

Advancements on an Active Hearing Protection Device for Musicians

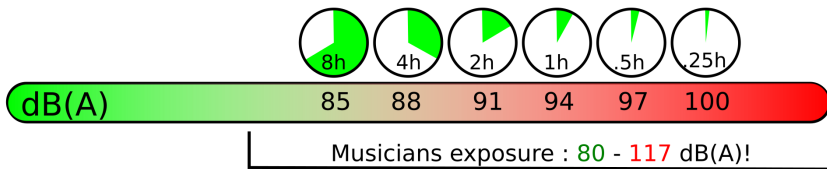
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Problem

Safe exposure (NIOSH)

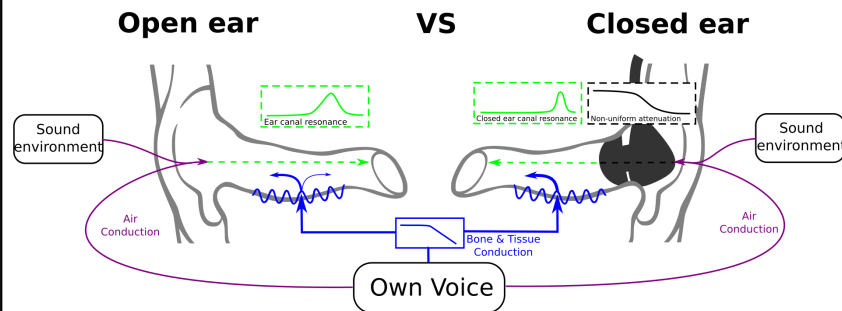


HPD usage rate : 6 - 64%

Reasons for not using HPD : Difficulties...

- ...hearing themselves 79%
- ...hearing others 72%
- ...intonation 57%
- ...balancing with other players 50%

Causes of complaints



Occlusion

Amplification of low frequencies of own voice/instrument relative to open ear by 10 to 40 dB. Caused by bone & tissue conduction propagating vibrations to closed ear canal.

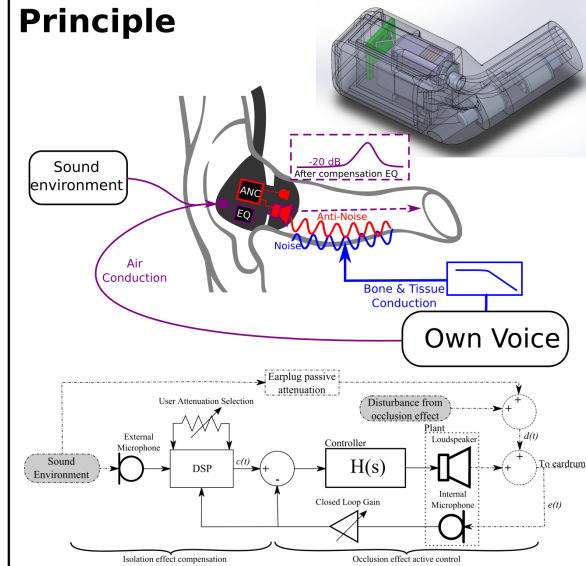
Isolation Effect

Sensation of feeling isolated from sound environment. Caused by many acoustical and psychoacoustical factors:

Modified ear resonance Non-uniform attenuation Overattenuation No loudness compensation

Solution

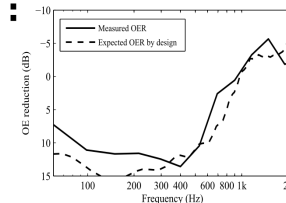
Principle



One size fits-all :

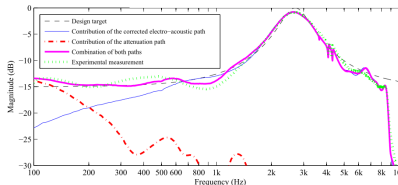
Occlusion

Reduction of 10 dB from 100 Hz to 500 Hz



Isolation Effect

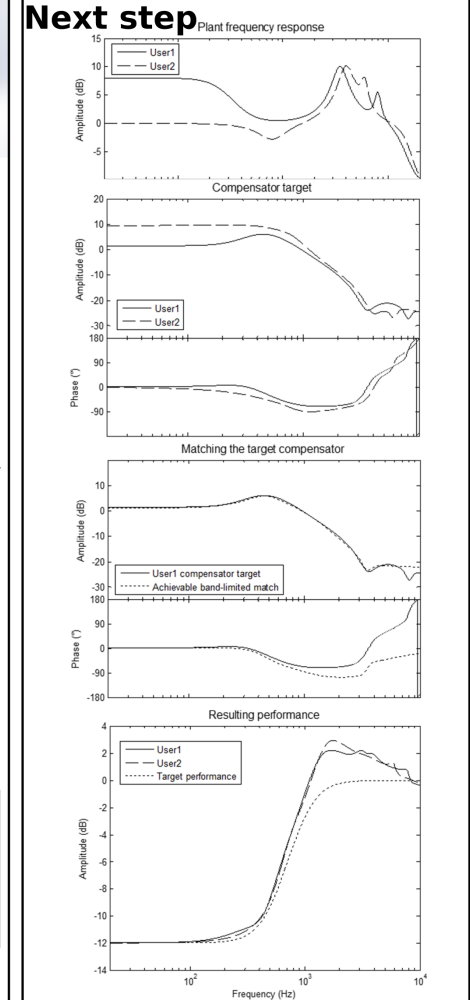
Up to 25 dB of quasi-uniform attenuation



Conclusions

Able to alleviate causes of discomfort using presented strategy
Next step: Complete and characterize implementation of custom occlusion effect reduction

Next step



References

Eaton & Gillis (2002)	Patel (2008)	Santoni & Fiorini (2010)	Santoni & Fiorini (2010)	Killion, DeVilbiss & Stewart (1988)
Royster, Royster & Killion (1991)	Huttunen, Suivonen & Pöykkö (2013)	Stenfelt, Wild, Hato & Goode (2002)	Henry & Letowski (2007)	Hagberg, Thiringer & Brandström (2005)
Fabbocchi (2010)	O'Brien, Ackermann & Driscoll (2014)	Stenfelt, Wild, Hato & Goode (2003)	Chasin (2005)	ISO 226:2003

Drawings

Chittka & Brockmann (2005)