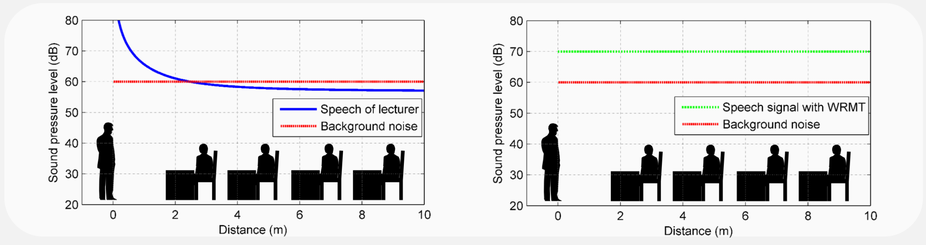
Practicability Study of a Setup for the Evaluation of Wireless Remote Microphone Technology

Hendrik Husstedt, Julia Steinhauer

German Institute of Hearing Aids, Bessemerstr. 3, 23562 Lübeck, Germany, contact: h.husstedt@dhi-online.de

1) Introduction

- Wireless remote microphone technology (WRMT) can
  - not only improve speech intelligibility
  - but also reduces listening effort [1, 2, 3]



- Although the advantages of WRMT are well known an individual and objective evaluation is required
  - To demonstrate the benefits to the patient and health insurance
  - To check and compare different systems

2) State-of-the-art & objectives

- In practice and literature, several settings are used to evaluate the performance of wireless remote microphone systems (WRMS), e.g.
  - Measurements in a real-life situation [4]
  - Using a realistic and complex test environment [4]
  - Using a simple and unrealistic test environment [5]
  - …
- The setups used provide either no realistic results or they are too complex to be used in everyday practice

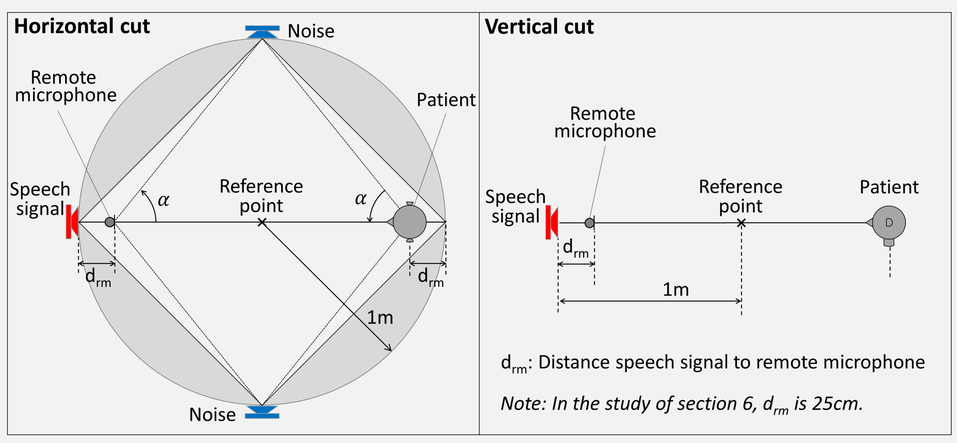
➡

Objectives:

- A measurement setup that is easy applicable and provides realistic results
- As reference environment, the listening situation in a classroom or during a lecture shall be emulated

3) Measurement setup

- Requirements: 2-channel speech audiometer with 3 speakers



4) Defining the speech and noise signal

Speech signal

- As speech signal the German Freiburger monosyllabic speech test is used [6]
- The distance to the speaker is emulated by adapting the speech level
  - The distance can be arbitrary without changing the size of the setup
  - Here a distance of 4m is chosen
- For the reference situation, the following specifications are assumed:
  - A lecture room with a volume of 300m³ and a reverberation time of 0.6s
  - A human speaker generates 65dB SPL at 1m distance

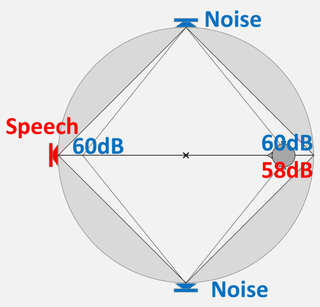
➡ In this reference situation, the speech level is 58dB SPL according to the Hopkins-Stryker equation [7, 8]

Noise signal

- An arbitrary noise signal can be chosen
  - Here white noise with 60dB SPL is applied

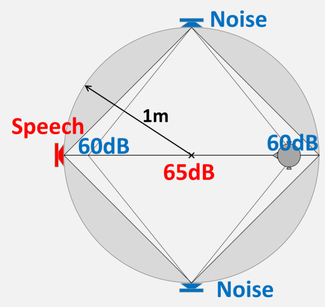
5) Measurement procedure

(I) Speech test **without** WRMS



Result I: Speech intelligibility (in %) for the everyday hearing condition, e.g. with hearing aids and/or cochlear implants, etc.

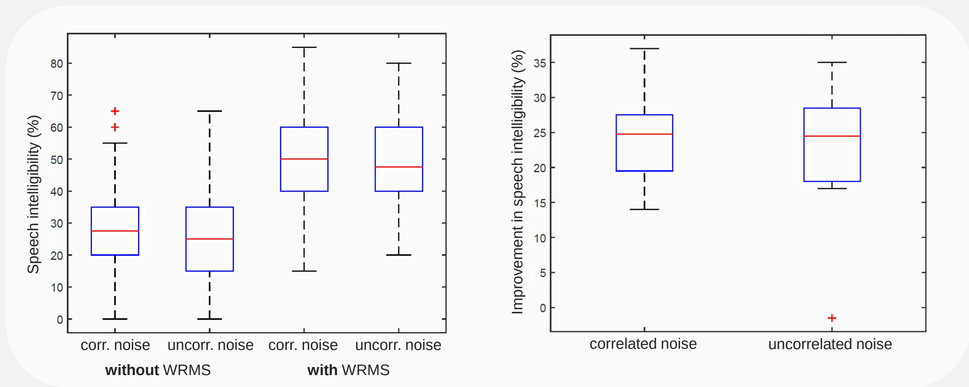
(II) Speech test **with** WRMS



Result II: Speech intelligibility (in %) with WRMS.
Note: This step can be repeated to compare different systems.

6) Study

- The practicability has been demonstrated with 14 elderly test persons with a symmetric hearing loss of type N3 according to table 2 in DIN EN 60118-15
- The effect of presenting the same noise signal with 2 speakers is analyzed [9]



7) Conclusion

- A measurement setup is presented that allows one to evaluate the individual benefit of a WRMS for a patient in a classroom situation
- The setup is designed so that it is easy applicable in everyday practice and that important features of a classroom situation are still preserved
  - The noise level is equal at the position of the remote microphone and at the position of the patient
  - The direction and level of the speech and noise signal are equal at both sides of the patients head
  - The speech and noise signal are not presented from the same direction
- The practicability has been demonstrated with 14 elderly test persons
- As result, the speech intelligibility with and without or with different WRMSs can be compared
- This result is so intuitive that also the patient can interpret it

References

[1] Valente, M., Hosford-Dunn, H. & Roeser, R., “Audiology: Treatment. 2 ed. 333 Seventh Avenue”, New York, NY, USA: Thieme Medical Publishers, Chap. 17-18, pp. 400-451, 2008

[2] Metz, M., “Sandlin's Textbook of Hearing Aid Amplification: Technical and Clinical Considerations. 3 ed.”, 5521 Ruffin Road, San Diego, CA, USA: Plural Publishing, Chap. 12, pp. 481-482, Chap. 17, pp. 629-658, 2014

[3] Crandell, C., Smaldino, J. & Flexer, C., “Sound field amplification: applications to speech perception and classroom acoustics”, 5 Maxwell Drive, Clifton Park, USA: Thomson Delmar Learning, Chap. 2, pp. 23-48, 2005

[4] Thibodeau, L., “Comparison of Speech Recognition With Adaptive Digital and FM Remote Microphone Hearing Assistance Technology by Listeners Who Use Hearing Aids”, American Journal of Audiology, 23(2), pp. 201-210, 2014

[5] ASHA Ad hoc commitee, “Guidelines for fitting and monitoring FM systems”, ASHA 2002 Desk Reference, Volume II, pp. 151-171, 2002

[6] DIN 45621-1:1995-08, “Word lists for recognition tests - Part 1: Monosyllabic and polysyllabic words”

[7] Hopkins, H. & Stryker, N., “A Proposed Loudness-Efficiency Rating for Loud-Speakers and the Determination of System Power Requirements for Enclosures”, Proceedings of the IRE, March, 36(3), pp. 315-335, 1948

[8] Davis, D. & Patronis, E., “Sound System Engineering. 3 ed.”, 70 Blanchard Road, Suite 4002, Burlington, MA, USA: Focal Press, Chap. 7, pp. 153-174, 2014

[9] Julia Steinhauer, “Untersuchung einer Messmethode zur Evaluierung von drahtlosen Übertragungsanlagen“, Fachhochschule Lübeck, Bachelor Thesis, 2015