

Acoustic-Structure Interaction with a Perfectly Matched Layer (PML)

#23521

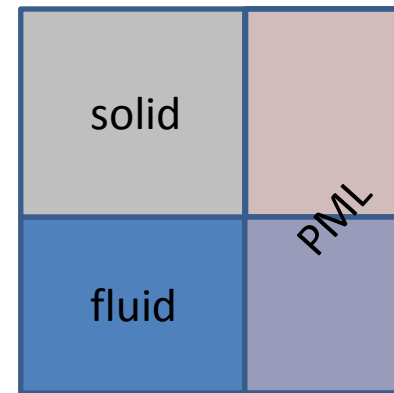
Background and Motivation

- This small tutorial model shows how to set up a model with both a solid mechanics and a pressure acoustics domain including a perfectly matched layer (PML). The PML is used to model an open or infinite domain for both the elastic waves and the pressure waves.
- The important lessons are:
 1. One PML should be added when the PML region of two physics touches. Set the PML typical wavelength manually and tweak the scaling (as described in this document).
 2. If the PML regions do not touch you should add two PMLs – one for each physics. In this case use the appropriate typical wavelength using the default *From physics* option.

Different PML configurations



If the PML regions do not touch you should add two PMLs – one for each physics. In this case the typical wavelength associated with each physics should be selected (from *Physics interface* option).



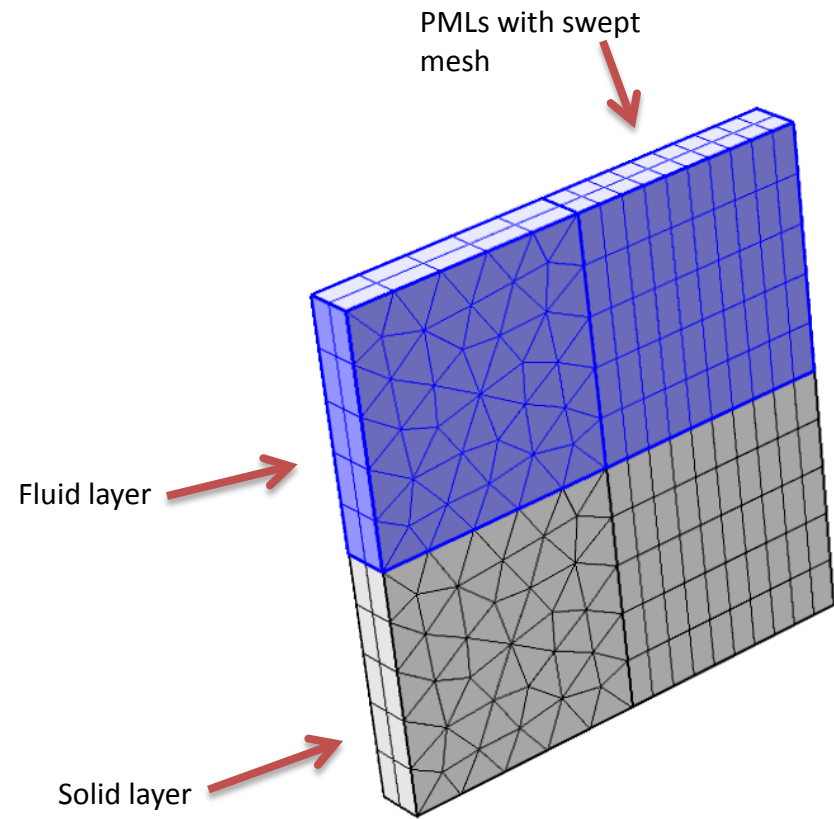
One PML should be added when the PML region of the two physics touches. Set the PML typical wavelength equal to the longest wavelength in the model (*User defined* option as in the model).

Meshing

- In general a structured mesh is preferred in the PML domains: swept or mapped. In the geometry step use the Layer option to create the PML layer geometry.
- In a typical situation when the scaling in the PML is controlled by a single physics use around 6 elements.
- In the situation where one PML is used for two physics (the touching PML configuration) use more mesh layers inside the PML region to get good attenuation performance (e.g. double the amount).

Geometry and Operating Conditions

- This example model consists of a fluid layer and a solid layer.
- Vibrations are induced in the solid and fluid by applying a velocity.
- Symmetry is used on the sides.
- A single PML is used to model an infinite fluid and solid domain.



Perfectly Matched Layer (PML)

▼ Geometry

Type:
Cartesian ▼

▼ Scaling

Coordinate stretching type:
Polynomial ▼

Typical wavelength from:
User defined ▼

Typical wavelength:
c_solid/freq

PML scaling factor:
1

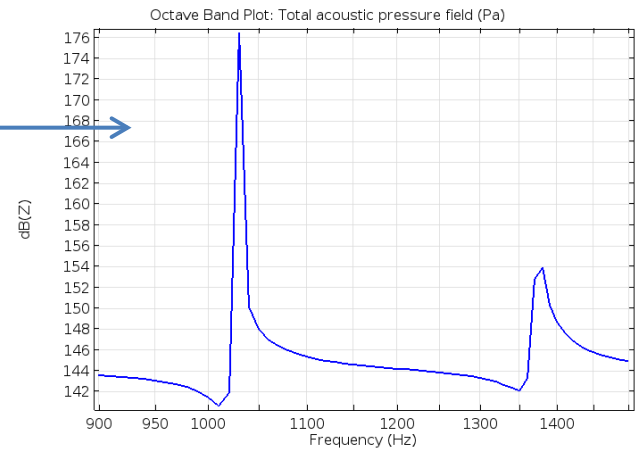
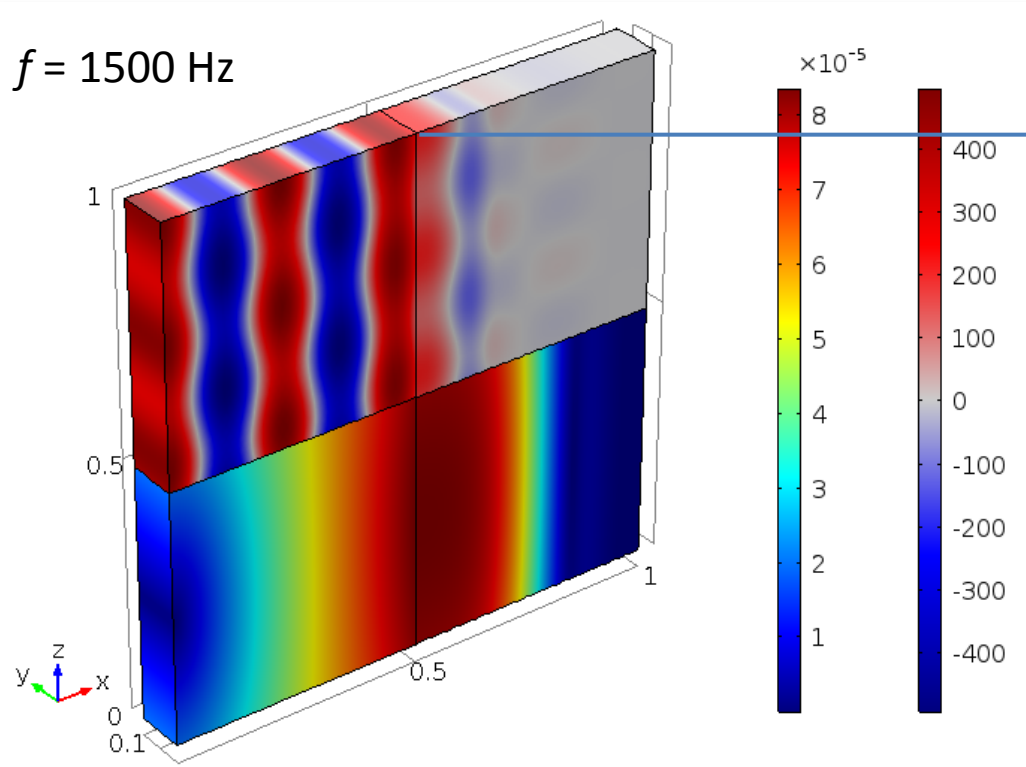
PML scaling curvature parameter:
3

Use Polynomial scaling for these coupled problems.

Use the largest speed of sound to define the typical wavelength equal to the longest in the system.

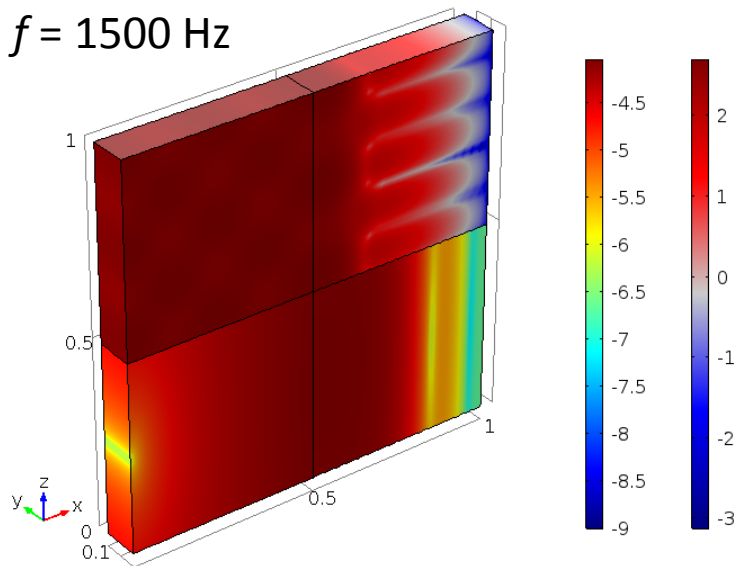
Increase the PML curvature factor to effectively increasing the resolution near the physical boundary. This will damp the small wavelengths.

Results: Pressure and Displacement



Results: \log_{10} of Fields

$f = 1500$ Hz



$f = 900$ Hz

