

Supplementary materials for  
**Effects of hand postures  
on voice directivity**

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## Directivity datasets

The datasets contain measured directivity patterns in SOFA format<sup>1</sup> according to the SOFA convention "GeneralTF". The directivity patterns were measured in the anechoic chamber of TH Köln applying a surrounding spherical microphone array, which has a diameter of 2 m and a shape of a pentakis dodecahedron with 32 cardioid microphones (Rode NT5) located at the vertices<sup>2</sup>.

The datasets comprise two measurements (*repeat#*) for each of the 13 subjects (*subject#*). Each subject's dataset contains directivity patterns for the following conditions:

- **REF**: Reference measurement – normal articulation of an [a].
- **HFM**: Holding a hand in front of the mouth while articulating an [a].
- **CAM**: Cupping the hand around the mouth while articulating an [a].

The naming of the measured and postprocessed datasets with 32 sampling points is: Directivity\_Postures\_{*subject#*}-{*repeat#*}.sofa

Additionally, datasets which have been spatially upsampled to a dense Lebedev grid with 2702 sampling points using the SUPDEq method<sup>3</sup> are filed: Directivity\_Postures\_{*subject#*}-{*repeat#*}\_upsampled.sofa

The transfer functions for each direction of the directivity pattern are stored in the data field *Data* separately for the real and imaginary part. The data field *ReceiverPosition* contains azimuth  $\phi$  and elevation  $\theta$  for each direction and in the third field the subject's optimal head radius is given, which we determined according to Algazi et al.<sup>4</sup> based on measurements of the head width, height, and length.

The Matlab script `Plot_Voice_Directivity_Postures_SOFA.m` included in the folder reads a SOFA file and creates various directivity plots. For the sparse datasets it performs spatial upsampling using the SUPDEq method. The script requires the SUPDEq toolbox<sup>5</sup>.

## Third-octave polar plots

Figure 1 and Figure 2 depict the directivity patterns in the horizontal and vertical plane in third-octave bands from 315 Hz to 8 kHz and averaged over all subjects.

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<sup>1</sup>Majdak, P., Iwaya, Y., Carpentier, T., Nicol, R., Parmentier, M., Roginska, A., Suzuki, Y., Watanabe, K., Wierstorf, H., Ziegelwanger, H., & Noisternig, M. (2013). "Spatially Oriented Format for Acoustics: A Data Exchange Format Representing Head-Related Transfer Functions," Proceedings of the 134th AES Convention, Rome, Italy, Paper 8880.

<sup>2</sup>Arend, J. M., Lübeck, T., & Pörschmann, C. (2019). A Reactive Virtual Acoustic Environment for Interactive Immersive Audio. In Proceedings of the AES International Conference on Immersive and Interactive Audio, York, UK, pp. 1–10.

<sup>3</sup>Pörschmann, C., Arend, J.M., & Brinkmann, F. (2019). "Directional Equalization of Sparse Head-Related Transfer Function Sets for Spatial Upsampling," IEEE/ACM Transactions on Audio, Speech, and Language Processing 27(6), pp. 1060-1071, doi: 59410.1109/TASLP.2019.2908057.

<sup>4</sup>Algazi, V. R., Avendano, C., & Duda, R. O. (2001). Estimation of a Spherical-Head Model from Anthropometry. J. Audio Eng. Soc., 49(6), pp.472–479.

<sup>5</sup>Available: <https://github.com/AudioGroupCologne/SUPDEq>

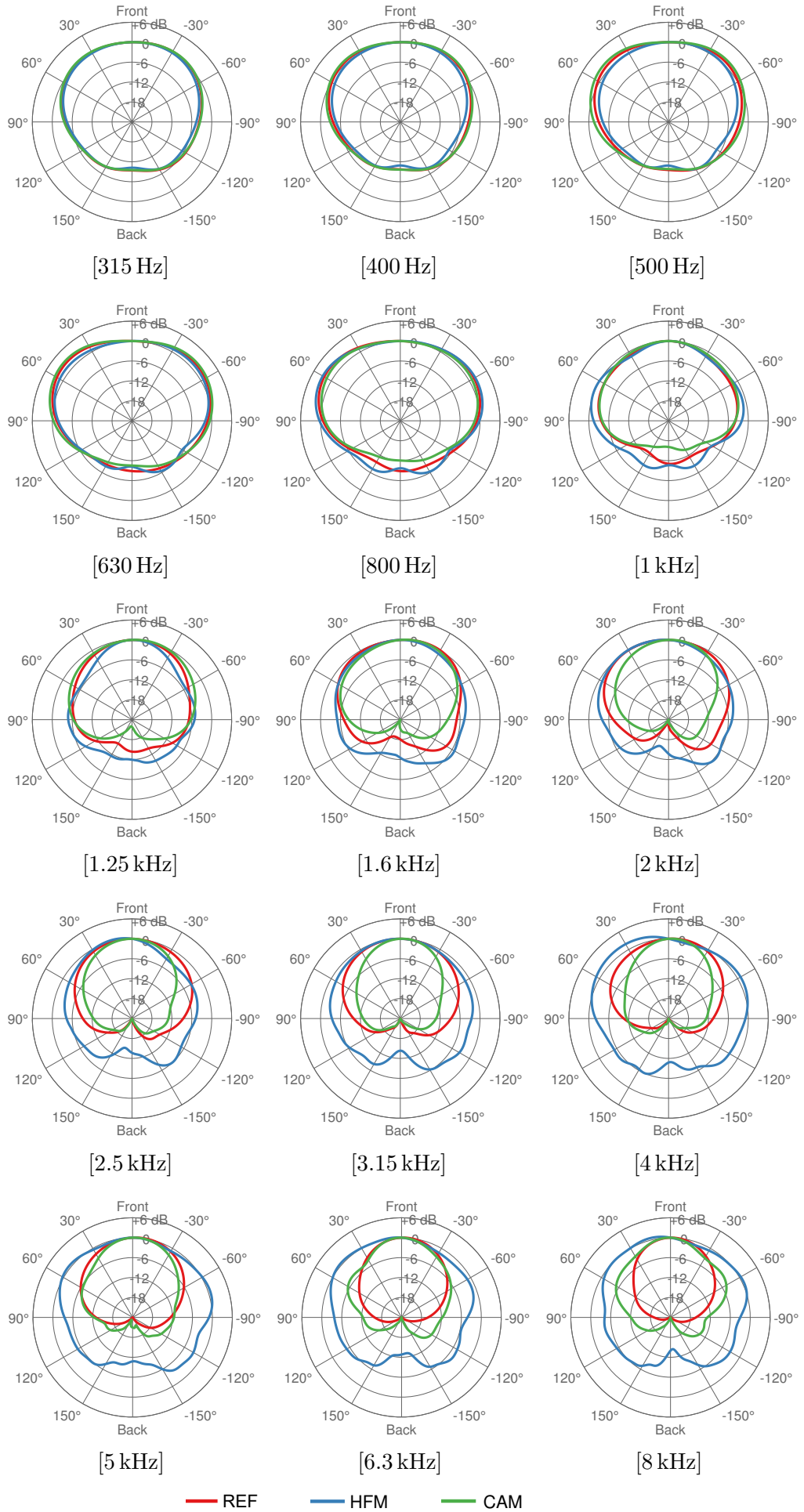


Figure 1: Polar plots of the directivity pattern in the horizontal plane, determined for the reference condition (REF) and the two hand postures HFM and CAM. Shown are the mean values in the third-octave bands between 315 Hz and 8 kHz.

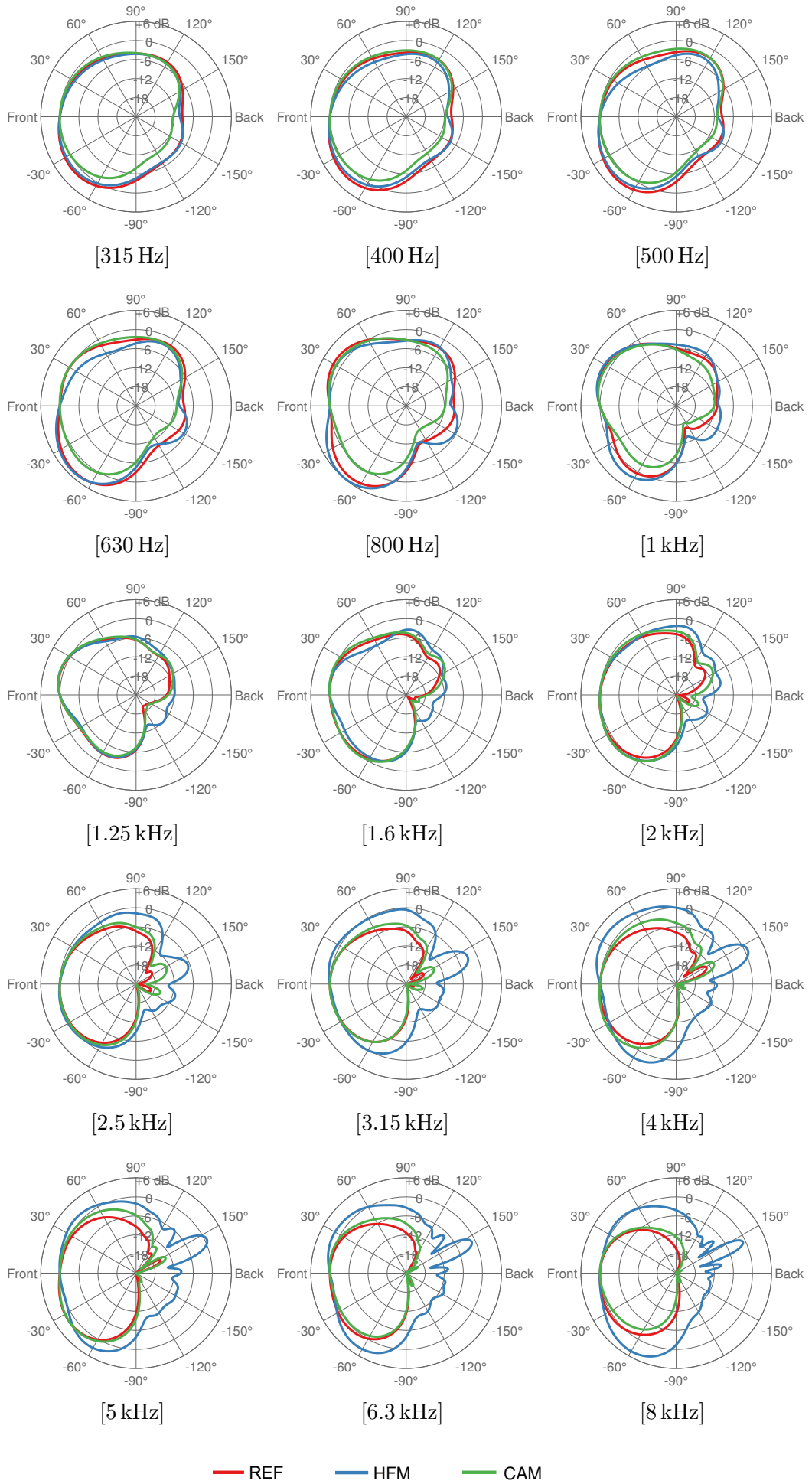


Figure 2: Polar plots of the directivity pattern in the vertical plane, determined for the reference condition (REF) and the two hand postures HFM and CAM. Shown are the mean values in the third-octave bands between 315 Hz and 8 kHz.