

## Exercise 9: Examples in 2D BEM. Acoustics in cavities, outdoor sound propagation and diffusers

The Boundary Element Method can be applied to different problems in the areas of outdoor sound propagation and room acoustics.

A full distribution version of OpenBEM is uploaded in the *Course Project* contents topic at DTU Learn. It includes the three formulations: 2D, 3D and axisymmetrical. The package contains some examples, which can be used as a starting point. Examine them. Use this implementation in your work instead of those tailored to previous exercises.

Below are three examples based on scripts in 2D OpenBEM. The scripts have been uploaded to DTU Learn and should be used together with the full OpenBEM.

### Example 1: Rectangular cavity

An example with a rectangular cavity is programmed in the Matlab script *Test\_Cavity\_Exercise*. It defines a rectangular 2D "room" and sets a point (line in 2D) source inside. It calculates field points inside to visualize the sound field.

- Run the script and identify its calculation parts. Understand the theory; you may check reference material (e.g. *Room Acoustics* by Kuttruff).
- The script has numbered tasks written down as comments. You may go through them in order. (Tasks 1 to 5 at lines 20, 24, 57, 35 and 66)

### Example 2: Sound barrier

The script *Test\_Barrier\_Exercise* calculates the sound field around a barrier set on a hard plane and excited by a line source. The insertion loss (SPL relative to free field), a common performance parameter in barriers, is also plotted.

- Run the script and identify its calculation parts.
- In this example, the proposed task is redesigning the barrier top (*topsegs* variable) to achieve a better performance of the barrier. See lines 30 to 39. Note that you need to update *sigmaB* in line 22: it must have one value per segment.

### Example 3: Diffusers

There is no script related with diffusers. You are welcome to program yourself an example where a simple QRD diffuser is calculated. The diffuser can be placed on the hard impedance plane and plane waves at different angles can be tried. You may also try a setup with no plane (free field). You may use the barrier script as a starting point. The scattered sound pressure around a semicircle at some distance (far field) away from the diffuser can be plotted to assess its diffusing properties. (See Kuttruff, 2.7).