An investigational study into the design of a low cost, adaptive hearing aid

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Introduction

Hearing loss is a prevalent problem that affects people in all parts of the world. It is caused by many factors including age, disease and trauma, and often results in a decreased quality of life [1]. Existing hearing aids are expensive, which makes them inaccessible to the majority of South Africans. It is therefore necessary to develop an inexpensive hearing aid that has all of the functionality of a high-end hearing aid.
This functionality includes:

- Amplifying specific frequency bands according to a person's audiogram
- The ability of the user to select the direction in which they wish to listen and to hear sounds in that direction louder than other directions

Objectives

- To create a full software simulation of a hearing aid
- To create a hardware proof of concept of a hearing aid which demonstrates limited functionality

Methodology

Simulated Hearing Aid

block diagram

Hardware Hearing Aid

block diagram

Testing

- Hearing aid placed on a rotating platform and rotated in 30^o increments with a constant direction selected on the device
- Sinusoidal signals with frequencies of 3340 Hz and 6000 Hz were played from a set direction
- Amplifications were applied to the frequency bands
- Output signals from the hearing aid were recorded

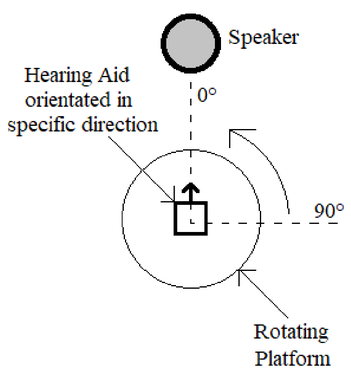

Figure 1: Procedure for testing the hearing aid

Results

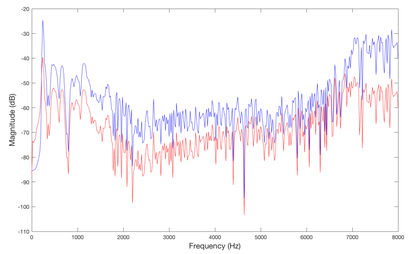

Figure 2: FFT Software

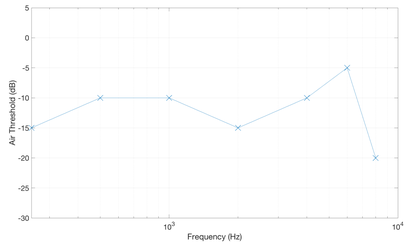

Figure 3: Audiogram

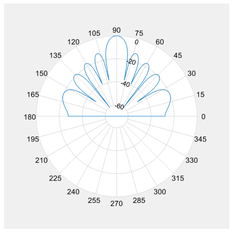

Figure 4: 90^o

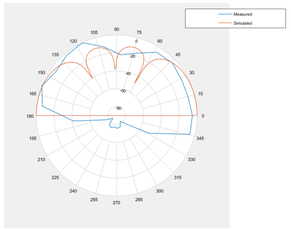

Figure 5: 0^o

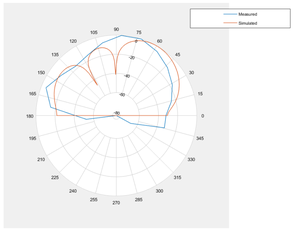

Figure 6: 60^o

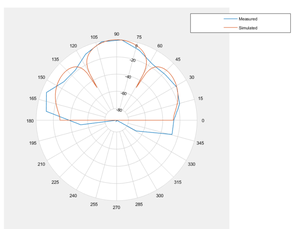

Figure 7: 90^o

Future Work

This project has been a proof of concept that an inexpensive adaptive hearing aid can be produced. For future development of the hearing aid, a number of improvements could be made including:

- Making use of higher quality omni-directional microphones
- Creating an integrated circuit chip to handle the preprocessing of the audio signals
- Making use of more microphones to improve the precision of the directionality feature

Conclusion

References

[1] D. V. Anderson, R. W. Harris, and D. M. Chabries. Evaluation of a hearing compensation algorithm. *1995 International Conference on Acoustics, Speech, and Signal Processing*, 5:3531–3533, 1995.