

VibroChair: A PIECE OF FURNITURE FOR REPRESENTING MULTI-TRACK AUDIO VIA VIBROTACTILE STIMULATION

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BACKGROUND

- Listeners with profound hearing impairment lack ability to experience to segregate sound sources in music
- Vibrotactile stimulation has been confined to single body parts; focus on representing multitrack audio is scarce

GOALS

- Develop a chair that uses vibrotactile stimulation for multiple body parts and can be part of a music listening experience at home / in a concert
- **Support auditory object formation by presentation of vibrotactile information**

VIBROTACTILE STIMULATION

- **Tactile nerve fibres and information channels in glabrous skin**, sensitive to music frequency range [Bolanowski1988, Mansfield2005]:
 - Pacinian corpuscles (PC) / P channel: 35...400 Hz
 - Rapid adapting (RA) / NP 1 channel: 10...100 Hz
- **JNDFs are very limited compared to auditory perception** [Merchel2020]
 - Whole-body vibration $\Delta f/f \approx 30\%$ ($f=5...40$ Hz) [Bellmann2002]
 - Fingertip, Forearm $\Delta f/f \approx 25\%$ ($f=25$ Hz)...
12% ($f=200$ Hz) [Mahns2006]
 - representation of melody information limited
- **Spatial acuity of few centimeters for frequencies between 100 Hz and 200 Hz**
 - might facilitate signal/instrument segregation

GEAR

- Custom-made **chair**
- **Shaker:** *Bodyshaker* (100 W): ~18 EUR
- **Amplifier:** *the t.racks DSP* (4x50 W): ~185 EUR

PROTOTYPE



PILOTING INSIGHTS

- With modern popular music, drums signal (incl. kick drum) is too **intrusive** to be presented **at back**
- **Spatial coherence** between auditory and vibrotactile stimulation desirable
- **High-frequency** sounds hard to represent
- **Perceived stereo width** increases with stems represented across different body parts

FUTURE WORK

- Elaborate signal processing to optimize vibration signals
- Evaluate auditory object formation and perception of elementary auditory attributes [loudness, spatial impression, timbre] with multisensory stimulation
- Evaluate hearing-impaired and CI listeners' experience with multitrack audio represented via vibrotactile stimulation

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