CODECHECK certificate 2024-25 for *Influence of the cochlear partition's flexibility on the macro mechanisms in the inner ear*

Item	Value
Title	Influence of the cochlear partition's flexibility on the macro mechanisms in the inner ear
Authors	Simon Kersten, Henning Taschke, Michael Vorländer
Ref. paper	https://doi.org/10.1016/j.heares.2024.109127
Codechecker	Jelle Langedijk, Tim Schellekens
Date of Check	2024-11-08
Summary	Full reproduction of figures 2,3,4,5,6,7 of the paper. Input was COMSOL data, so the simulation itself is not run.
Repository	https://zenodo.org/records/13897017
Ref. certificate	10.5281/zenodo.14533794

Table 1: CODECHECK summary

Output	Comment
codecheck_output/fig2.png	Figure 2 of the paper. Raw output Python script.
codecheck_output/fig3.png	Figure 3 of the paper. Raw output Python script.
codecheck_output/fig4.png	Figure 4 of the paper. Raw output Python script.
codecheck_output/fig5.png	Figure 5 of the paper. Raw output Python script.
codecheck_output/fig6.png	Figure 6 of the paper. Raw output Python script.
codecheck_output/fig7.png	Figure 7 of the paper. Raw output Python script.
codecheck_output/fig7_textwidth.png	Figure 7 of the paper. Textwidth changes to avoid legend to obscure important parts of the graphic.

Table 2: Summary of output files generated

Summary

The codecheck was successfully executed. The code provided was supposed to produce figures 2-7 from the paper, and did so successfully, but excluding referenced data.

Tough, the COMSOL data (that is an input to the code) is rather big (20+GB), it might be wise for the next time to make a separate repository for such "big" data. This idea is already discussed in person with the first author of the paper.

CODECHECKER notes

The default aspect ratio of the plots make them appear "cramped", the codecheckers advice to change the `` `textwidth` `` variable to the value `` `14` ``. `codecheck_output/fig7_textwidth.png` is made with that setting.

Installation prerequisites and computational environment

The code was run using Python 3.13 (both on Windows 10 and Windows 11) using VSCode and Jupyter. The code is set up in such a way that individual blocks can be executed (as long as it is done in the correct order), allowing one to inspect output (the figure's) step-by-step. The code itself does not write the figure away to the computer, so this block-wise execution with the `ipy-kernel` is a must to see the visualizations on the fly.

N.B.: a codechecker could also add their own "save"statements to write the pictures to their computer, instead.

The code has relatively few dependencies:

- `Numpy`
- `Scipy`
- `Pyfar`
- `Pathlib`
- `Matplotlib`

The codecheckers installed these packages using `pip`.

Data preparation

None required. Data was presented properly in the repository; the code reads it in correctly.

Running the code

See the points at "computational environment". `ipy-kernel` is almost a must to execute the code without the earlier mentioned manual interventions.

Outputs

Below the figures produced by the codecheckers vs the ones in the paper are listed side by side.

Figure 2 (Paper,CodeCheck)

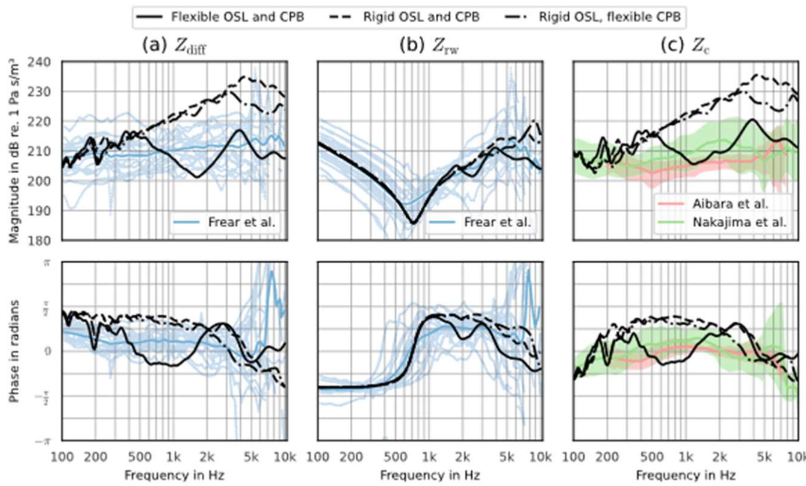


Fig. 2. Magnitude and phase of cochlear impedances with flexible versus rigid OSL and CPB. For comparison, mean and individual data from Frear et al. (2018) are shown for Z_{diff} and Z_{rw}. Z_{c} is compared to experimental data by Aibara et al. (2001) and Nakajima et al. (2009) (mean ± standard deviation).

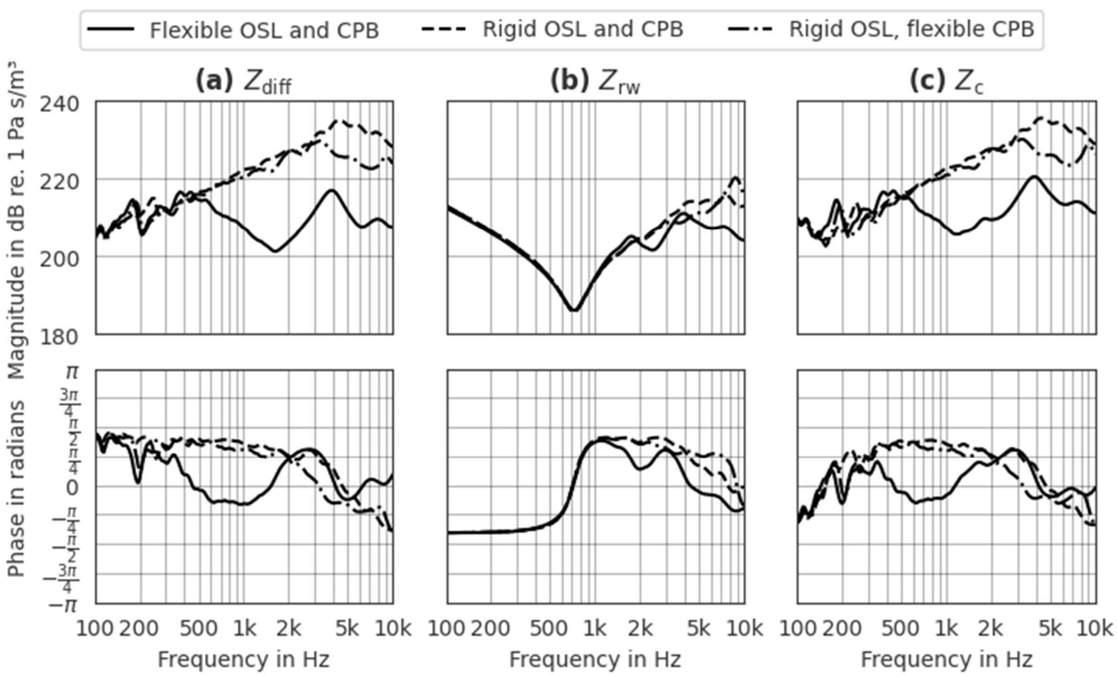


Figure 3 (Paper,CodeCheck)

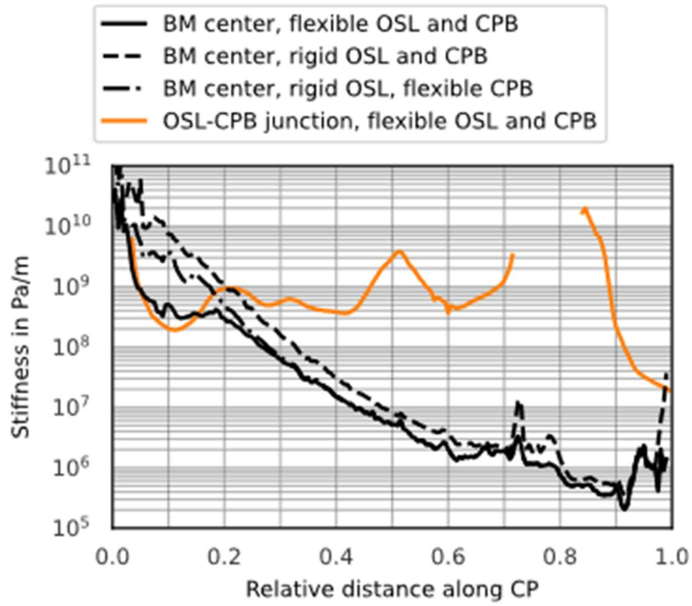


Fig. 3. CP stiffness evaluated at radial BM center with flexible OSL and CPB (solid black line), rigid OSL and rigid CPB (dashed black line), and rigid OSL/flexible CPB (dash-dotted black line) along the CP. For comparison, the stiffness at the OSL–CPB junction with flexible OSL and CPB is shown in orange (note that it approaches infinity for the scenarios with rigid OSL).

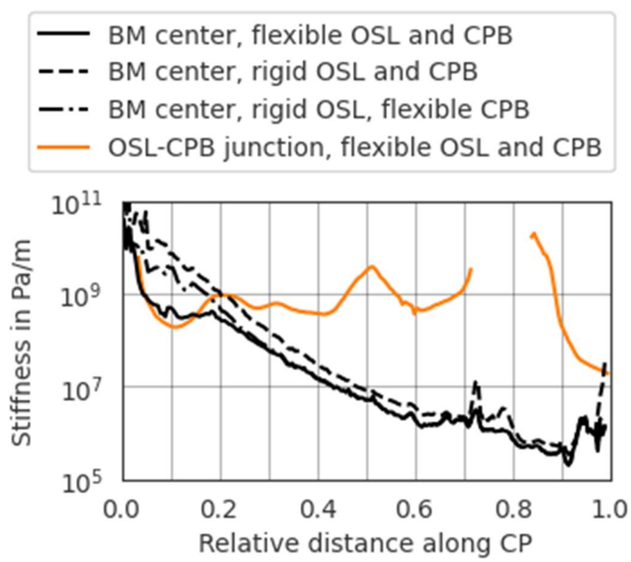


Figure 4 (Paper,CodeCheck)

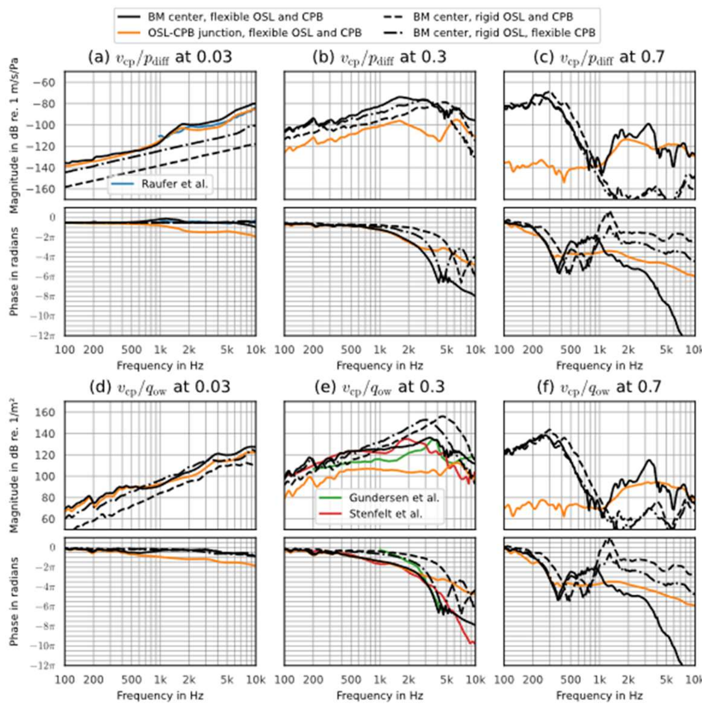


Fig. 4. CP velocity v_{cp} normalized to differential cochlear pressure p_{diff} (top row), and OW volume velocity q_{ow} (bottom row) evaluated at relative distances of 0.03 (left), 0.3 (center), and 0.7 (right) along the CP. Solid black lines indicate results with a flexible OSL and CPB, dashed black lines with a rigid OSL and rigid CPB, and dash-dotted black lines with a rigid OSL and flexible CPB, each evaluated at the radial BM center. Solid orange lines indicate the velocity at the OSL–CPB junction with a flexible OSL (note that it equals zero in the scenarios with rigid OSL). The experimental data from Raufer et al. (2019) in (a) was measured close to the base at the radial center of the BM. The data from Gundersen et al. (1978) and Stenfelt et al. (2003) at a distance 12 mm from base (corresponds to approximately 0.3 relative distance in the model) in (e) was recalculated following the method in Frear et al. (2018).

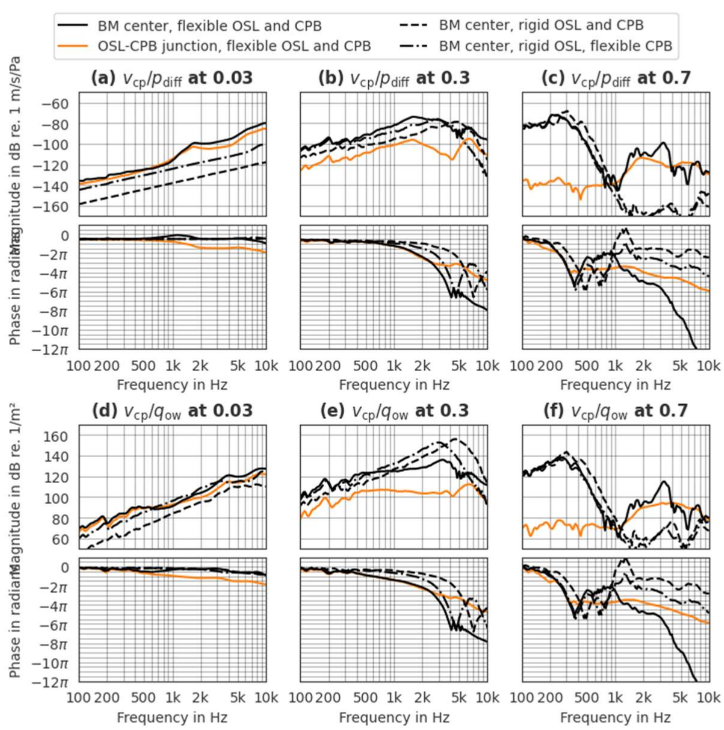


Figure 5 (Paper,CodeCheck)

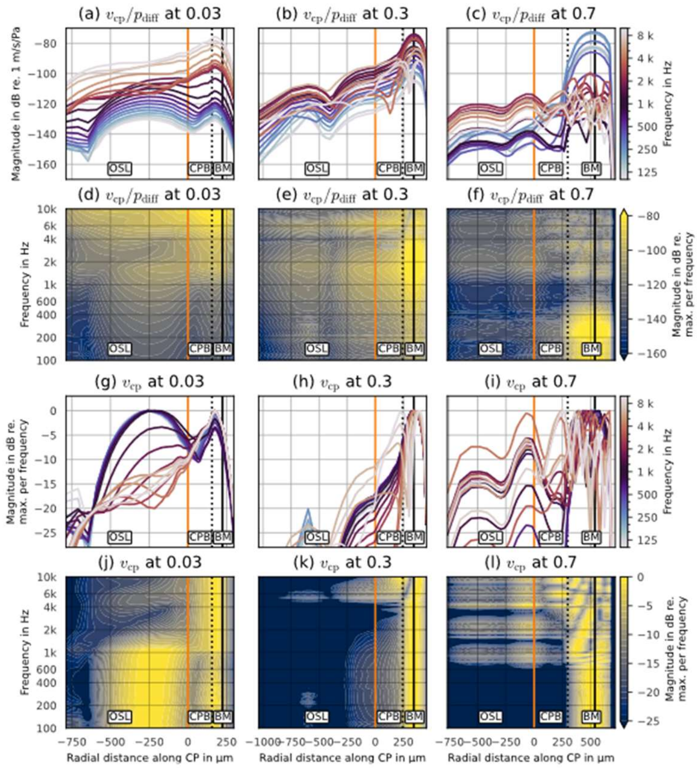


Fig. 5. Profiles of CP velocity v_{cp} with flexible OSL and CPB along radial locations (x-axis), evaluated at relative longitudinal distances of 0.03 (left column), 0.3 (center column), and 0.7 (right column). The vertical black solid lines indicate the BM center, and the orange lines indicate the OSL–CPB junction, corresponding to the radial positions in Fig. 4. The dotted black lines indicate the CPB–BM connection. Panels (a)–(c) depict the magnitudes of v_{cp} normalized to the differential cochlear pressure p_{diff} from 100 Hz to 10 kHz (bright blue to bright red, with 1 kHz in black). Panels (d)–(f) display v_{cp}/p_{diff} in terms of the color-coded magnitude, with frequencies indicated on the y-axis. Panels (g)–(i) and (j)–(l) show the magnitudes of v_{cp} normalized to the maximum per frequency, following the same formats as panels (a)–(c) and (j)–(l), respectively.

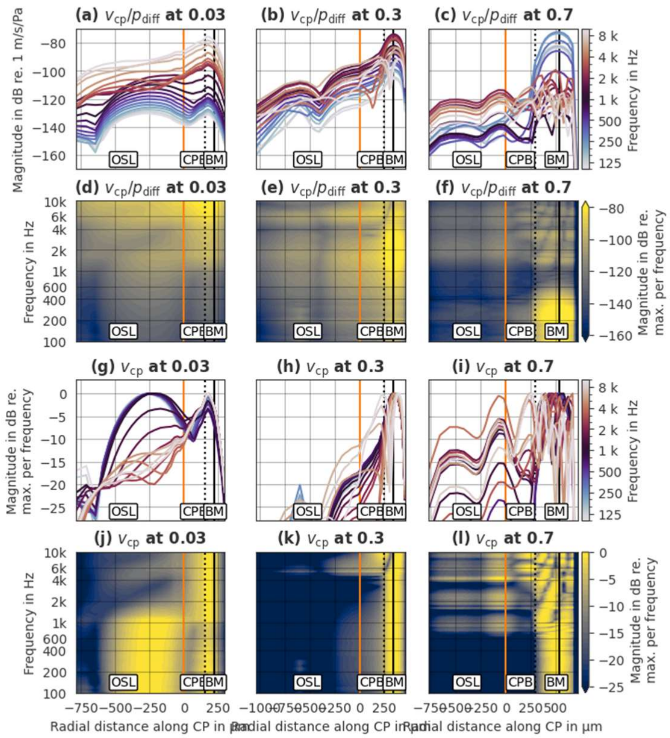


Figure 6 (Paper,CodeCheck)

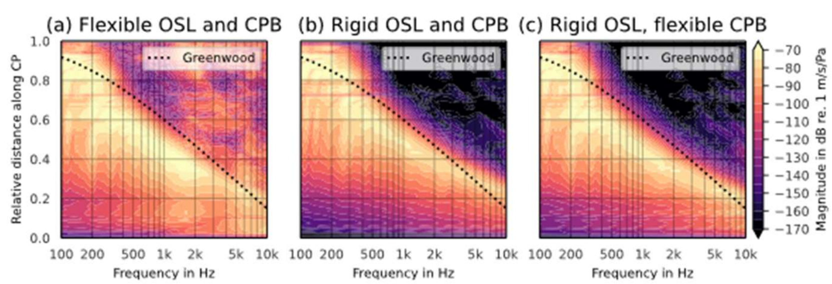


Fig. 6. Magnitude of CP velocity at the radial BM center normalized to differential cochlear pressure p_{diff} with flexible OSL and CPB (left), rigid OSL and CPB (center), and rigid OSL/flexible CPB over frequency (x-axes) and relative distance along the CP (y-axes). The tonotopic map after Greenwood (1990) is provided for reference.

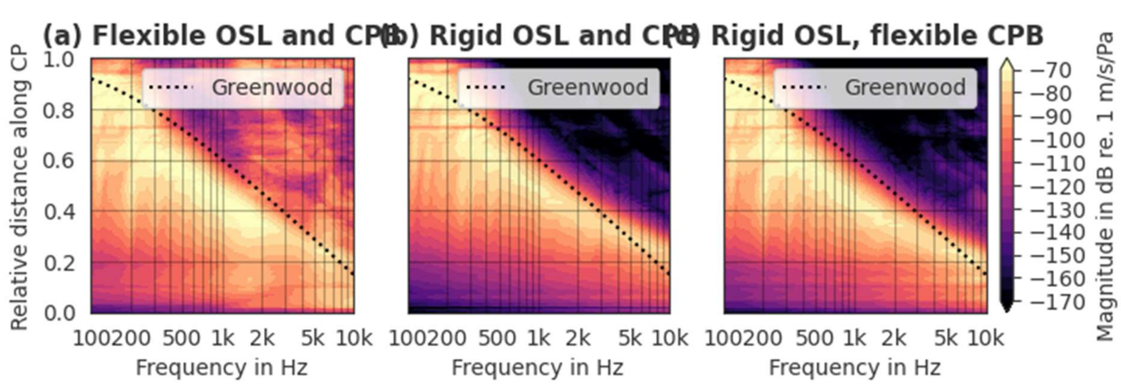


Figure 7 (Paper,CodeCheck,CodeCheck with different textwidth setting)

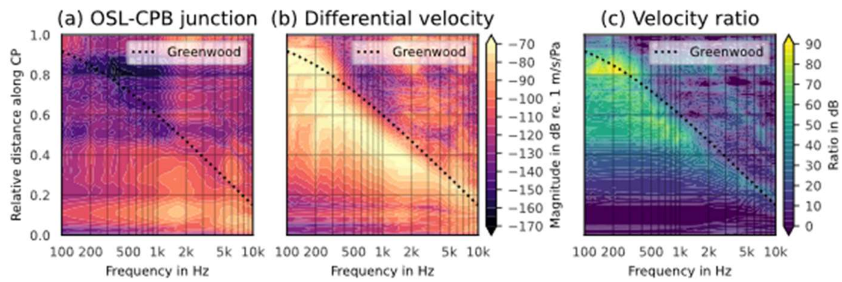
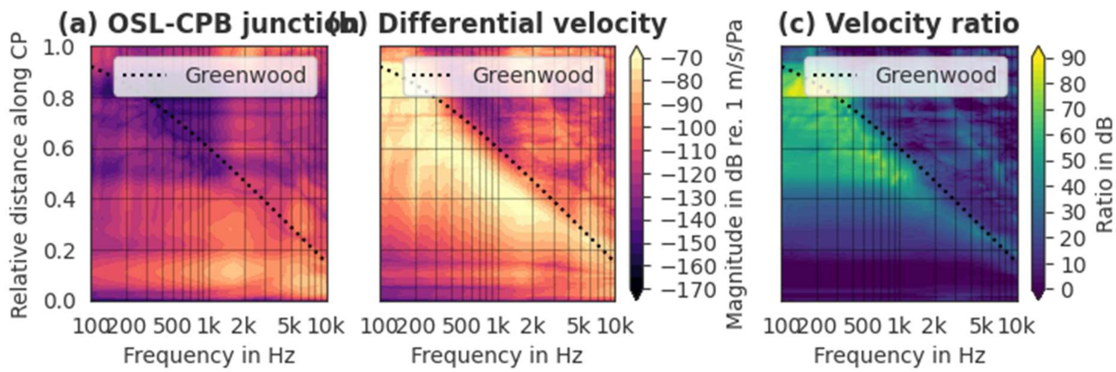
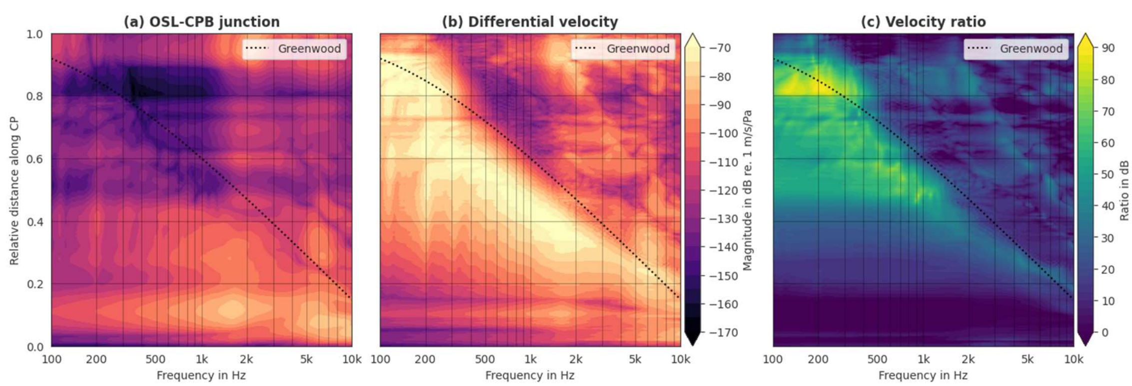


Fig. 7. (a) CP velocity at the OSL–CPB junction and (b) differential velocity between BM center and OSL–CPB junction, both normalized to the differential pressure p_{diff} over frequency (x-axes) and relative longitudinal distance along the CP (y-axes). These results are given for the condition with flexible OSL and CPB. The color ranges correspond to those in Fig. 6. In (c), the ratio of the velocity at the BM center to the velocity at the OSL–CPB junction is illustrated. The tonotopic map after Greenwood (1990) is provided for reference.





Acknowledgements

This CodeCheck is made as part of the "Computational Acoustics" track of the 2024 edition of the Autumn School Series on Acoustics (ASSA) at the Eindhoven University of Technology, The Netherlands.