Assignment

Homework HL1

Master program in Music and Acoustic Engineering
Musical Acoustics
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POLITECNICO
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Problem

Characterization of a string instrument sounboard

a) Design your sounboard: define a 2D geometry of your choice (needs to be more complex than a single geometric shape such as a rectangle, a square or circle) and build the 3D object to obtain the desired plate. The soundboard needs to present some sort of soundhole(s). Define a rectangle on the plate surface and extrude it by a few millimiters. This element will act as the "bridge" of our instrument.

Starting from a blank material, create an isotropic version of Engelmann Spruce: define an isotropic material utilizing the values in the table provided below (use density, E_L, ν_{LR}) and assign it to both the soundboard and the bridge.

b) Perform eigenfrequency simulation in free boundary. Export some images of the modes.

c) Perform eigenfrequency simulation applying fixed constraints to the sides(or lower edges) of the plate. Export some images of the modes.

d) Redefine Engelmann Spruce as an orthotropic material, using the values reported in the table below, and repeat assignments b) and c)

Starting from a blank material, define Red Maple as an orthotropic material and assign it to the bridge. Apply a $1[N/m^2]$ load to the top surface of the bridge. The direction of the load must be perpendicular to the application surface.

e) Consider the plate in free boundary conditions and perform a frequency domain simulation. Define a list of frequencies in the frequency field of the study. The first part of the list must consist of a range of regularly spaced values starting below the first eigenfrequency and ending above the fifth one. The second part of the list must include the actual values of the first five eigenfrequencies.

f) Export plots of the plate displacement and compare them with the ones obtained from the eigenfrequency study.

g) Plot the velocity, along the direction perpendicular to the plate at the bridge position, as a function of frequency. Compute the velocity as the surface average of the velocity field over the contact area between the bridge and the top plate.

Density [kg/m^3]			
Engelmann Spruce	350		
Red Maple	540		
Young's Moduli [GPa]			
	E_L	E_R	E_T
Engelmann Spruce	9.79	1.25	0.58
Red Maple	12.43	1.74	0.83
Shear Moduli [GPa]			
	G_{LR}	G_{RT}	G_{LT}
Engelmann Spruce	1.21	0.10	1.17
Red Maple	1.65	0.30	0.92
Poissons's Ratios			
	ν_{LR}	ν_{RT}	ν_{LT}
Engelmann Spruce	0.422	0.53	0.462
Red Maple	0.434	0.762	0.509

Provide the solution by Oct. 23, 2023, using the WeBeep assignment tool.

- **The report must fit in 10 pages of the Latex template available at https://www.overleaf.com/read/rnkchgybrrsm;**
- **Answer concisely;**
- **Describe – concisely - the procedure used to obtain the results: if an error is present, I cannot identify the reason – numerical or conceptual - if the procedure is not described: in grading I will be forced to use the worst-case option.**
- **All students who participated to the same group must upload the report;**
- **In the PDF file and in the filename, specify the name, surname and ID of all the students participating to the HW, if more than one student worked on it.**