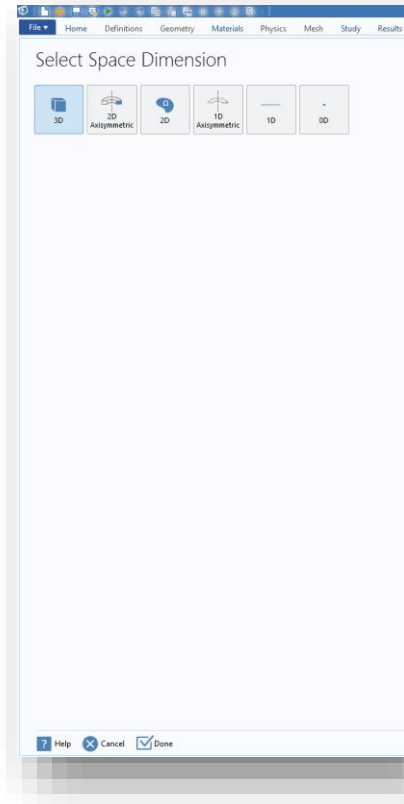
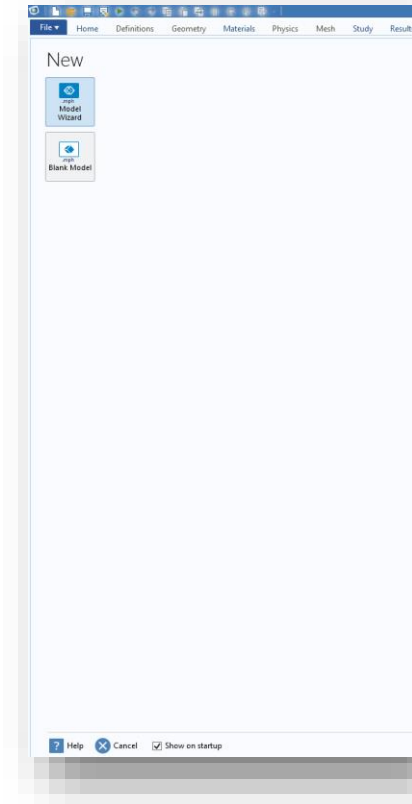


BEM model reproduktoru

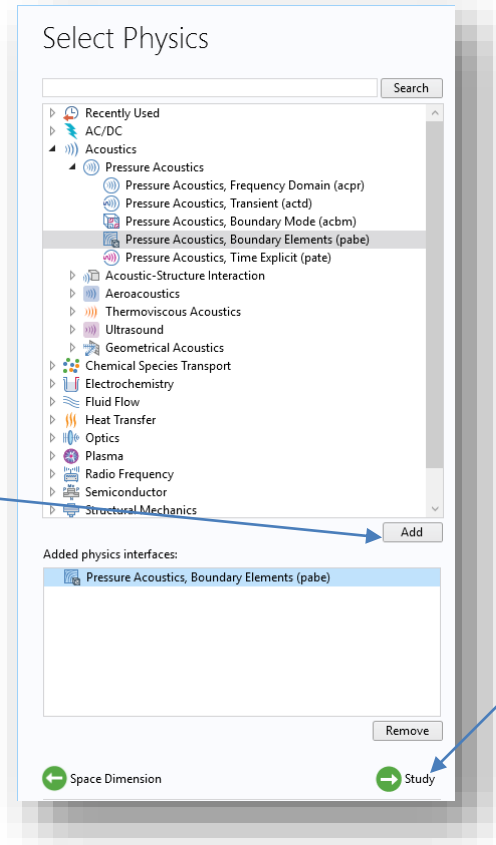
Matouš Lorenc
lorenc@humusoft.cz
+420 284 011 749

1) Model Wizard / 3D



2) Acoustics / Pressure Acoustics / Pressure Acoustics, Boundary Elements (*pabe*)

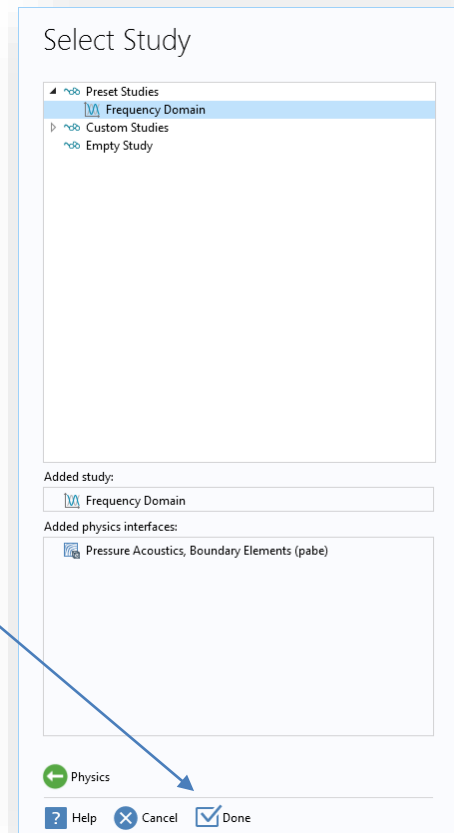
Fyzikální rozhraní se přidá kliknutím na „Add“



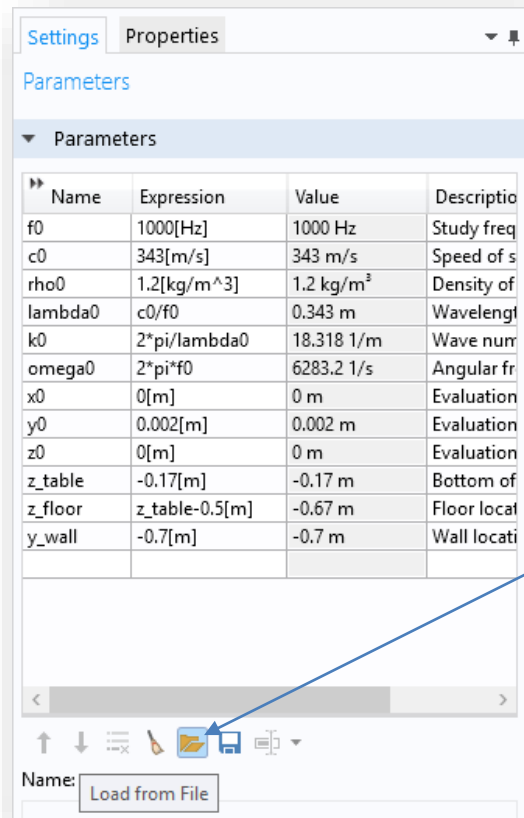
Přejít k výběru studie

3) Select Study -> Frequency Domain

Dokončit základní nastavení
Model Wizard



4) Global Definitions/ Parameters



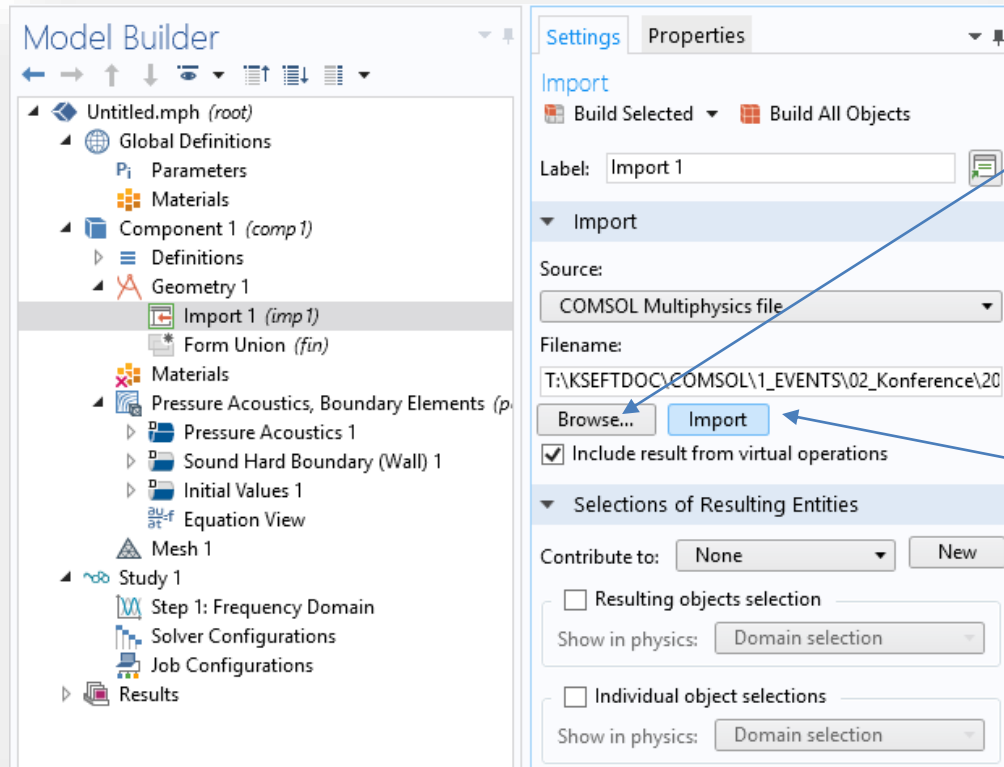
The screenshot shows the 'Parameters' table in the COMSOL software interface. The table has four columns: Name, Expression, Value, and Description. A blue arrow points from the 'Load from File' button in the bottom toolbar to the text on the right.

| Name | Expression | Value | Description |
|---------|----------------|-----------------------|-------------|
| f0 | 1000[Hz] | 1000 Hz | Study freq |
| c0 | 343[m/s] | 343 m/s | Speed of s |
| rho0 | 1.2[kg/m^3] | 1.2 kg/m ³ | Density of |
| lambda0 | c0/f0 | 0.343 m | Wavelengt |
| k0 | 2*pi/lambda0 | 18.318 1/m | Wave num |
| omega0 | 2*pi*f0 | 6283.2 1/s | Angular fr |
| x0 | 0[m] | 0 m | Evaluation |
| y0 | 0.002[m] | 0.002 m | Evaluation |
| z0 | 0[m] | 0 m | Evaluation |
| z_table | -0.17[m] | -0.17 m | Bottom of |
| z_floor | z_table-0.5[m] | -0.67 m | Floor locat |
| y_wall | -0.7[m] | -0.7 m | Wall locati |

COMSOL

Načíst parametry ze souboru
BEM_parameters.txt

5) Component 1 / Geometry 1 / Import 1



Načíst geometrii
BEM_geometrie.mphbin

Dokončit akci
,Import‘

6) Component 1 / Materials / Add Material from Library / Built-in / Air

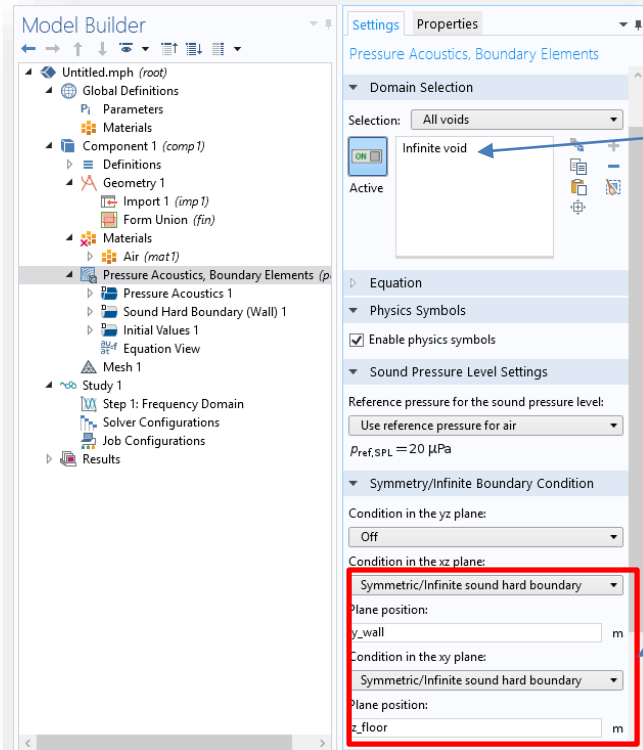
The screenshot shows the COMSOL Model Builder interface. On the left, the 'Model Builder' tree shows the hierarchy: Untitled.mph (root) > Global Definitions > Parameters > Materials > Component 1 (comp 1) > Materials > Air (mat1). The 'Air' material is selected. The right-hand pane shows the 'Properties' for the selected material. The 'Label' is 'Air'. Under 'Geometric Entity Selection', the 'Geometric entity level' is set to 'Domain' and the 'Selection' dropdown is open, showing 'All voids' selected. Below this, there is an 'Infinite void' checkbox which is checked. At the bottom, the 'Material Contents' table is visible:

| Property | Variable | Value |
|--|----------|-------|
| <input checked="" type="checkbox"/> Density | rho | rho(g |
| <input checked="" type="checkbox"/> Speed of sound | c | cs(T[|

V Materiálové Knihovně v sekci Built-In jsou materiály vlastní jádru COMSOL Multiphysics, jako je třeba vzduch

Jako výpočetní oblast volíme Infinite Void, nikoli doménu...

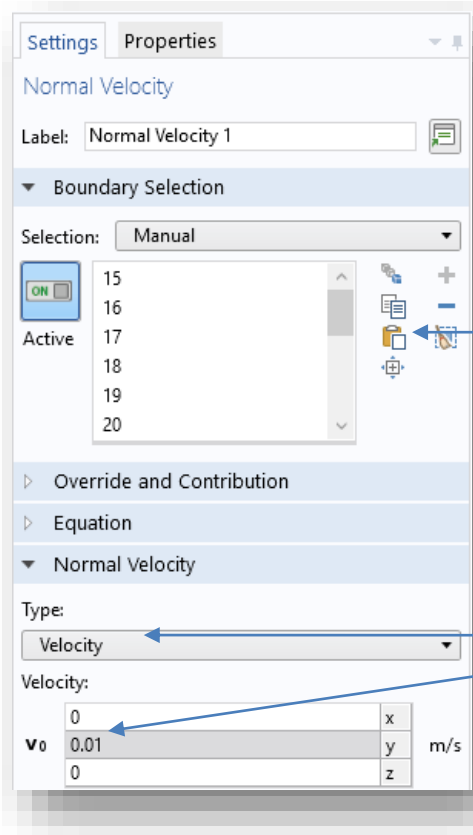
7) Component 1 / Pressure Acoustics, Boundary Elements (*pabe*)



Fyzikální rozhraní definovat pro Infinite Void

Podmínky v rovinách xz a xy změnit z *Off* na *Symmetric/Infinite sound hard boundary* s parametry *y_wall* respektive *z_floor*

8) Component 1 / *pabe* / Normal Velocity 1



Plochy můžete ,naklikat', vybrat pomocí ,Select Box', nebo zkopírovat seznam ploch prostřednictvím ,Paste Selection'

Definujeme normálovou rychlost na rozhraních 15-26, 29-31, 33

Změňte typ normálové rychlosti na pole rychlostí ,Velocity' a jeho ypsilonové složce zadejte velikost 0.01 m/s

9) Study 1 / Step 1: Frequency Domain

The screenshot displays the COMSOL Model Builder interface. On the left, the 'Model Builder' tree shows the project structure, with 'Study 1 / Step 1: Frequency Domain' selected. The right-hand 'Settings' pane is open to the 'Frequency Domain' study settings. The 'Compute' button is highlighted with a blue arrow. The 'Frequencies' field is set to 'f0' Hz, also indicated by a blue arrow. The 'Compute' button is labeled with a blue arrow pointing to it.

Model Builder

- Untitled.mph (root)
 - Global Definitions
 - Parameters
 - Materials
 - Component 1 (comp1)
 - Definitions
 - Geometry 1
 - Import 1 (imp1)
 - Form Union (fin)
 - Materials
 - Air (mat1)
 - Pressure Acoustics, Boundary Elements (p)
 - Pressure Acoustics 1
 - Sound Hard Boundary (Wall) 1
 - Initial Values 1
 - Normal Velocity 1
 - Equation View
 - Mesh 1
 - Study 1
 - Step 1: Frequency Domain
 - Solver Configurations
 - Job Configurations
 - Results

Settings Properties

Frequency Domain

Compute

Label: Frequency Domain

Study Settings

Frequency unit: Hz

Frequencies: f0 Hz

Load parameter values: Browse... R

Reuse solution from previous step: Auto

Results While Solving

Physics and Variables Selection

Modify model configuration for study step

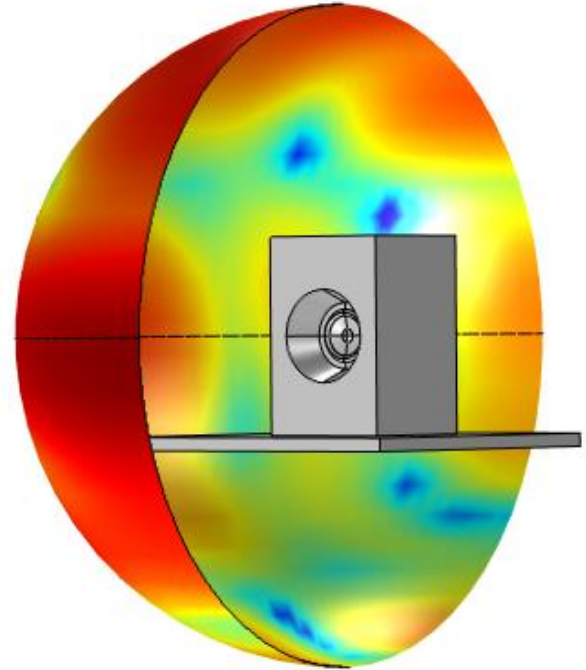
| Physics interface | Solve for | Discretiz |
|-----------------------------|-------------------------------------|-----------|
| Pressure Acoustics, Boun... | <input checked="" type="checkbox"/> | Physic |

Values of Dependent Variables

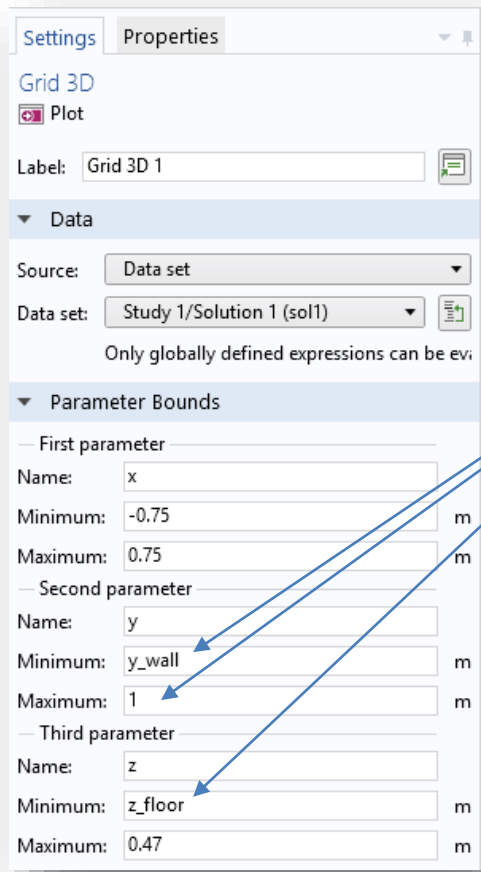
Frekvenci zadejte pomocí
parametru f0 (1 kHz)

Výpočet spustíte tlačítkem
Compute

BEM Postprocessing



10) Results / Data Sets / Grid 3D 1

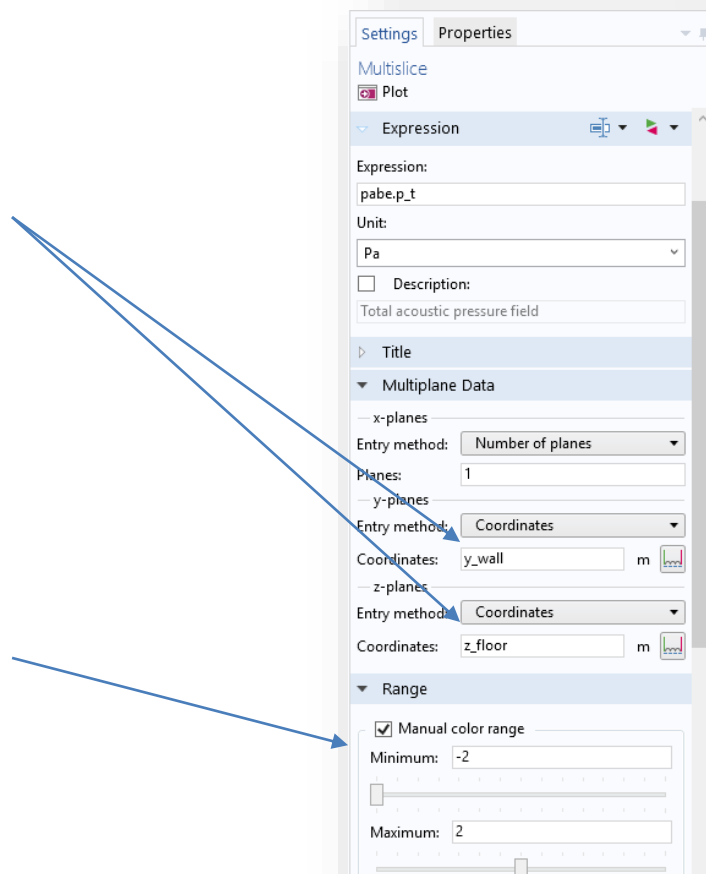


Nastavte limity pro osy y a z tak, aby se výsledky vykreslovaly pouze v levém horním kvadrantu

11) Results / Acoustic Pressure (pabe) / Multislice 1

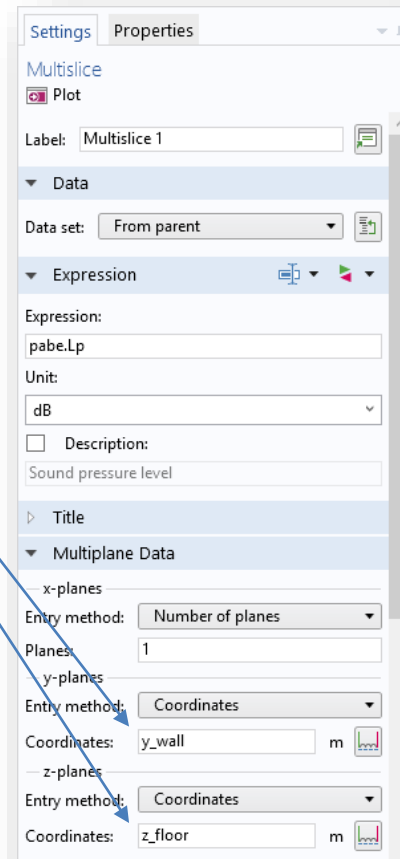
Definujeme řezy v osách y, z pomocí souřadnic, volbou Coordinates. Pro osu y zvolíme souřadnici y_wall a pro osu z souřadnici z_floor

Upravte Color Range tak, aby vykresloval hodnoty od -2 do 2 Pa



12) Results / Sound Pressure Level (pabe) / Multislice 1

Znovu definujeme řezy v osách y, z pomocí souřadnic, volbou Coordinates. Pro osu y zvolíme souřadnici y_wall a pro osu z souřadnici z_floor



13) Results / Polar Plot Group 4 / Far Field 1

1) Do nově vytvořené skupiny Polar Plot Group 4 přidejte graf typu Far Field

2) Vynášenou veličinou je pabe.Lp v dB

3) Změňte parametry vykreslení

Rovinu vyhodnocení Far Field si můžete zobrazit tímto tlačítkem:

