POLITECNICO MILANO 1863	051483 Musical Acoustics Module 1: Modeling of musical instruments Academic Year 2022/2023	Homework Laboratory III Musical Instruments modeling

Assignment: Modeling Techniques

Implement the piano string FD model considering the hammer interaction.
The problem is analyzed on the slides:

- 06_modeling_of_musical_instrument
- Pages 23-35
- A detailed description is provided in the references (page 36)

Complete the code template homework_piano.m.

- Compute the simulation of a C2 piano string with correct CFL condition (0.5 pt)
- Implement FD scheme correctly (0.5 pt)
- The total signal length is 8s (0.1 pt)
- Approximate the sound by averaging the string displacement over a small portion of the string (12 spatial samples). (0.3 pt)
  - The center of the average portion will be specular with respect to the hammer striking position.
- After the FD computation:
  - Plot the whole string diplacement at each time instant (0.2 pt)
  - Plot the estimated sound signal (0.2 pt)
  - Play the sound (0.1 pt)
  - Save the estimated sound signal in a file named: (0.1 pt)
    - yourIDnumber_surname_piano.wav

Suggested parameters:

- $f_1 = 65.4$[Hz] C2 fundamental frequency
- $b_1 = 0.5$
- $b_2 = 6.25 \times 10^{-9}$
- $w = 0.2$ width of the hammer spatial window g
- $Vh_0 = 2.5$[m/s] initial hammer velocity
- $\kappa = \epsilon$ is the string stiffness coefficient
- Other parameters can be found on the slides and articles or derived from the given ones.

Hint:

- Refer to Chaigne et. Al. for
  - The condition on maximum spatial step X
  - Hammer-string contact duration

Exercise 2:
Provide the solution of exercise 6 from the modeling of musical instrument exercise session, which is the refined model of the acoustic guitar.

- Model 20 resonances without string model (0.25 pt)
- Include the guitar string model (0.25 pt)

- Write a matlab script in that: (0.5pt)
  - Executes the model
  - Plot the signal
  - Play the signal
  - Save it on disk
- Comment results.

Please provide the answers in a report as a PDF file which explains how the FD scheme and the guitar model are implemented and your choices. In addition, you must provide the source codes and the output audio files.
All the files must be included in a .zip file named:

yourIDnumber_surname_homework_piano.zip

Upload the required file using the WeBeep platform in the “Assignment HL3” delivery folder. One file for each student must be uploaded. If more than one student participated to the assignment, write on the cover page of the assignment the name, surname and ID of the participating students.