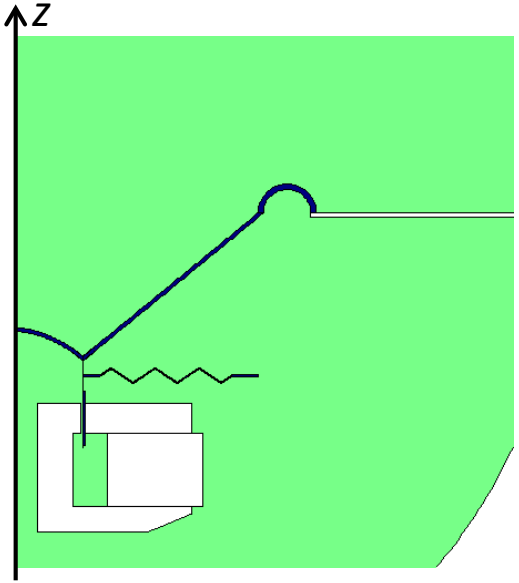
Advanced Acoustic Applications

- Non-linear Losses in Structure



- Transient model
- Geometric non-linearity in solids
- Material models for rubber etc.
- Linear acoustics
- Harmonic distortion products (frequency doubling)
- Total harmonic distortion (THD)

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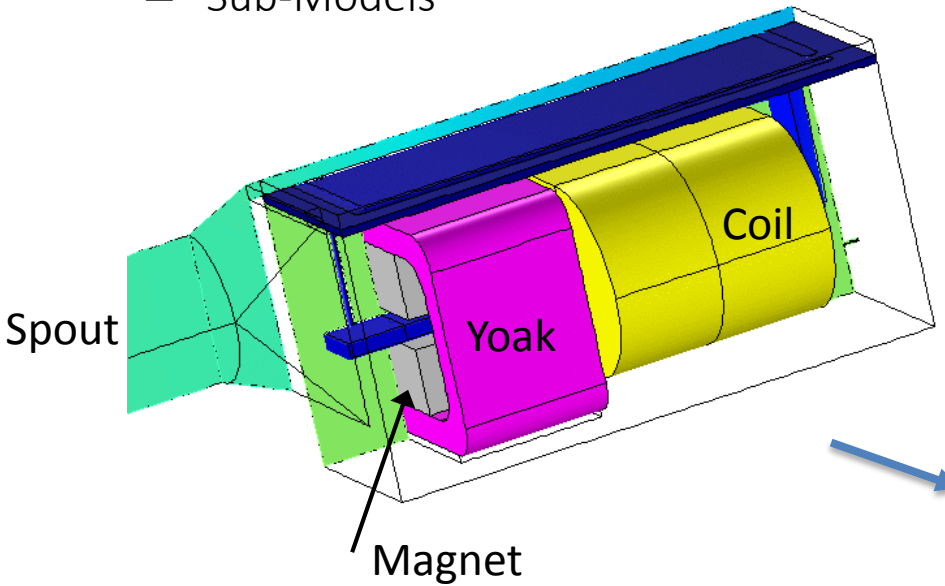
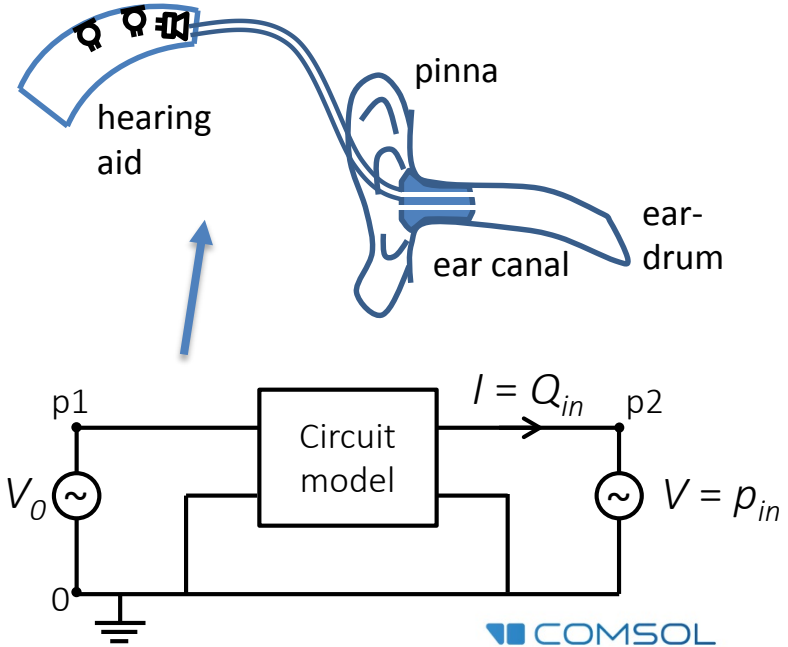
Advanced Acoustic Applications

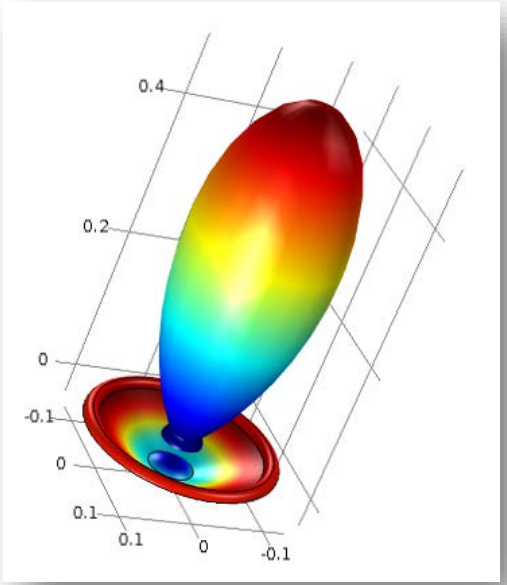
- Device Modeling and System Modeling
  - Sub-Models





Advanced Acoustic Applications

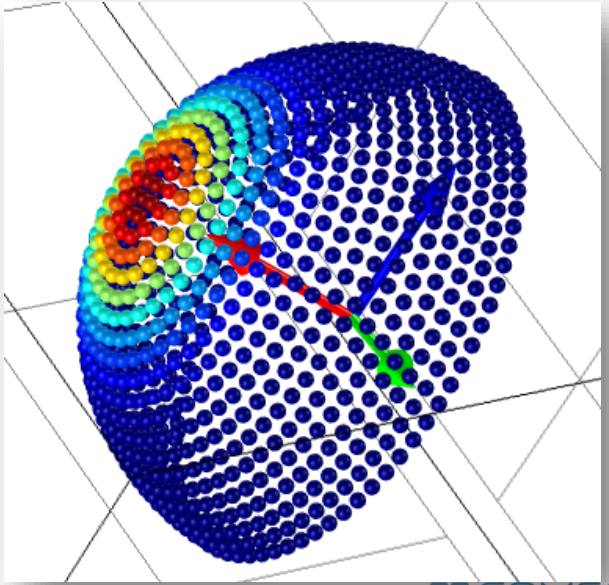
- Realistic Ray Acoustics Speaker Source: FEM to Ray Coupling



FEM

Intensity match at 1 m

Phase match at 1 m



Ray Acoustics

Special Operators and Modeling Doc

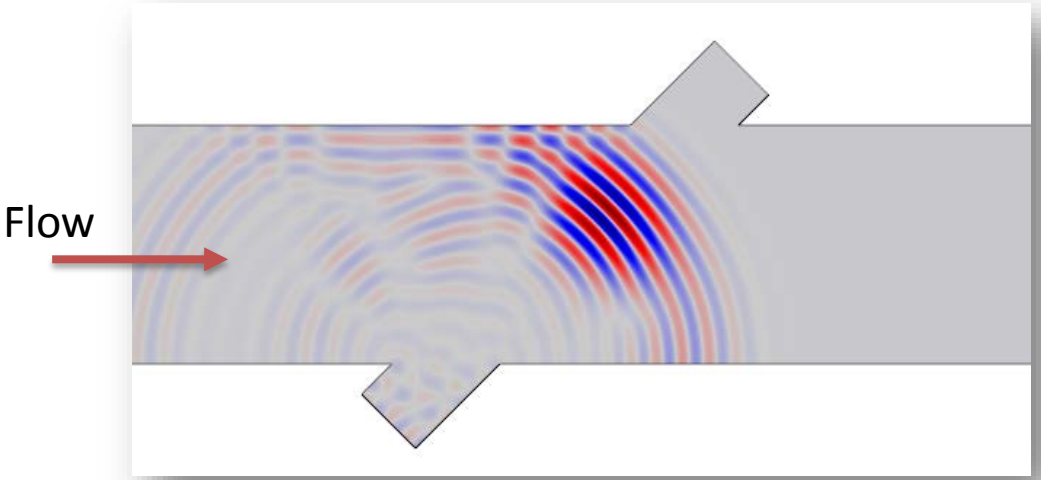
- In the documentation look for *Built-In Operators:*
  - withsol() and with()
  - at2(), at3()
  - timeint()
  - sum()
- In the Acoustics Module User's Guide have a look at the *Modelling* chapters

The Acoustics Roadmap

- Time explicit methods using discontinuous Galerkin (DG)
- Ports in acoustics
- Physics induced mesh
- Boundary elements (BEM)

The Acoustics Roadmap

- Time Explicit Methods using Discontinuous Galerkin (DG)



- Memory efficient
- Solve large problems in 3D!
- Intrinsic numerically stable for, for example, Linearized Euler
- Conservative form
- Scales well on clusters

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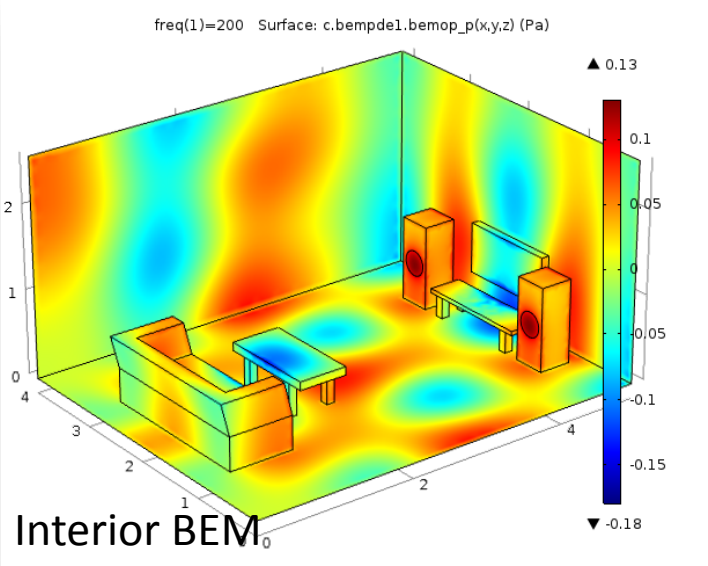
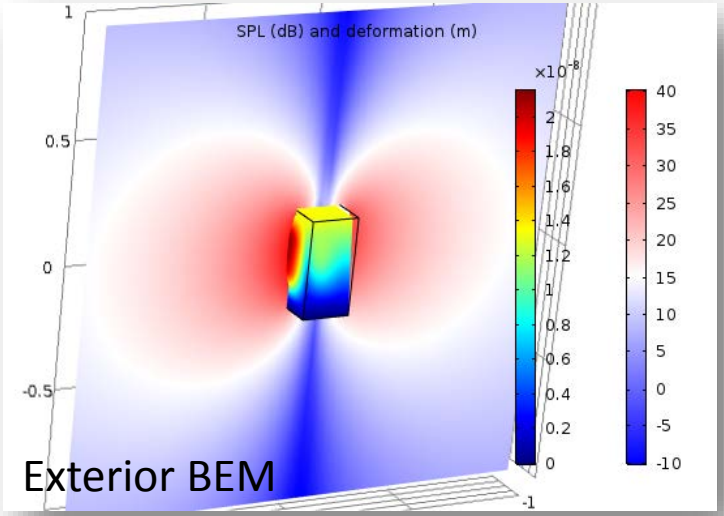
The Acoustics Roadmap

- Boundary Elements (BEM)





- Large radiating bodies
- “Far-field” for vibrating structures
- FEM-BEM models

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The Invited Presenters

- **Modeling Metamaterials with a Time-Domain Perfectly Matched Layer Formulation**
  Hisham Assi and R. S. C. Cobbold
  University of Toronto, Toronto, ON, Canada

- **PA Loudspeaker System Design Using Multiphysics Simulation**
  Riccardo Balistreri
  QSC Audio Products, LLC., Costa Mesa, CA, USA

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