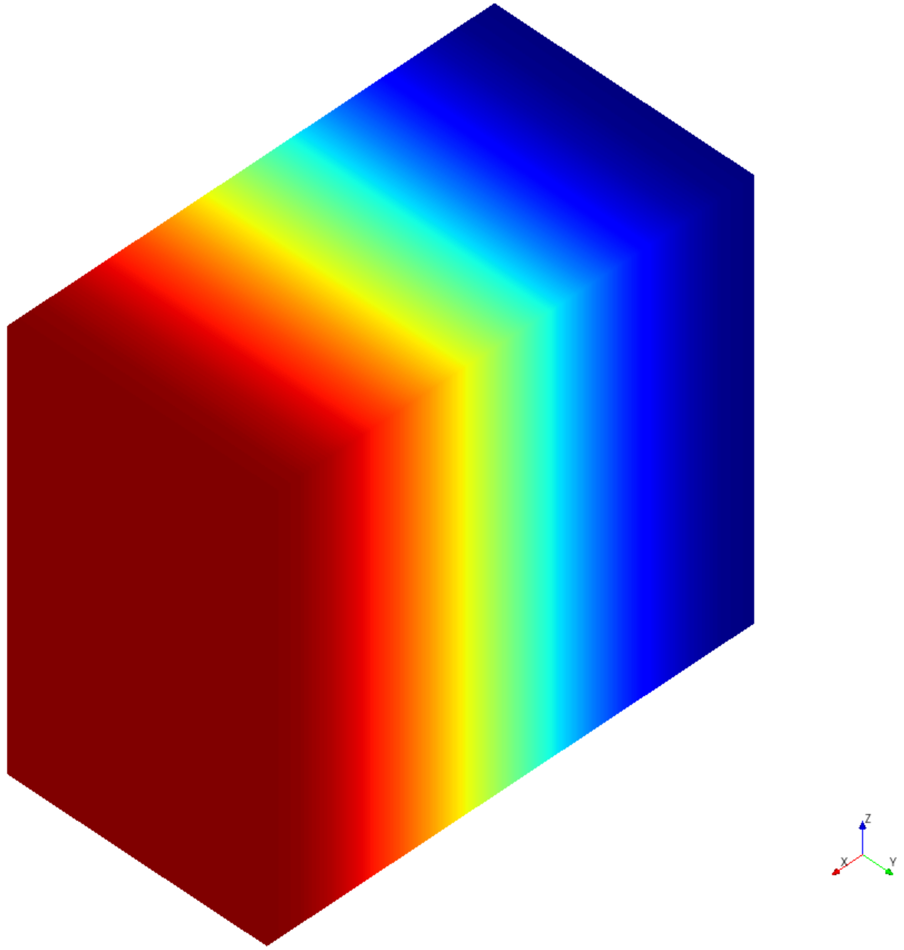
Cavity frequency response with monopole excitation

Actran Student Edition Tutorial

Workshop description

Introduction

- This workshop introduces the acoustic cavity and resonance phenomena with a simple cavity model
- The objectives of this workshop are the following :
  - Calculate the cavity frequency response under a monopole excitation
  - Get introduced to the notion of acoustic resonance
  - Get introduced to the direct frequency response analysis of Actran
- Software version
  - Actran 2022 Student Edition



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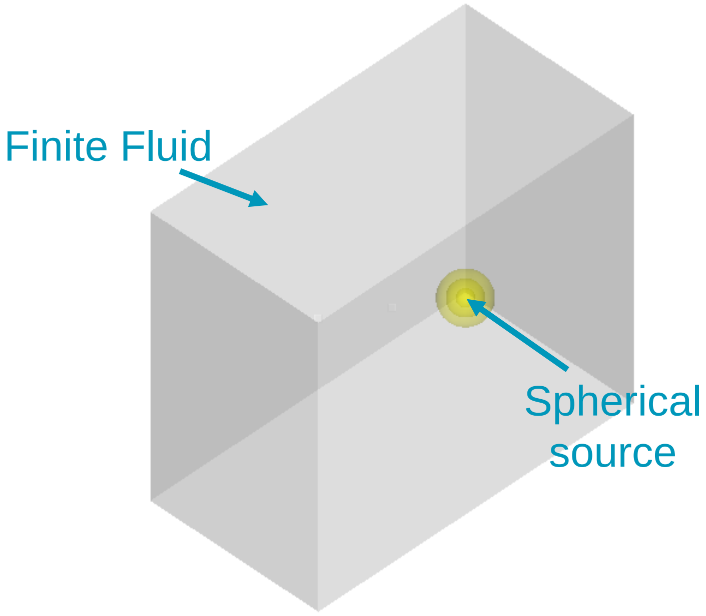
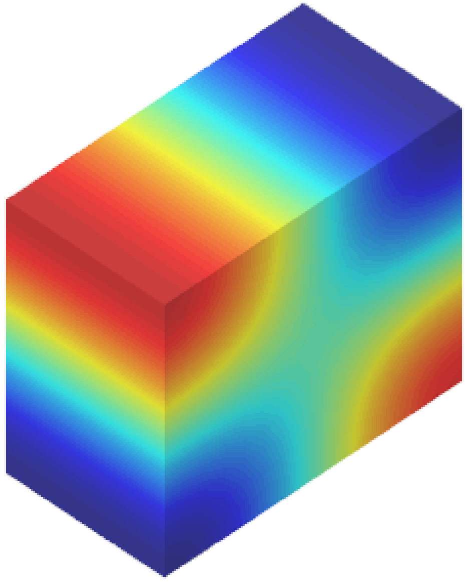
Workshop strategy

Frequency response from a harmonic excitation	• A *Direct Frequency Response* analysis is defined
Acoustic cavity	• A *finite fluid component* is defined • The walls of the cavity are assumed rigid
Excitation is an acoustic monopole in the cavity	• A *spherical source* boundary condition is defined

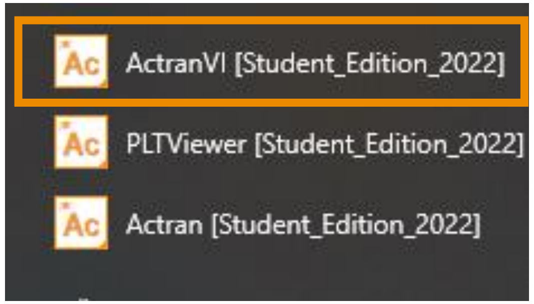




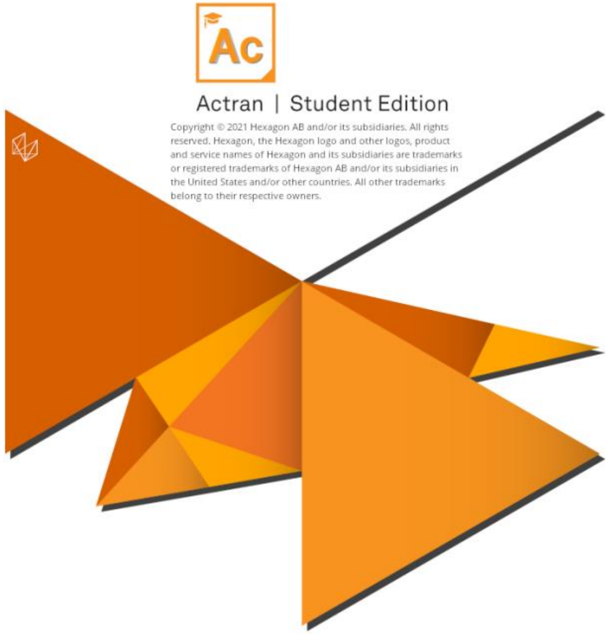
Workshop pre-processing

Start ActranVI

- Start ActranVI:
  - Shortcut is available through the Windows Start Menu



(Windows Start Menu)



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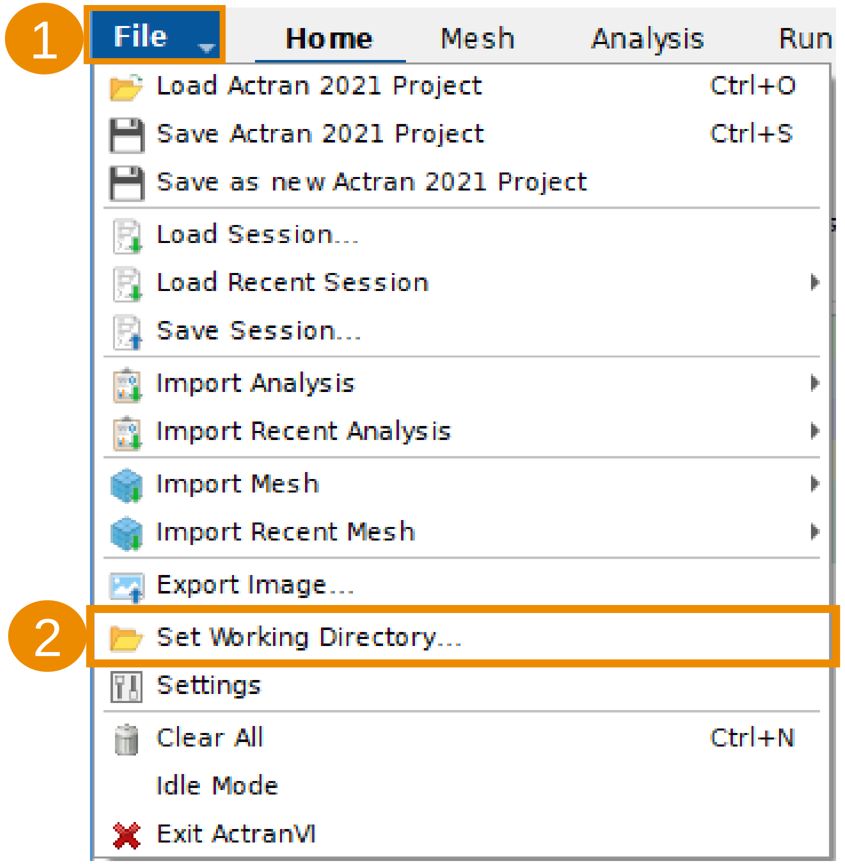
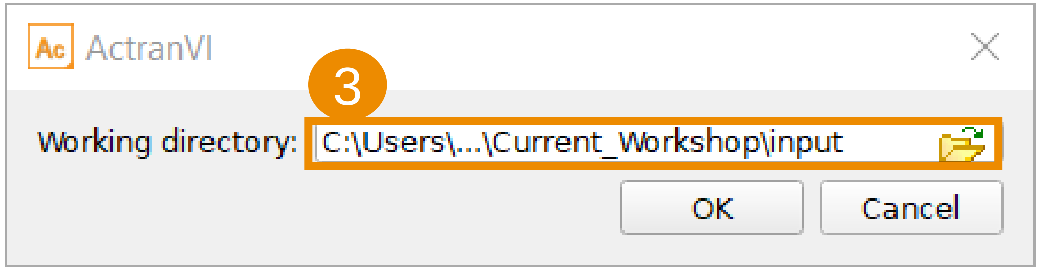
Set the working directory

Select the workshop input directory as the working directory

- The working directory is the project directory where all ActranVI related files are output





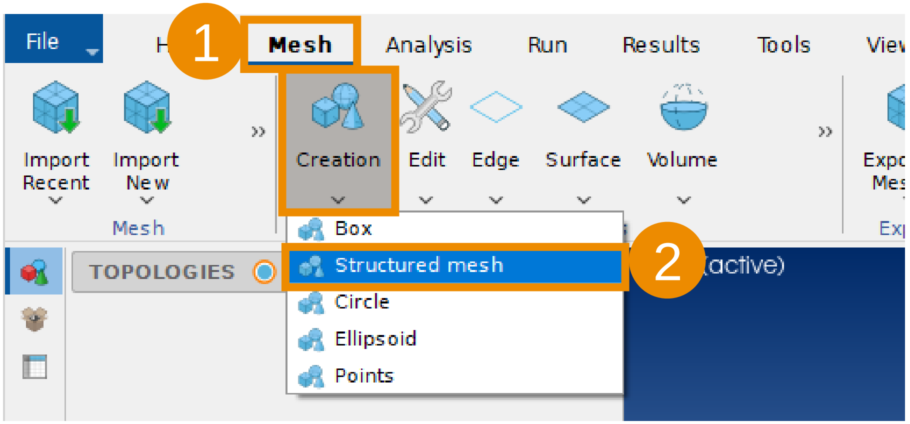
The working directory path should not contain any space or special character

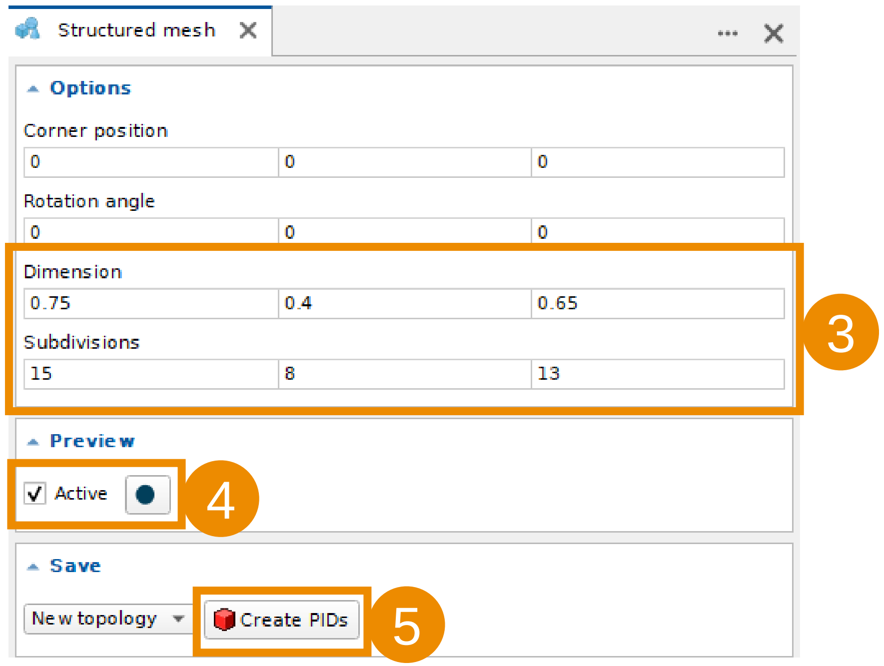
Create the mesh

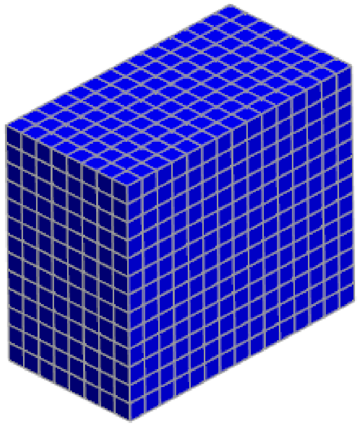
Select structured mesh tool in *Meshing Tools*

Set the dimension and activate the Preview

Create PID







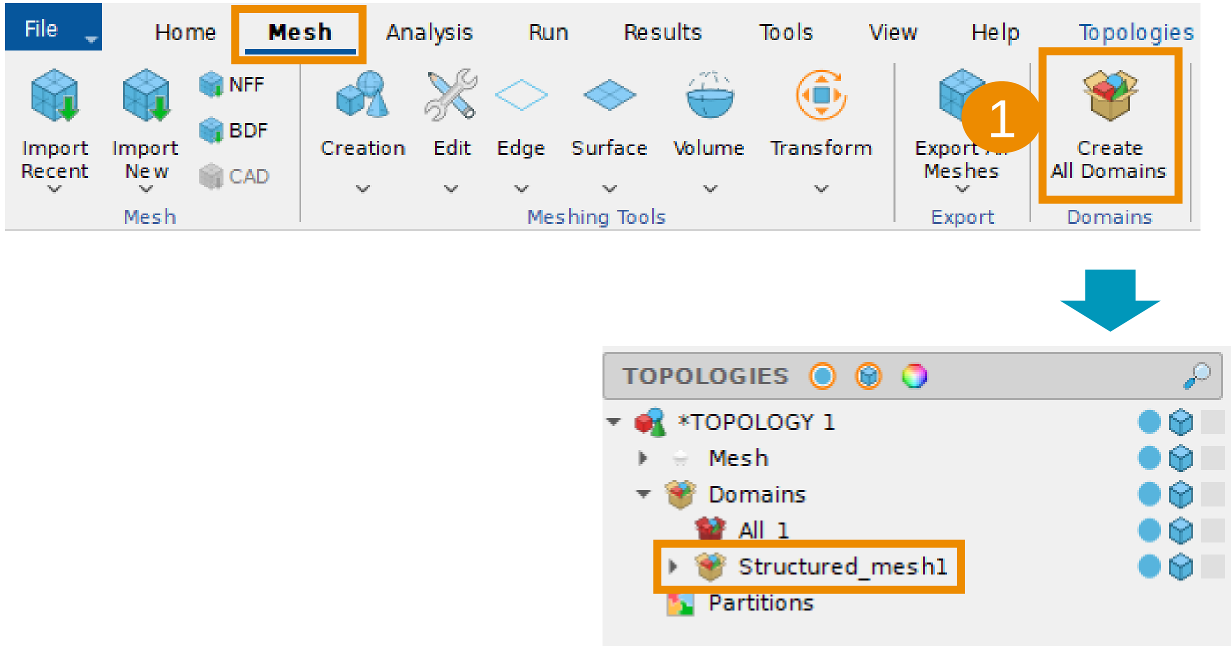
Create the domain

Auto create domain

- Automatic domain creation based on PIDs
- One domain per PID

A *Domain* is a group of one or several PIDs

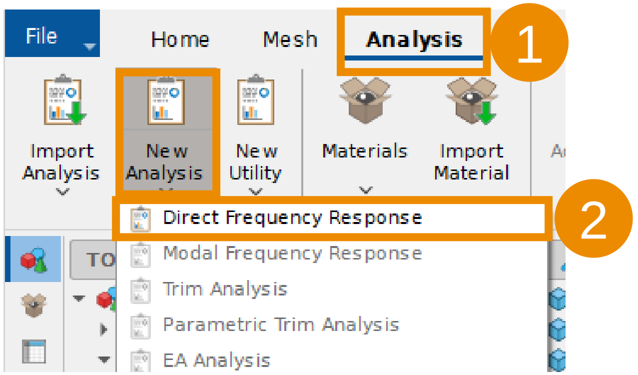
- *Domains* link PIDs to the analysis objects
- *Domains* decouple the topology from the analysis

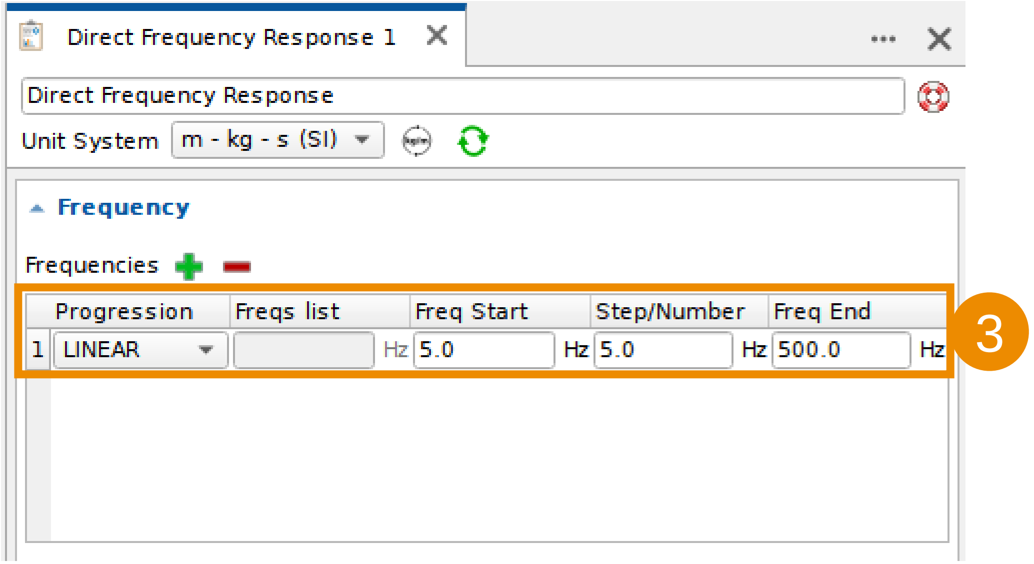


Create the Direct Frequency Response Analysis

Add a *Direct Frequency Response* analysis

- A *DFR* is a computation procedure which provides the response of a vibro-acoustics system to a specific excitations in physical coordinates
- Set the frequency range and the step





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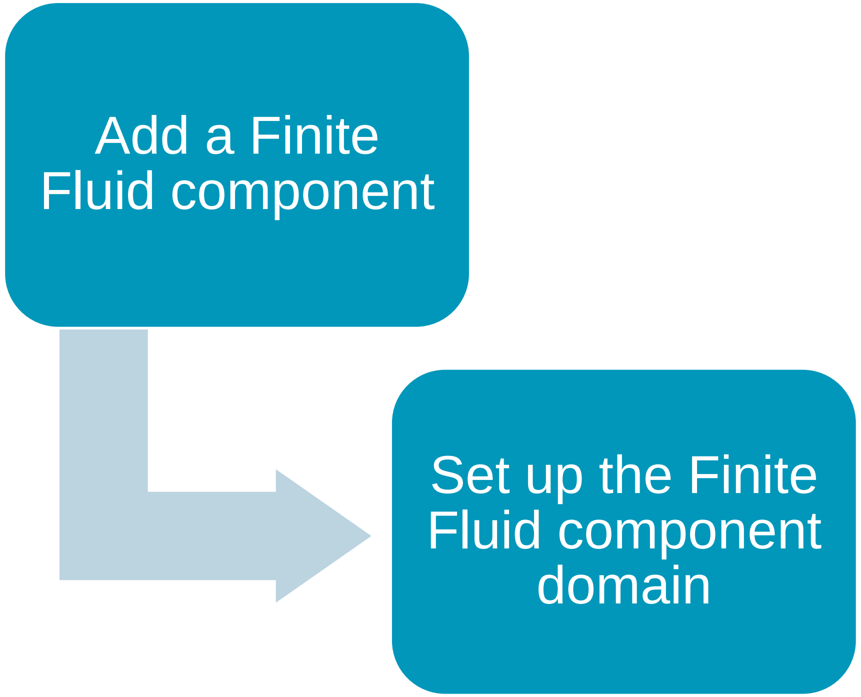
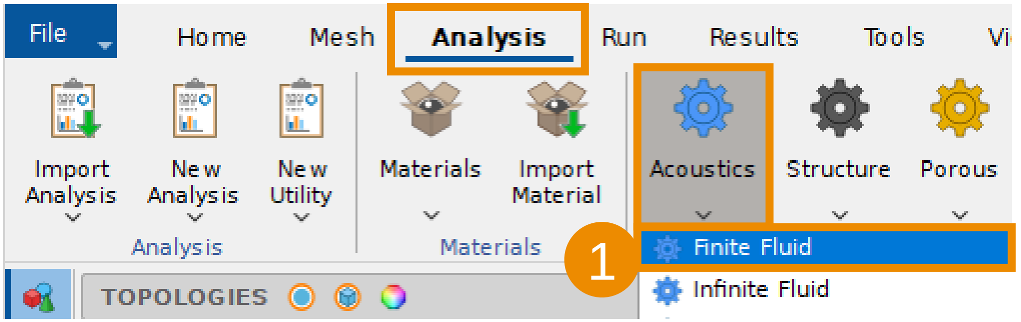
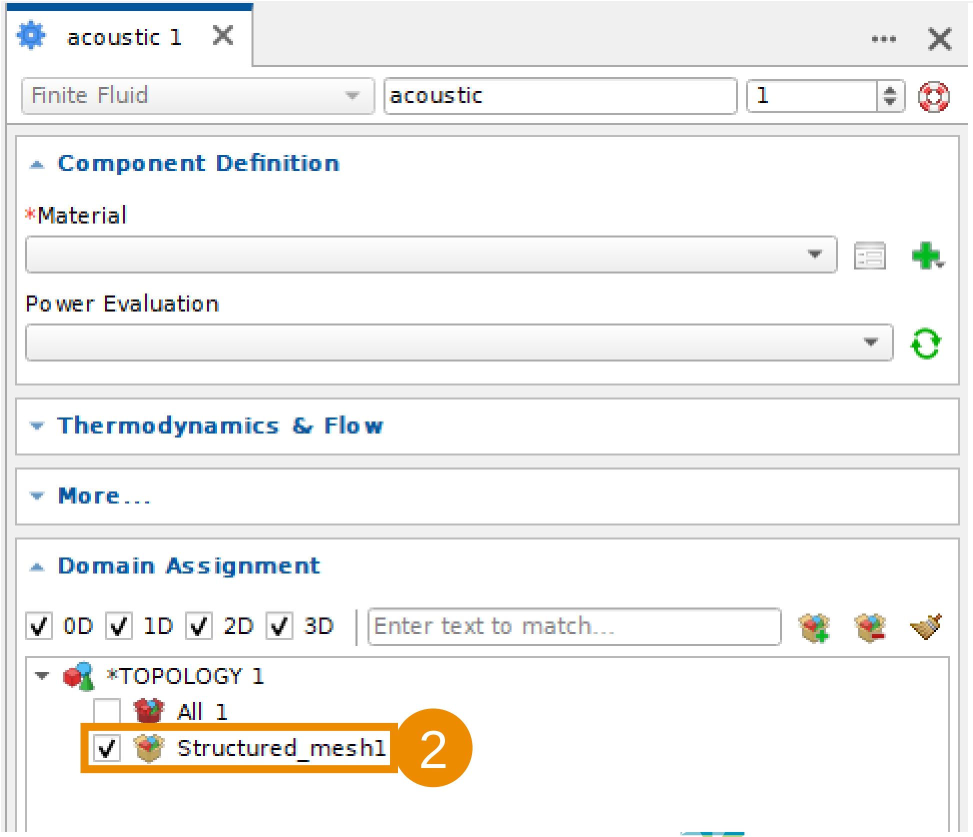
Create a Finite Fluid component (1)



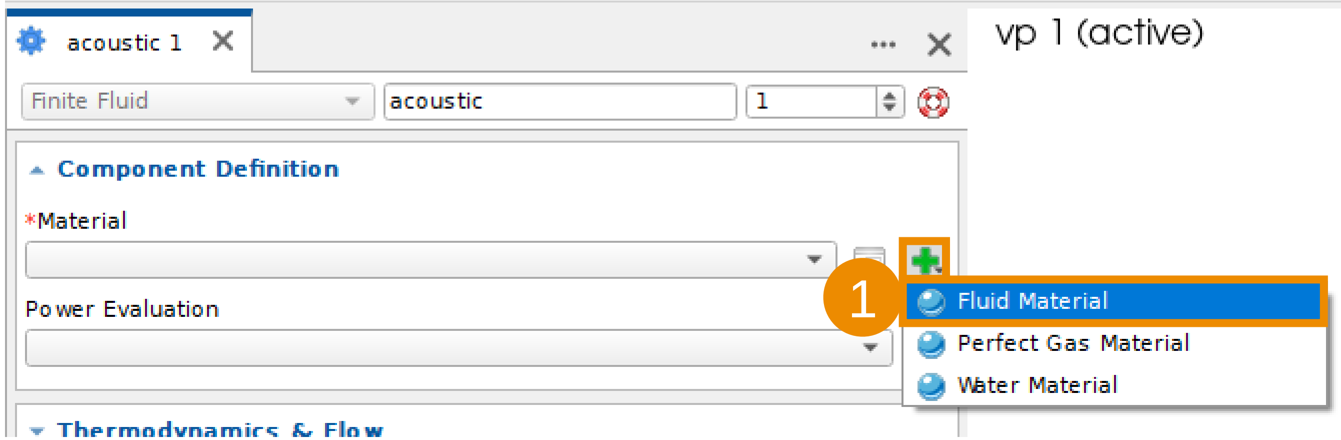


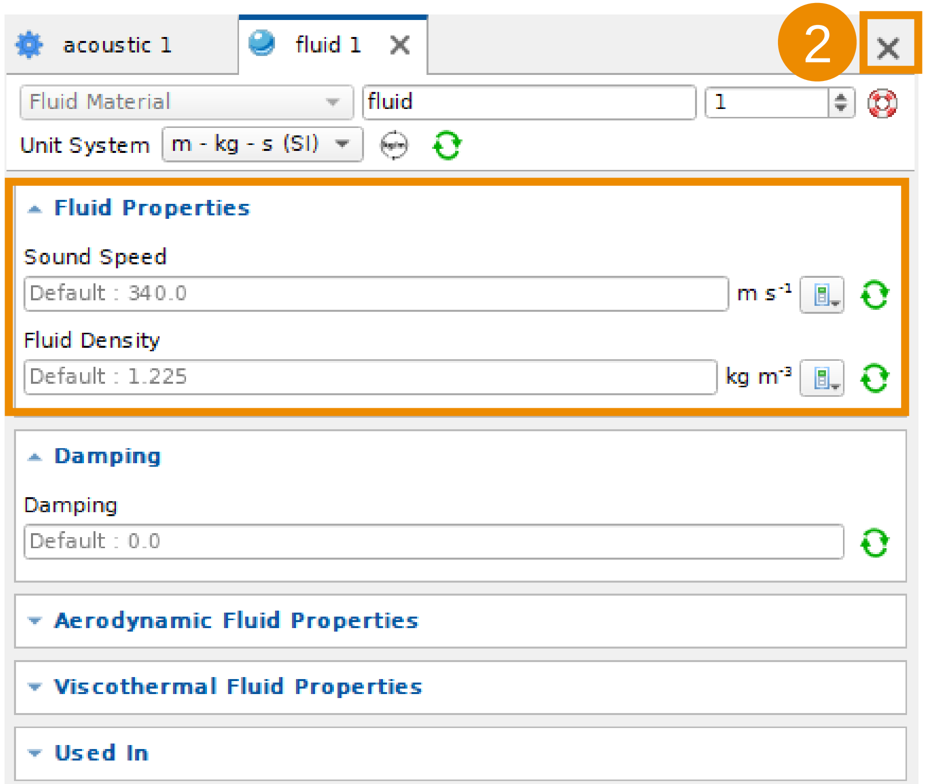


Create a Finite Fluid component (2)

Define a material for air

- Add a Fluid Material
- Leave the values by default :
  - $c = 340\ m/s$
  - $\rho = 1.225\ kg/m^3$





Close both property windows (material & component)

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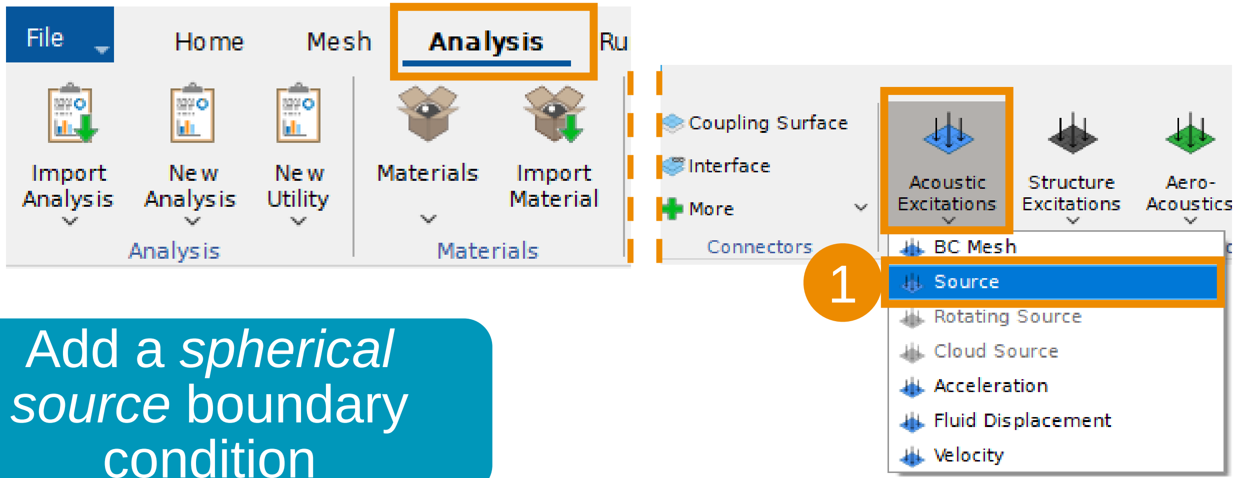
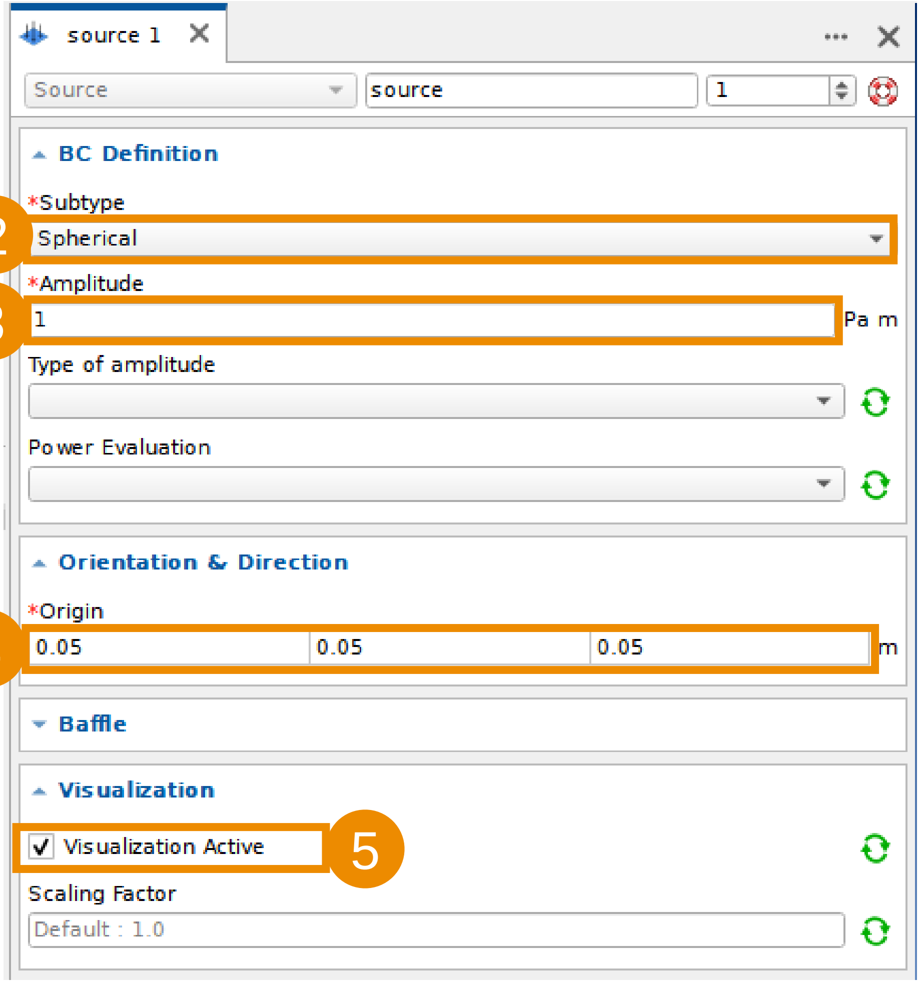
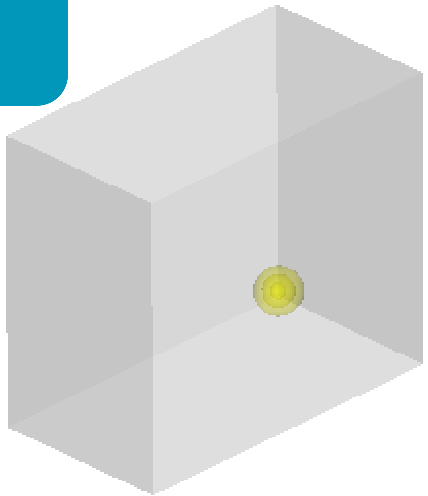
Create a Spherical Source



Add a *spherical source* boundary condition

Set up the *source* carachteristics





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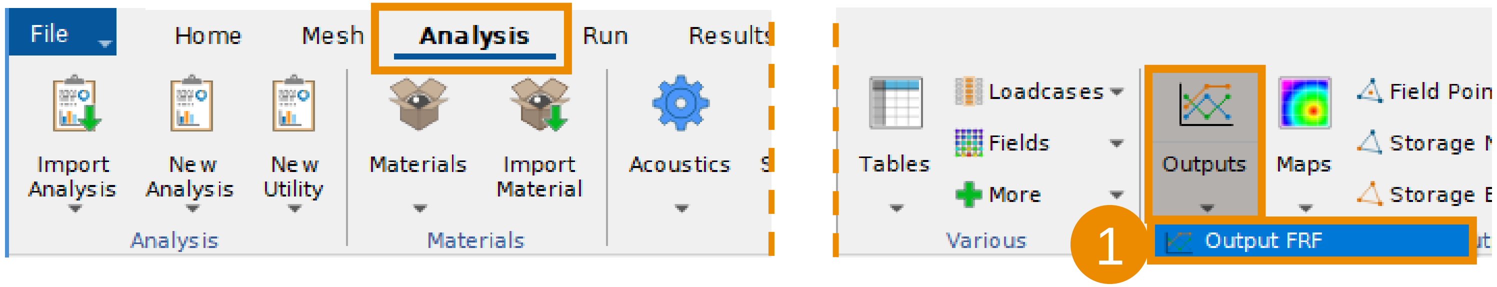
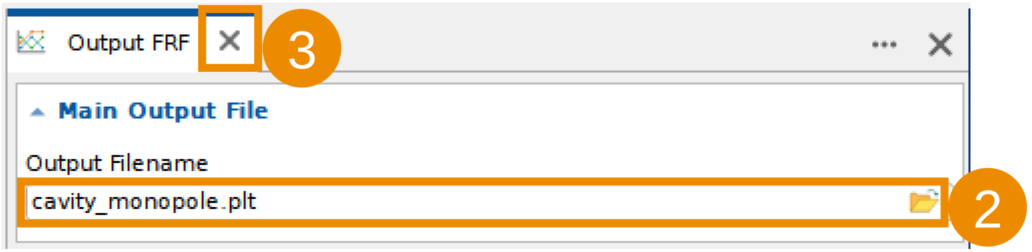
Post-processing parameters – FRF

Create an output FRF post-processing parameter

Specify the name of the output file

Close the property window





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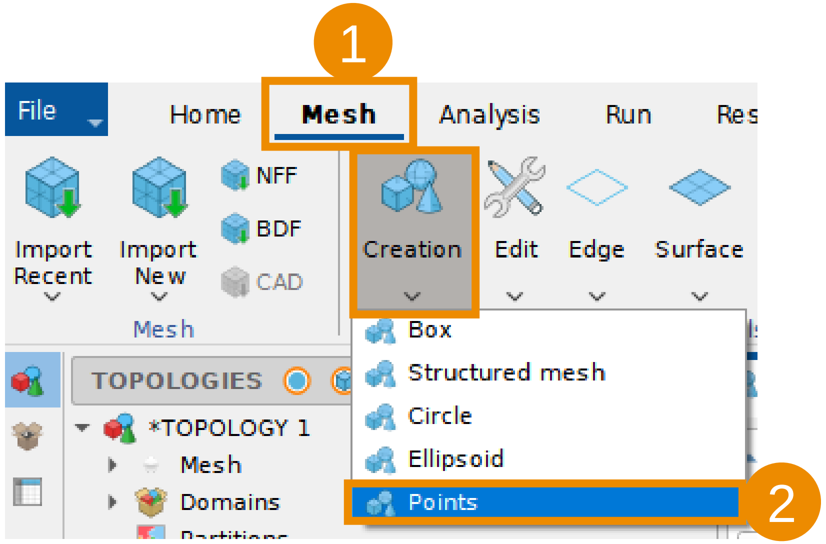
Post-processing parameters – FRF

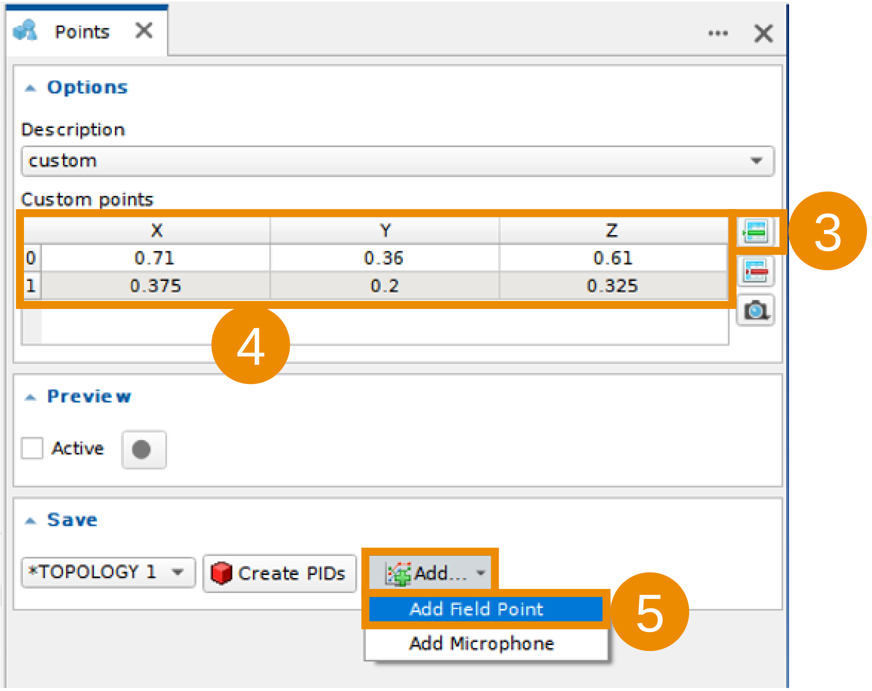
Add virtual microphones

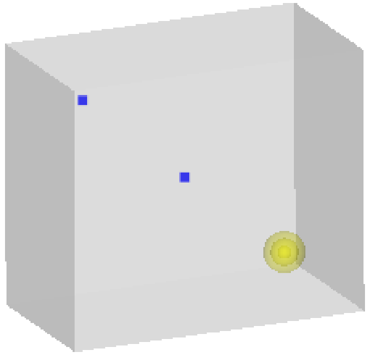
Create virtual microphones

At the center of the box

In the corner of the box





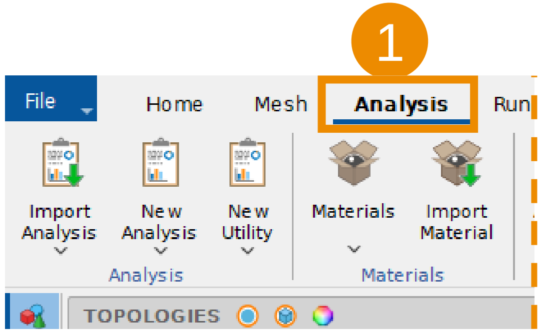


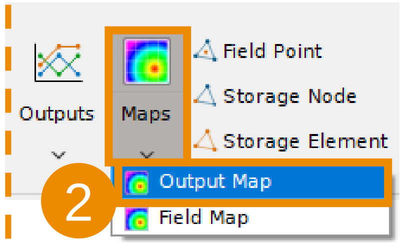
Post-processing parameters – Maps

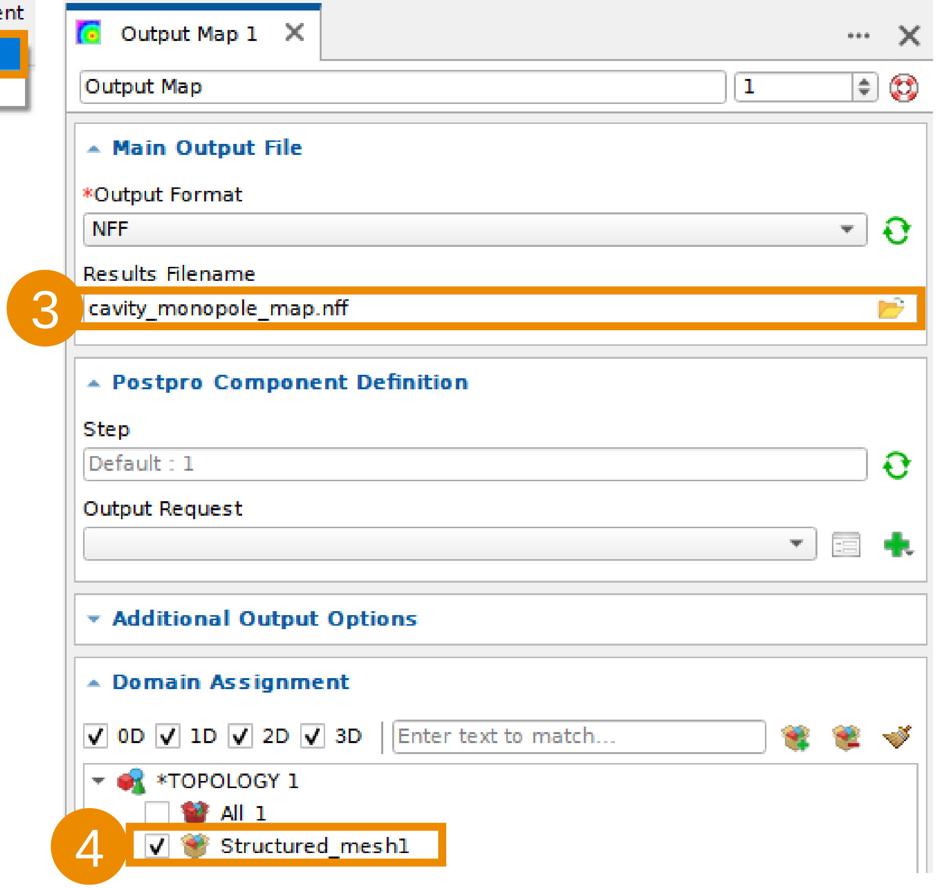
Create an output map

Specify the output format as *NFF* and the filename as *cavity_monopole_map.nff*

Assign the domain to the acoustic fluid





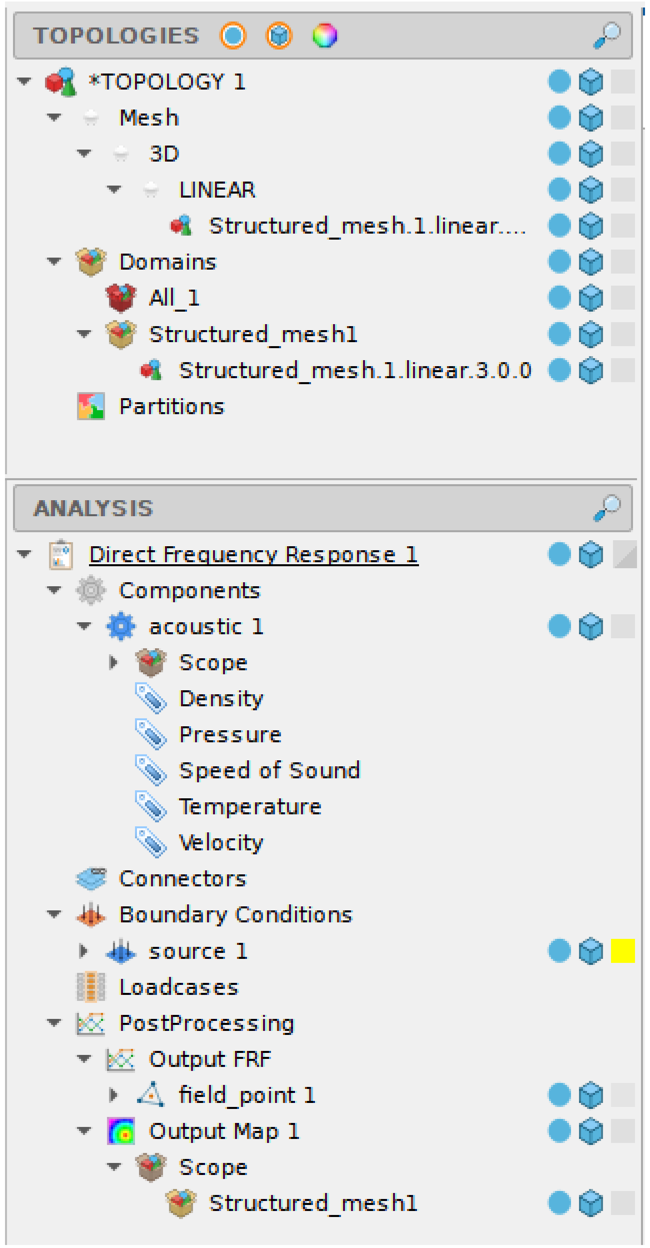


Check the analysis

The *Analysis* setup is now complete

All the parts of the *Analysis* are available and editable on the data tree panel

Check if the data tree is identical to the one shown



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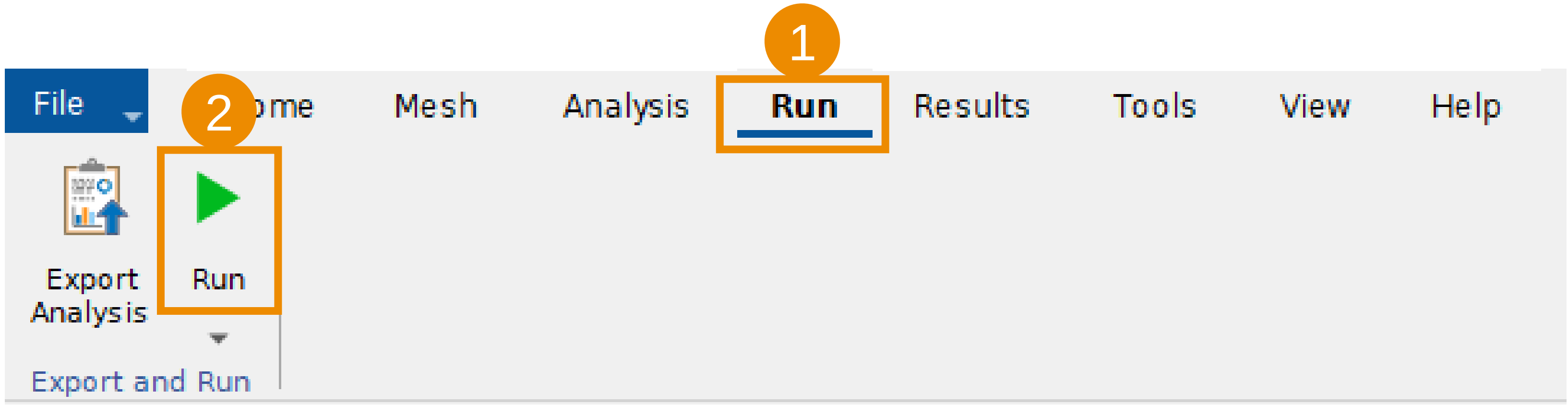
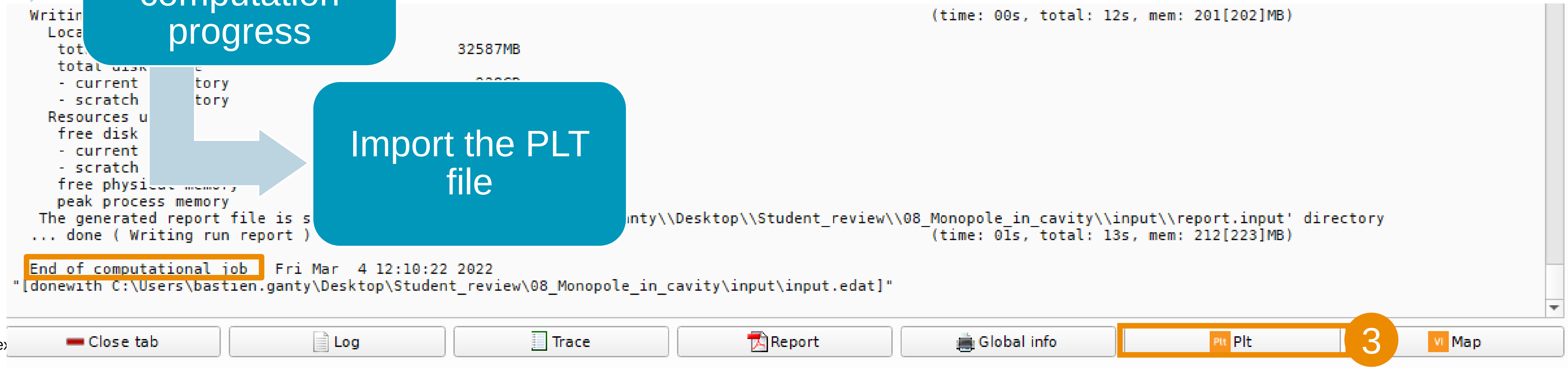
Launch the analysis in ActranVI

Launch the computation

Check the log showing the computation progress

Import the PLT file

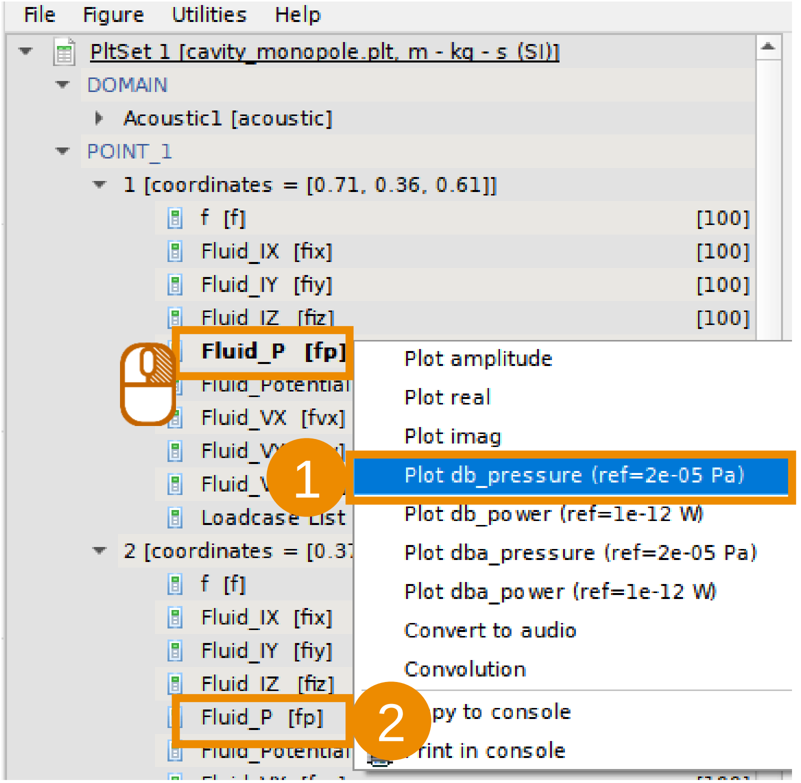


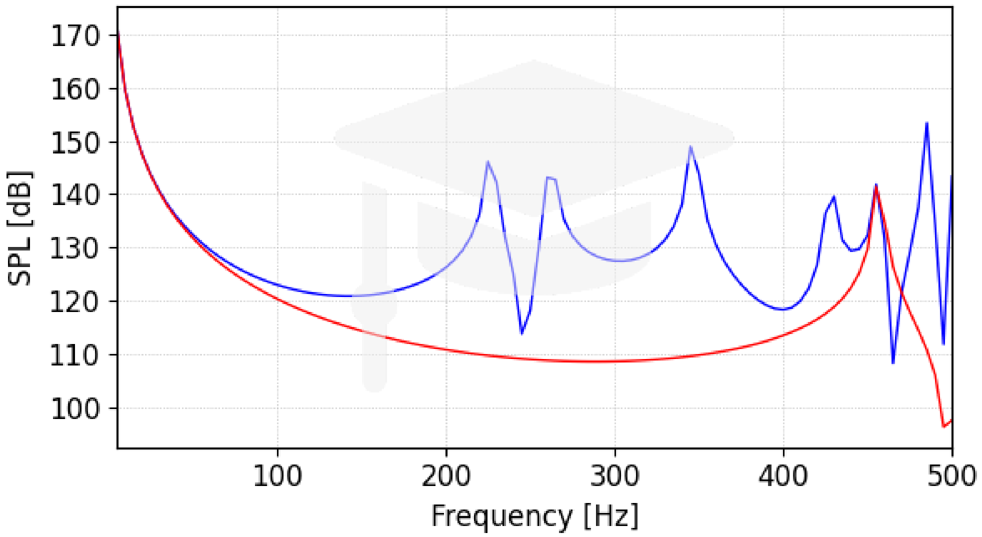


Post-processing

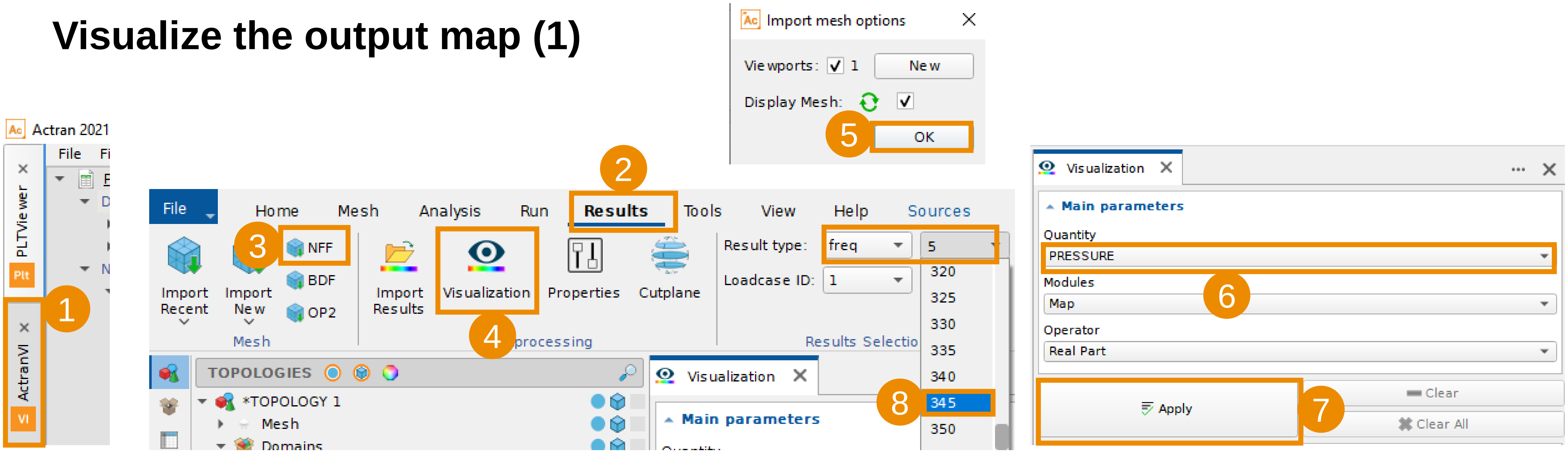
Plot the pressure results

- Plot the pressure at both virtual micrphones
- Microphone in the corner captures all the eigen-frequency of the cavity (225, 260, 345Hz,…)
- Microphone at center, which “node” of many modes (0 pressure) only captures 455Hz eigen-frequency





Visualize the output map (1)



Go back to ActranVI → Import the file *cavity_monopole_map.nff* → Plot the Pressure → Select the peak frequencies to plot

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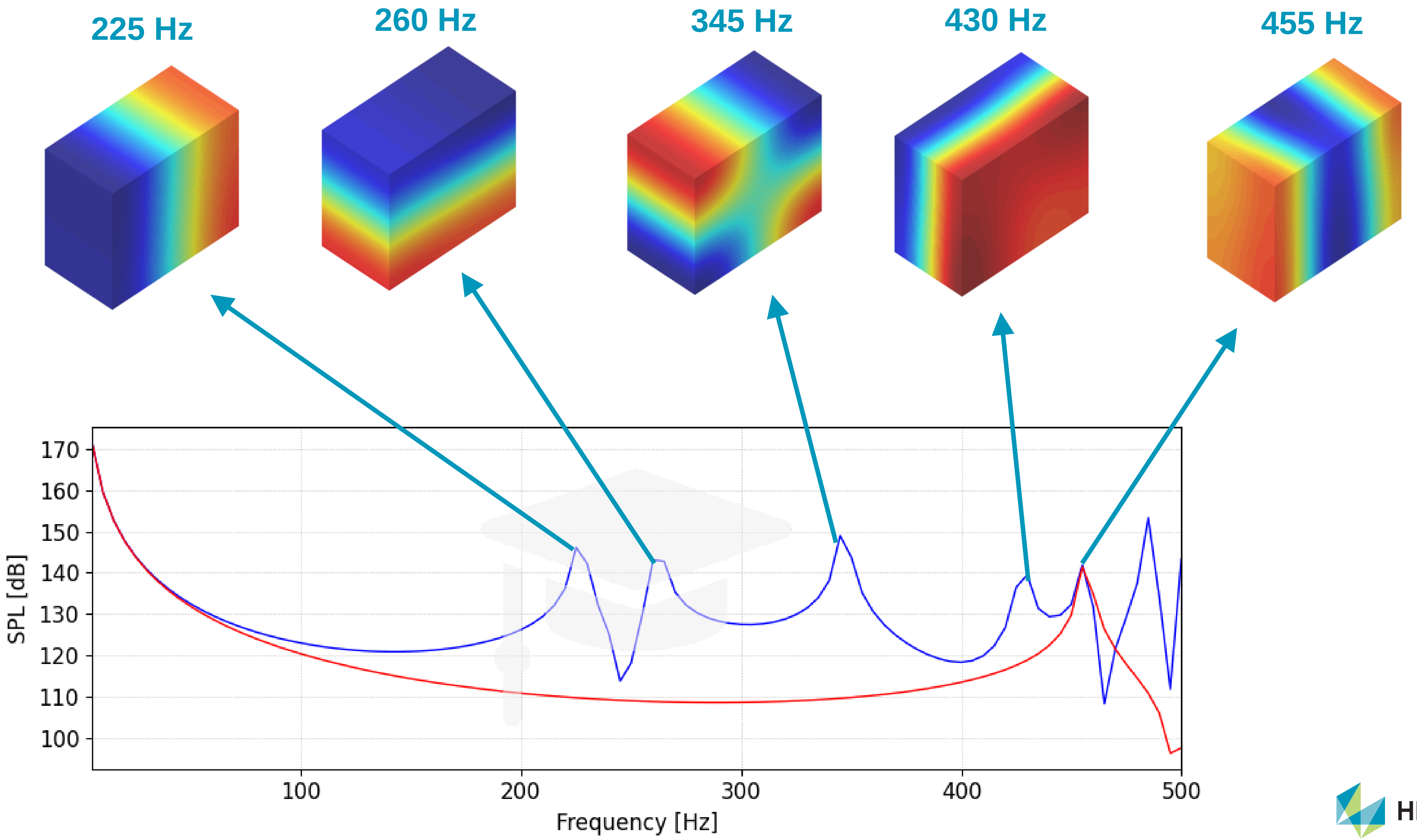
Visualize the output map (2)



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Conclusions

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- The Frequency response of a cavity has been created

- The model involved
  - A Frequency Response analysis (DFR)
  - Finite Fluid component for the cavity
  - A spherical source
  - FRF and Map outputs to export the pressure repartition in the cavity

- The results highlighted
  - Different response of the virtual microphones due to the presence of node at the center of the cavity for several frequencies

- Going further
  - Change the cavity geometry to check how the cavity response is modified
  - Change the source location to check how the cavity response is modified

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