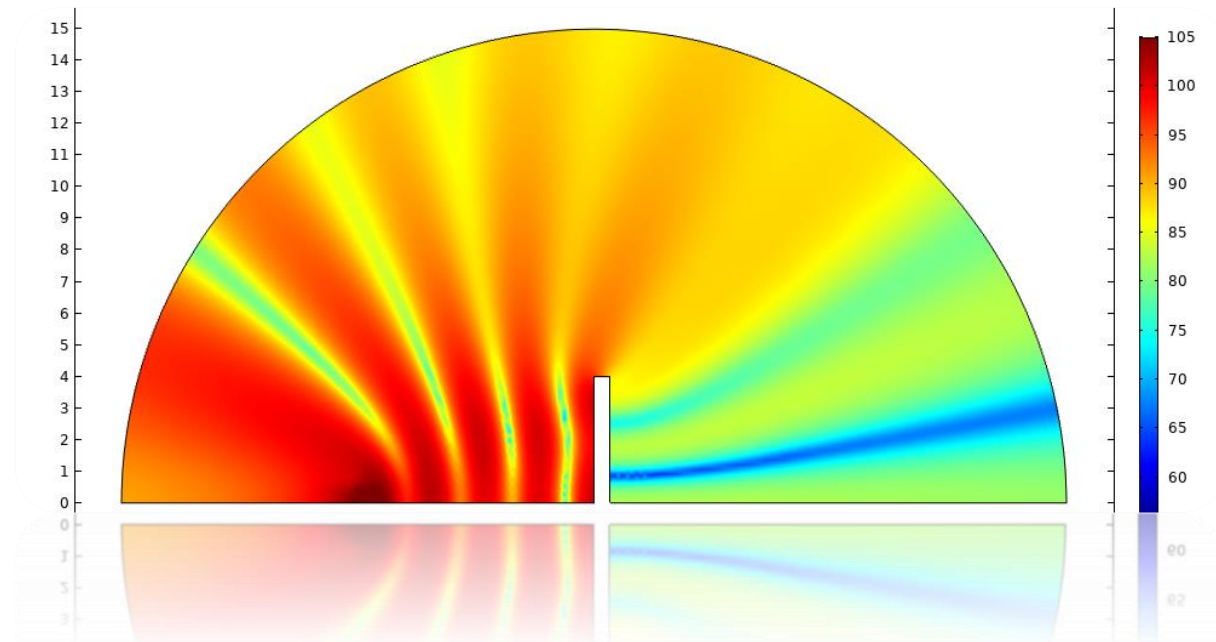




# Visualization of a Noise Barrier for Educational Purposes

Yvonne Heggemann, Tabea Breitkreutz



# Contents

1. Project Idea
2. Educational Objective
3. App Layout
4. Methodology
5. Fields of Application

# Project Idea

# Project Idea

## Network



**Leadership:**

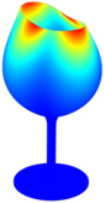
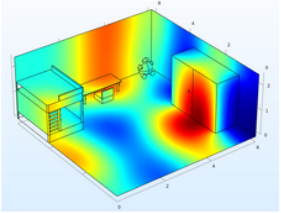


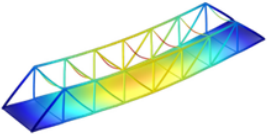

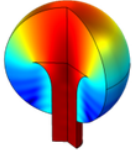
**TU Munich**  
Johannes Schmid  
Michael Buba

**Cooperation with:**



# Project Idea

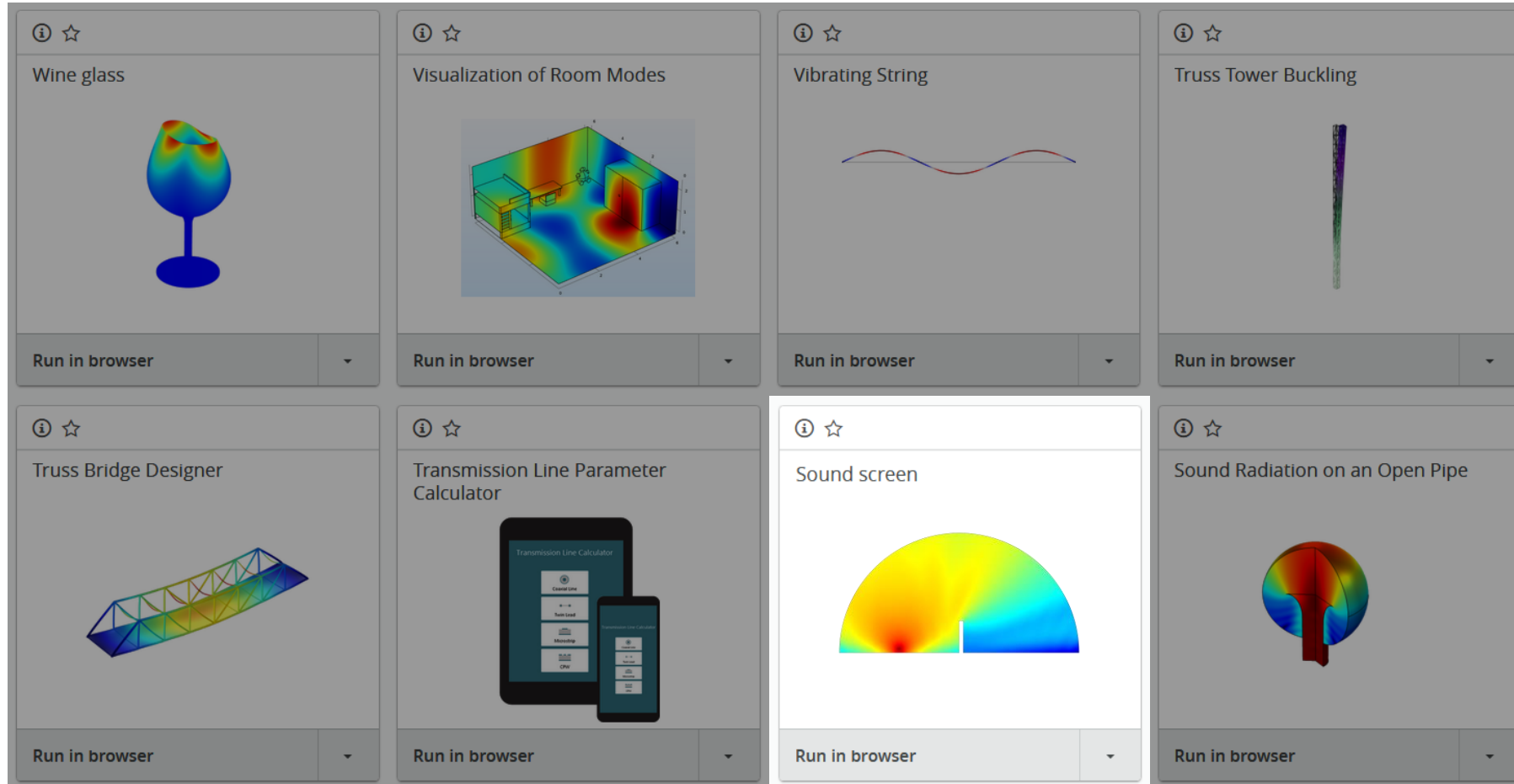
## App Library

<p>📄 ☆</p> <p>Wine glass</p>  <p>Run in browser ▾</p>	<p>📄 ☆</p> <p>Visualization of Room Modes</p>  <p>Run in browser ▾</p>	<p>📄 ☆</p> <p>Vibrating String</p>  <p>Run in browser ▾</p>	<p>📄 ☆</p> <p>Truss Tower Buckling</p>  <p>Run in browser ▾</p>
<p>📄 ☆</p> <p>Truss Bridge Designer</p>  <p>Run in browser ▾</p>	<p>📄 ☆</p> <p>Transmission Line Parameter Calculator</p>  <p>Run in browser ▾</p>	<p>📄 ☆</p> <p></p> <p>Run in browser ▾</p>	<p>📄 ☆</p> <p>Sound Radiation on an Open Pipe</p>  <p>Run in browser ▾</p>

Source: <https://apps.vib.ed.tum.de:2037/app-lib>

# Project Idea

## App Library



Source: <https://apps.vib.ed.tum.de:2037/app-lib>

# Educational Objective

# Educational Objective

## **Simulate the impact of a noise barrier**

- Diffraction on the edge of the wall
- Show the impact of a movable measurement point
- How do different absorption coefficients influence the sound?

## **Compare simulation and calculations**

regarding different parameters in DIN compliant scenarios



# App Layout

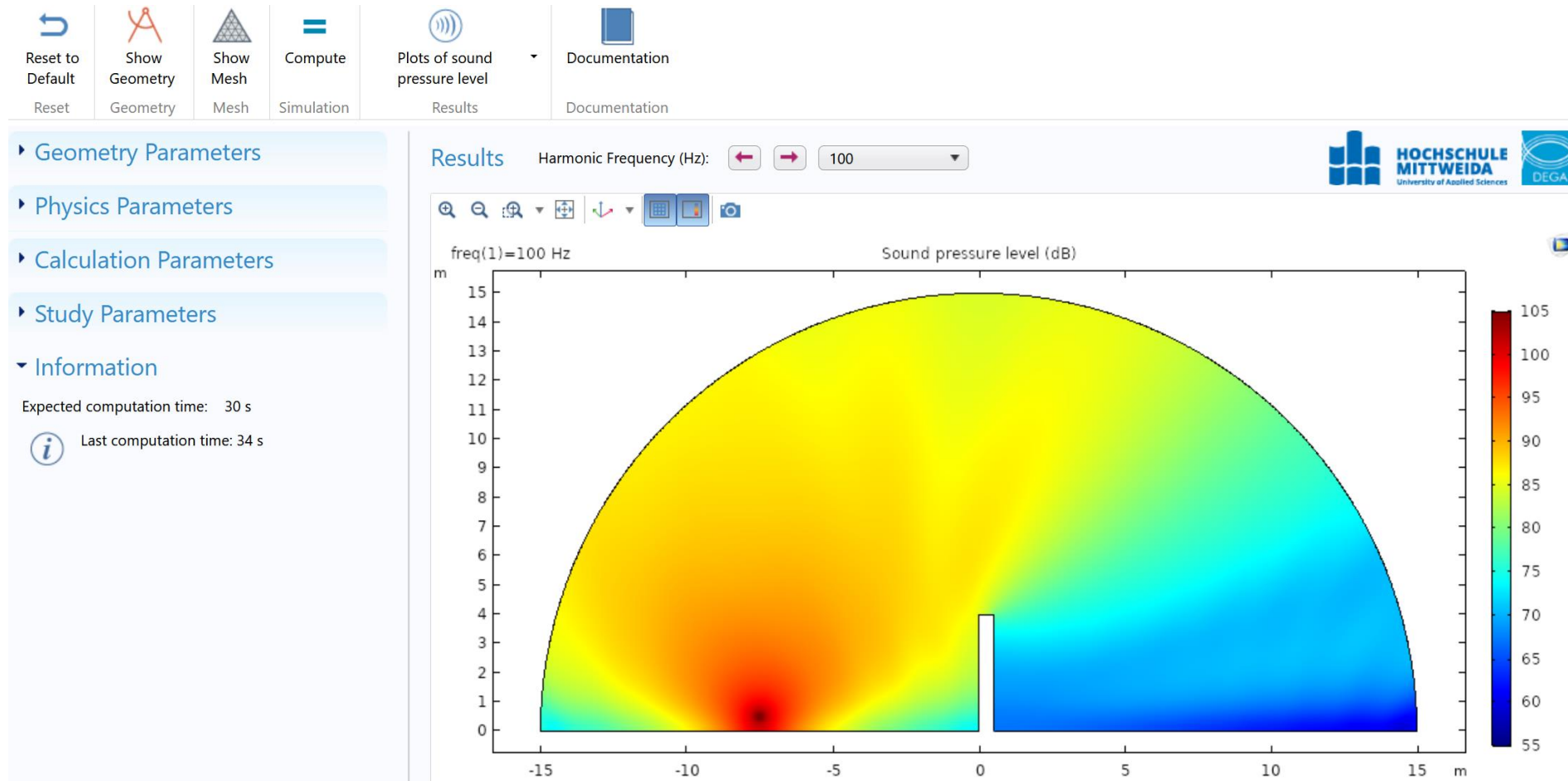
# App Layout

## General Structure

The screenshot displays a software application interface for noise barrier simulation. At the top, a toolbar contains icons for 'Reset to Default', 'Show Geometry', 'Show Mesh', 'Compute', 'Plots of sound pressure level', and 'Documentation'. Below the toolbar, a sidebar on the left lists parameter categories: 'Geometry Parameters', 'Physics Parameters', 'Calculation Parameters', 'Study Parameters', and 'Information'. The 'Information' section shows 'Expected computation time: 30 s' and 'Last computation time: 34 s'. The main area is titled 'Results' and features a 'Harmonic Frequency (Hz)' dropdown set to '100'. The central plot shows a semi-circular noise barrier on a coordinate system with axes ranging from -15 to 15 meters. A vertical barrier is located at x=0, and a small square marker is at approximately (10, 4.5). The plot includes a toolbar with zoom and pan controls.

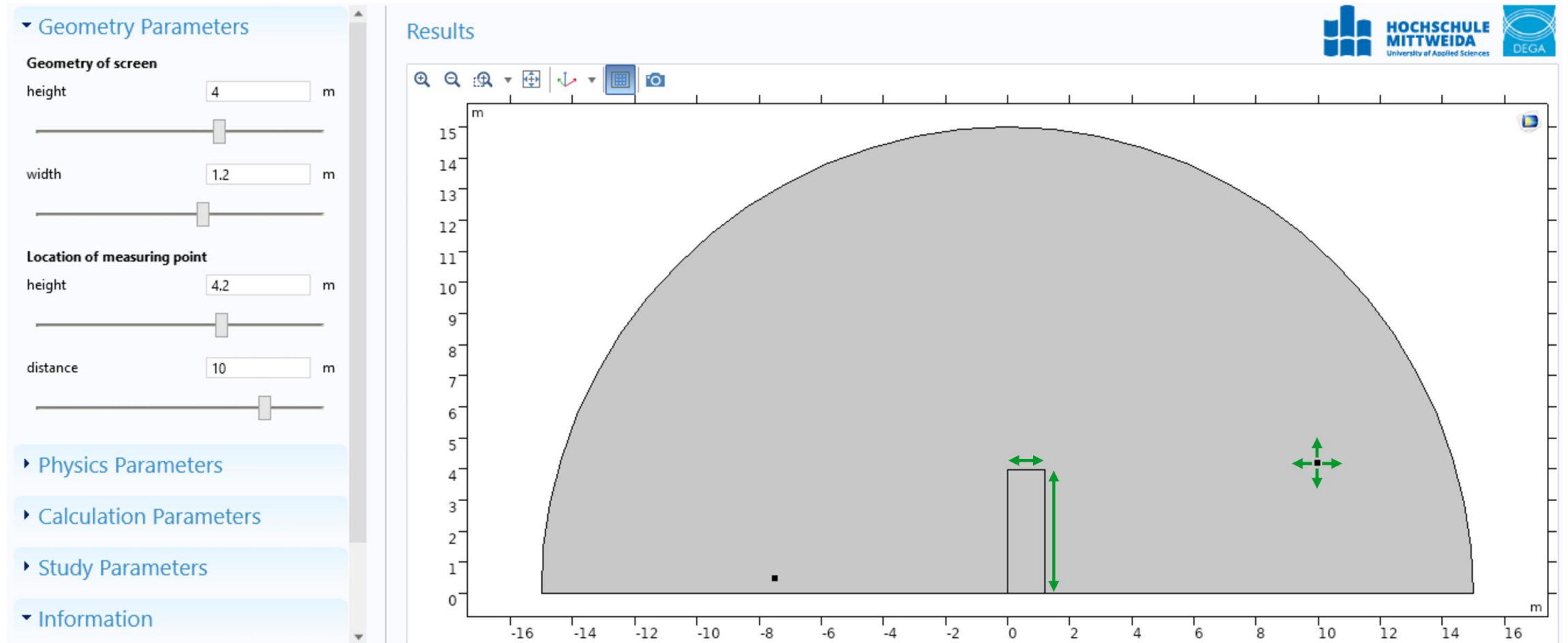
# App Layout

## General Structure



# App Layout

## Geometry



# App Layout

## Physics

### Geometry Parameters

### Physics Parameters

Sound power level of source  dB  
Density of air:  kg/m<sup>3</sup>  
Speed of sound in air:  m/s

#### Reflection settings

absorption coefficient of street

$\alpha_{st} =$

absorption coefficient of floor behind screen

$\alpha_f =$

absorption coefficient of the screen facing the car

$\alpha_s =$

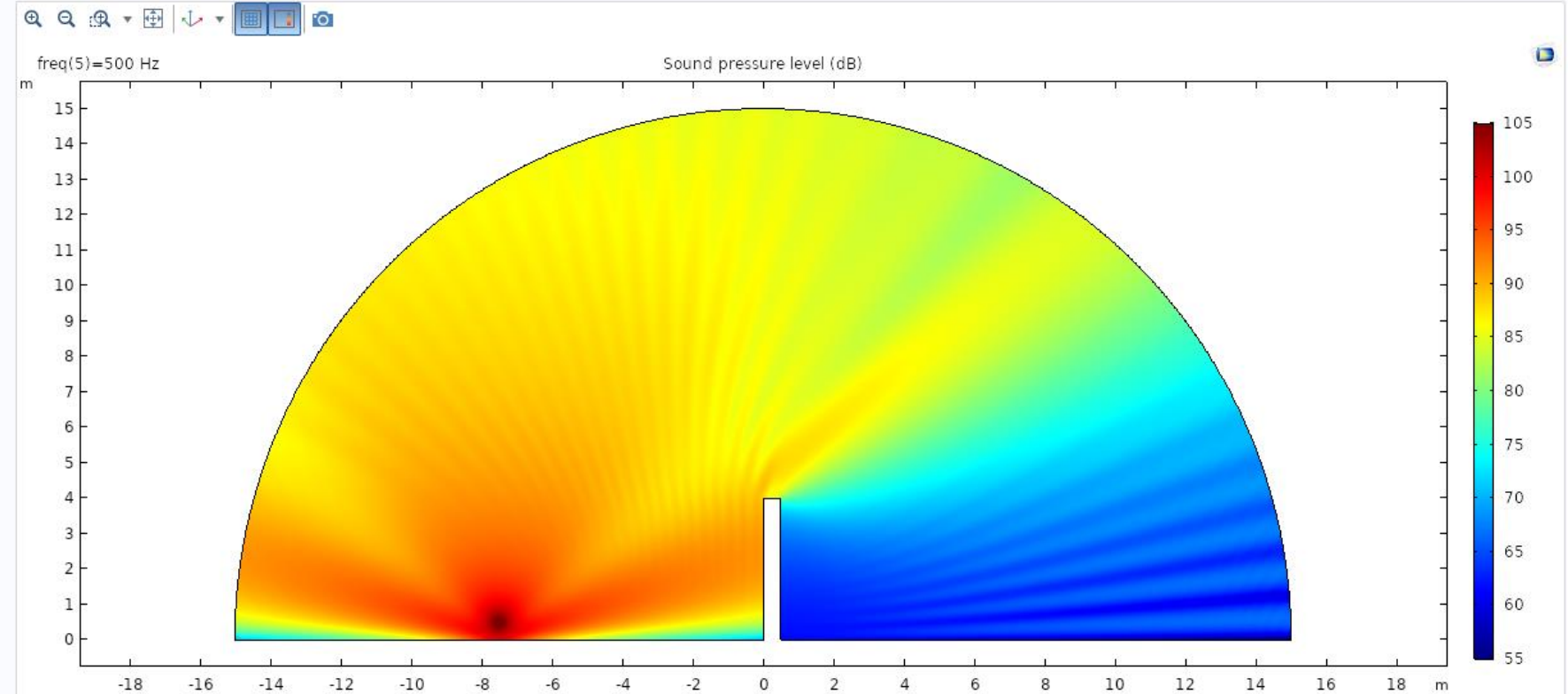
### Calculation Parameters

### Study Parameters

### Information

### Results

Harmonic Frequency (Hz):



# App Layout

## Physics

### ▶ Geometry Parameters

### ▼ Physics Parameters

Sound power level of source  dB

Density of air:  kg/m<sup>3</sup>

Speed of sound in air:  m/s

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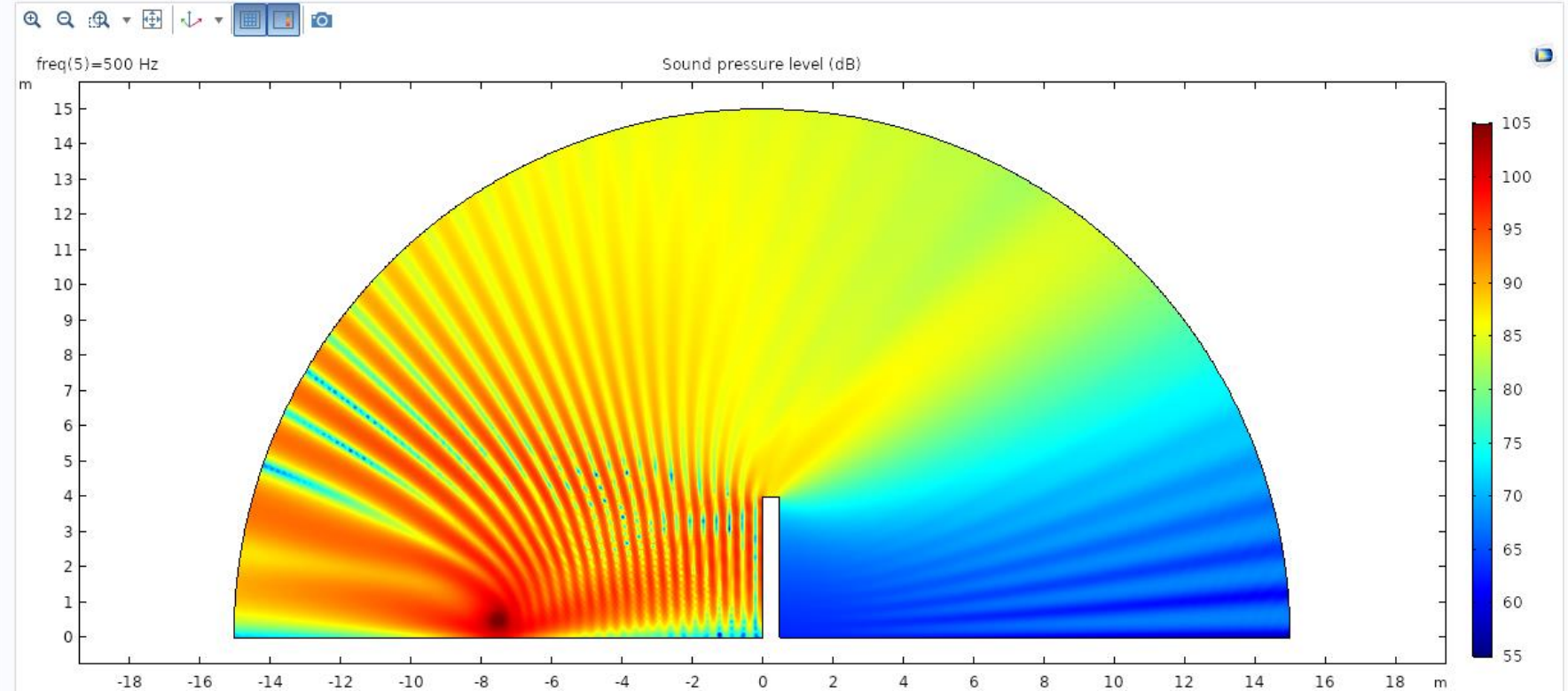
### ▶ Calculation Parameters

### ▶ Study Parameters

### ▶ Information

### Results

Harmonic Frequency (Hz):



# App Layout

## Calculations

### ▼ Calculation Parameters

$$f = \text{500} \text{ Hz}$$

$$N = 0.9613$$

$N$  is the Fresnel number, which indicates the ratio of path difference to wavelength. If it is 0, the measurement point is on the line of sight; if it is negative, the measurement point is above the line of sight.

$$D_z = 12.9 \text{ dB}$$

$D_z$  is calculated with the formula by (KURZE, 1971), which is used in ZTV-Lsw 22:

$$D_z = 20 \lg \left( \frac{\sqrt{2\pi N}}{\tanh \sqrt{2\pi N}} \right) \text{dB} + 5 \text{dB}$$

# App Layout

## Calculations

### Calculation Parameters

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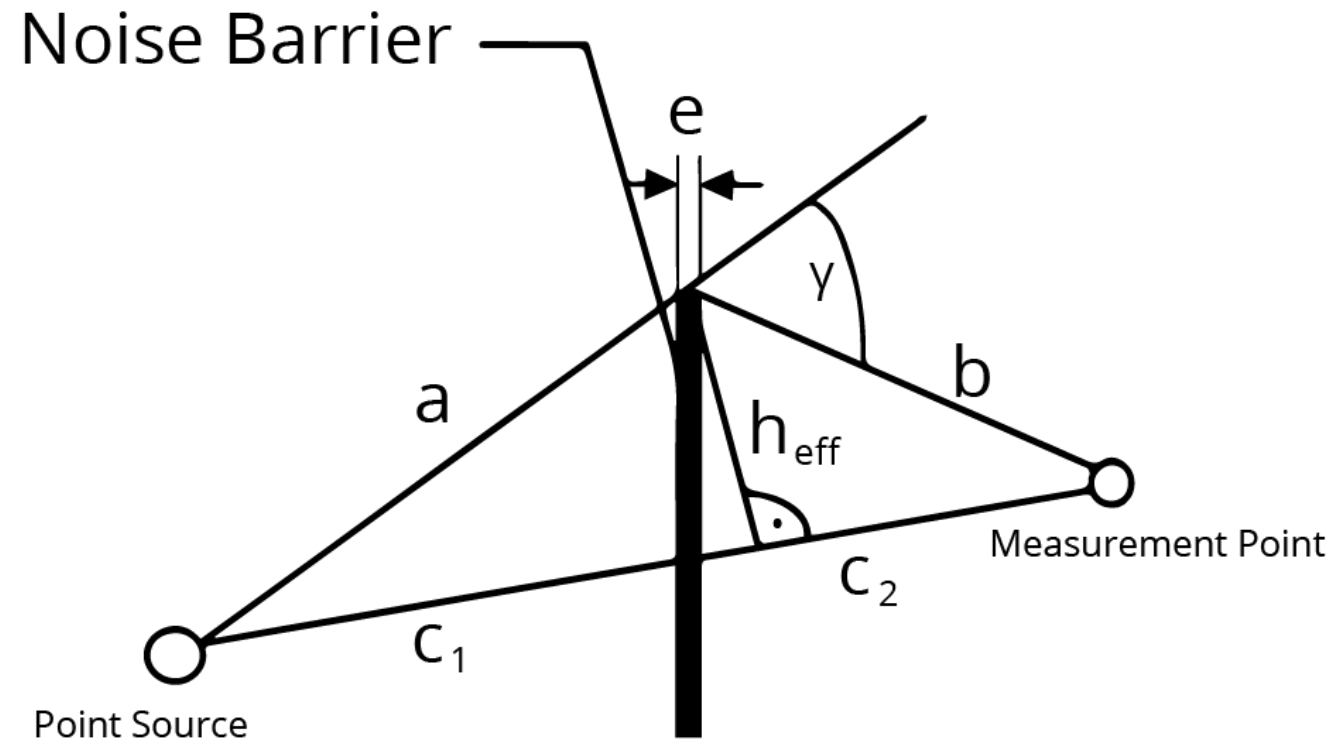
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# App Layout

## Calculations



Hübelt, J. and Schulze, C. (2007), Forschung Strassenbau und Strassenverkehrstechnik, Vol. 973, Wirtschaftsverlag N. W. Verlag für neue Wissenschaft, Bremerhaven, p. 19.

# App Layout

## Calculations

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# App Layout Calculations

## Caution!

All calculations refer to the standard setting (all absorption coefficients set to 1).

The barrier attenuation  $D_z$  can only be calculated for a measurement point within and below the line of sight. Above the line of sight the inverse square law for sound propagation in full space applies and  $D_z$  will be set to 0, even though in reality the value steadily decreases from 5 to 0 dB.

$L_p$  is calculated with the inverse square law in full space.

$$\begin{aligned}L_p &= L_w - 11 \text{ dB} - 20 \lg \left( \frac{r}{\text{m}} \right) \text{ dB} \\ &= 70.2 \text{ dB}\end{aligned}$$

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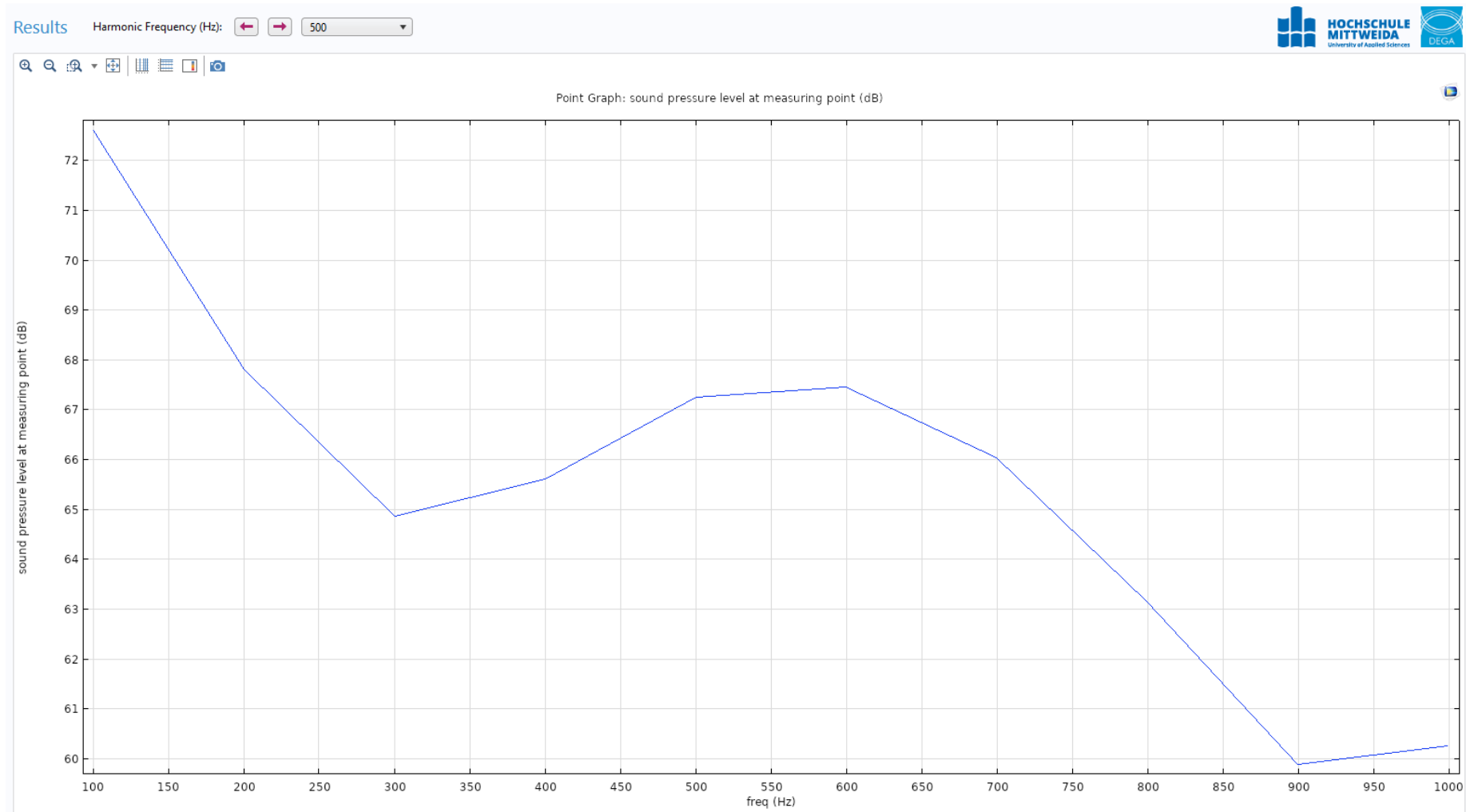
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# App Layout

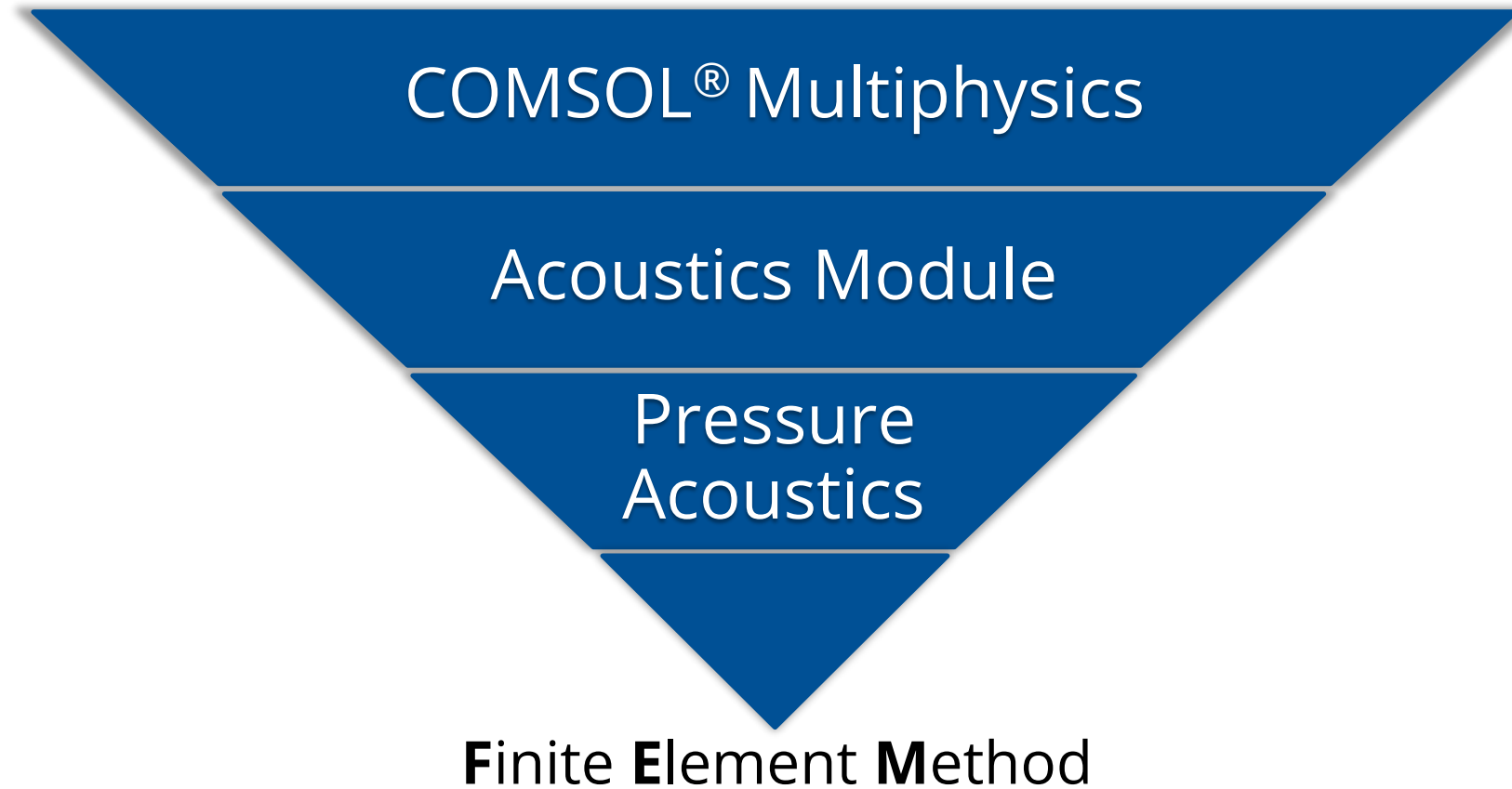
## Point Graph



# Methodology

# Methodology

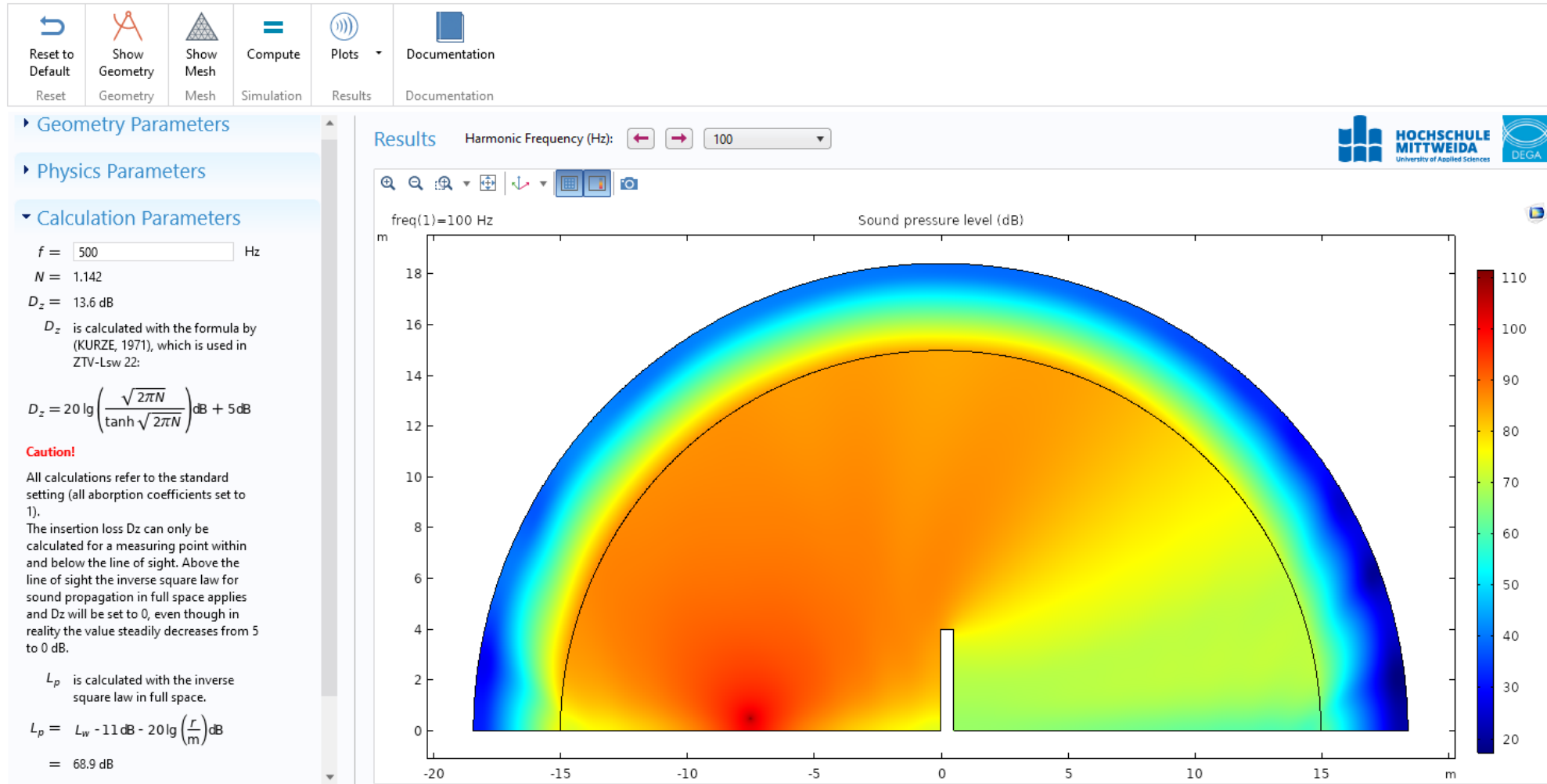
## COMSOL Modules





# Methodology

## Perfectly Matched Layer



# Fields of application

# Fields of application

**Mittweida UAS:** Media / Audio and Acoustical Engineering

Specialisation: Acoustics (Prof. Jörn Hübelt)

- Noise Protection (4<sup>th</sup> semester)
- Acoustic Modeling and Simulation (6<sup>th</sup> semester)

➔ **Free to use for everyone:**

<https://apps.vib.ed.tum.de:2037/app-lib>



# Thank You



**HOCHSCHULE  
MITTWEIDA**  
University of Applied Sciences



<https://apps.vib.ed.tum.de:2037/app-lib>

**Yvonne Heggemann**  
yheggema@hs-mittweida.de

**Tabea Breitzkreutz**  
tbreitkr@hs-mittweida.de

Media and Acoustical Engineering  
Specialisation: Acoustics

**Hochschule Mittweida**  
University of Applied Sciences  
Technikumplatz 17 | 09648 Mittweida  
Engineering Sciences

[hs-mittweida.de](https://hs-mittweida.de)