Helia Relano Iborra - DTU Orbit (23/11/2018)

Helia Relano Iborra

Organisations

PhD Student, Department of Electrical Engineering
16/04/2015 → present
heliaib@elektro.dtu.dk
VIP

Hearing Systems
17/04/2015 → present
VIP

Research outputs:

Extending a computational model of auditory processing towards speech intelligibility prediction
A speech intelligibility model is presented based on the computational auditory signal processing and perception model (CASP; Jepsen et al., 2008). CASP has previously been shown to successfully predict psychoacoustic data obtained in normal hearing (NH) listeners in a wide range of listening conditions. Moreover, CASP can be parametrized to account for data from individual hearing-impaired listeners (Jepsen and Dau, 2011). In this study, the CASP model was investigated as a predictor of speech intelligibility measured in NH listeners in conditions of additive noise, phase jitter, spectral subtraction and ideal binary mask processing.

General information
State: Published
Organisations: Department of Electrical Engineering, Hearing Systems
Contributors: Iborra, H. R., Zaar, J., Dau, T.
Pages: 319-326
Publication date: 2018

Host publication information
Title of host publication: Proceedings of the International Symposium on Auditory and Audiological Research
Volume: 6
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Electronic versions:
isaar2017_heliaib_final.pdf
Source: PublicationPreSubmission
Source-ID: 160674856
Research output: Research - peer-review ; Article in proceedings – Annual report year: 2018

Predicting Speech Intelligibility Using a Nonlinear and Level-Dependent Auditory Processing Front End
Relaño-Iborra et al. [2016, J. Acoust. Soc. Am., 140(4), 2670-2679] proposed a model, termed sEPSMcorr, which showed that the correlation between the envelope representations of clean and degraded speech is a powerful predictor of speech intelligibility in a wide range of listening conditions. However, due to its simplistic linear preprocessing, sEPSMcorr cannot account for the level-dependent effects and nonlinear properties of the sound transduction in the auditory periphery, which is a prerequisite for accounting for the consequences of sensorineural hearing loss. Thus, in the present study, a more realistic, nonlinear preprocessing was combined with the correlation-based back end. Specifically, the front end of the computational auditory signal processing and perception model [CASP; Jepsen et al. (2008), J. Acoust. Soc. Am. 124(1), 422-438] was employed, which has been shown to successfully account for psychoacoustic data in conditions of, e.g., spectral masking, amplitude-modulation detection as well as forward masking, for both normal-hearing (NH) and hearing impaired listeners. The proposed speech-based CASP model, denoted sCASP, receives the clean and degraded speech signals as input. The signals are processed through outer- and middle-ear filtering, a nonlinear auditory filterbank including inner- and outer hair-cell processing, adaptation, as well as a modulation filterbank. The internal representations at the output of these stages are analyzed using a correlation-based back end. Speech intelligibility predictions obtained with the speech-based CASP implementation are presented and compared to NH listener data obtained in conditions of additive noise, phase jitter, ideal binary mask processing and reverberation. The results demonstrate a large predictive power of the model. As the front end of sCASP can - unlike the front end of its predecessor sEPSMcorr- be parametrized to account for sensorineural hearing loss, the proposed framework may provide a valuable basis for evaluating the consequences of different aspects of hearing loss on speech intelligibility in the various experimental conditions

General information
Prediction of speech intelligibility based on a correlation metric in the envelope power spectrum domain

A powerful tool to investigate speech perception is the use of speech intelligibility prediction models. Recently, a model was presented, termed correlation-based speech-based envelope power spectrum model (sEPSMcorr) [1], based on the auditory processing of the multi-resolution speech-based Envelope Power Spectrum Model (mr-sEPSM) [2], combined with the correlation back-end of the Short-Time Objective Intelligibility measure (STOI) [3]. The sEPSMcorr can accurately predict NH data for a broad range of listening conditions, e.g., additive noise, phase jitter and ideal binary mask processing.

General information
State: Published
Organisations: Department of Electrical Engineering, Hearing Systems
Contributors: Iborra, H. R., Zaar, J., Dau, T.
Publication date: 2018
Peer-reviewed: Yes
Event: Poster session presented at 41st annual ARO Midwinter Meeting, San Diego, United States.
Source: PublicationPreSubmission
Source-ID: 160675317
Research output: Research - peer-review › Poster – Annual report year: 2018

The speech-based envelope power spectrum model (sEPSM) family: Development, achievements, and current challenges

Intelligibility models provide insights regarding the effects of target speech characteristics, transmission channels and/or auditory processing on the speech perception performance of listeners. In 2011, Jørgensen and Dau proposed the speech-based envelope power spectrum model [sEPSM, Jørgensen and Dau (2011). J. Acoust. Soc. Am. 130(3), 1475-1487]. It uses the signal-to-noise ratio in the modulation domain (SNRenv) as a decision metric and was shown to accurately predict the intelligibility of processed noisy speech. The sEPSM concept has since been applied in various subsequent models, which have extended the predictive power of the original model to a broad range of conditions. This contribution presents the most recent developments within the sEPSM “family:” (i) A binaural extension, the B-sEPSM [Chabot-Leclerc et al. (2016). J. Acoust. Soc. Am. 140(1), 192-205] which combines better-ear and binaural unmasking processes and accounts for a large variety of spatial phenomena in speech perception; (ii) a correlation-based version [Relaño-Iborra et al. (2016). J. Acoust. Soc. Am. 140(4), 2670-2679] which extends the predictions of the early model to non-linear distortions, such as phase jitter and binary mask-processing; and (iii) a recent physiologically inspired extension, which allows to functionally account for effects of individual hearing impairment on speech perception.

General information
State: Published
Organisations: Department of Electrical Engineering, Hearing Systems
Contributors: Relano-Iborra, H., Chabot-Leclerc, A., Scheidiger, C., Zaar, J., Dau, T.
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: The Journal of the Acoustical Society of America
Volume: 141
Article number: 3970
ISSN (Print): 0001-4966
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
A correlation metric in the envelope power spectrum domain for speech intelligibility prediction

**General information**

State: Published
Organisations: Department of Electrical Engineering, Hearing Systems
Contributors: Iborra, H. R., May, T., Zaar, J., Scheidiger, C., Dau, T.
Publication date: 2016
Peer-reviewed: Yes
Event: Poster session presented at ARCHES/ICANHEAR 2016, Zurich, Switzerland.

**Electronic versions:**

ARCHES_poster_final3.pdf

Research output: Research - peer-review › Poster – Annual report year: 2017

Predicting speech intelligibility based on a correlation metric in the envelope power spectrum domain

A speech intelligibility prediction model is proposed that combines the auditory processing front end of the multi-resolution speech-based envelope power spectrum model [mr-sEPSM; Jørgensen, Ewert, and Dau (2013). J. Acoust. Soc. Am. 134(1), 436–446] with a correlation back end inspired by the short-time objective intelligibility measure [STOI; Taal, Hendriks, Heusdens, and Jensen (2011). IEEE Trans. Audio Speech Lang. Process. 19(7), 2125–2136]. This "hybrid" model, named sEPSMcorr, is shown to account for the effects of stationary and fluctuating additive interferers as well as for the effects of non-linear distortions, such as spectral subtraction, phase jitter, and ideal time frequency segregation (ITFS). The model shows a broader predictive range than both the original mr-sEPSM (which fails in the phase-jitter and ITFS conditions) and STOI (which fails to predict the influence of fluctuating interferers), albeit with lower accuracy than the source models in some individual conditions. Similar to other models that employ a short-term correlation-based back end, including STOI, the proposed model fails to account for the effects of room reverberation on speech intelligibility. Overall, the model might be valuable for evaluating the effects of a large range of interferers and distortions on speech intelligibility, including consequences of hearing impairment and hearing-instrument signal processing.

**General information**

State: Published
Organisations: Department of Electrical Engineering, Hearing Systems
Contributors: Relaño-Iborra, H., May, T., Zaar, J., Scheidiger, C., Dau, T.
Pages: 2670–2679
Publication date: 2016
Peer-reviewed: Yes

**Publication information**

Journal: Journal of the Acoustical Society of America
Volume: 140
Issue number: 4
ISSN (Print): 0001-4966
Ratings:
BFI (2018): BFI-level 2
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.77 SJR 0.695 SNIP 1.224
Web of Science (2017): Impact factor 1.605
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 1.83 SJR 0.819 SNIP 1.271
Web of Science (2016): Impact factor 1.547
Projects:

**Characterizing the effects of distortion and audibility loss on speech recognition**
Iborra, H. R., PhD Student, Department of Electrical Engineering  
Dau, T., Main Supervisor, Department of Electrical Engineering  
May, T., Supervisor, Department of Electrical Engineering  
Zaar, J., Supervisor, Department of Electrical Engineering  
Samfinansieret - Andet  
01/07/2015 → 31/01/2019  
Award relations: Characterizing the effects of distortion and audibility loss on speech recognition  
Project: PhD

Activities:

**University of Salamanca**  
Period: 1 Sep 2017 → 31 Dec 2017  
Helia Relano Iborra (Visiting researcher)  
Department of Electrical Engineering  
Hearing Systems  
**Description**  
4 months research stay at the Auditory Computation & Psychoacoustics group of the Institute of Neurosciences f the UNiversity of Salamanca with Professor Enrique A. Lopez-Poveda  
Activity: Visiting an external institution › Visiting another research institution

**Trends in Hearing (Journal)**  
Period: Aug 2017  
Helia Relano Iborra (Reviewer)  
Department of Electrical Engineering  
Hearing Systems  
**Related journal**  
**Trends In Hearing**  
2331-2165  
Scopus rating (2017): CiteScore 1.95, Web of Science (2018): Indexed yes  
Indexed in DOAJ  
Local database  
Activity: Research › Peer review of manuscripts

**The speech-based envelope power spectrum model (sEPSM) family: Development, achievements, and current challenges**  
Period: 29 Jun 2017  
Helia Relano Iborra (Guest lecturer)  
Department of Electrical Engineering
Hearing Systems

Description
Intelligibility models provide insights regarding the effects of target speech characteristics, transmission channels and/or auditory processing on the speech perception performance of listeners. In 2011, Jørgensen and Dau proposed the speech-based envelope power spectrum model [sEPSM, Jørgensen and Dau (2011). J. Acoust. Soc. Am. 130(3), 1475-1487]. It uses the signal-to-noise ratio in the modulation domain (SNRenv) as a decision metric and was shown to accurately predict the intelligibility of processed noisy speech. The sEPSM concept has since been applied in various subsequent models, which have extended the predictive power of the original model to a broad range of conditions. This contribution presents the most recent developments within the sEPSM “family:” (i) A binaural extension, the B-sEPSM [Chabot-Leclerc et al. (2016). J. Acoust. Soc. Am. 140(1), 192-205] which combines better-ear and binaural unmasking processes and accounts for a large variety of spatial phenomena in speech perception; (ii) a correlation-based version [Relaño-Iborra et al. (2016). J. Acoust. Soc. Am. 140(4), 2670-2679] which extends the predictions of the early model to non-linear distortions, such as phase jitter and binary mask-processing; and (iii) a recent physiologically inspired extension, which allows to functionally account for effects of individual hearing impairment on speech perception.

Degree of recognition: International Links:
http://dx.doi.org/10.1121/1.4989047

Related event
173rd Meeting of the Acoustical Society of America and the 8th Forum Acusticum
25/06/2017 → 29/06/2017
Boston, United States
Activity: Talks and presentations › Conference presentations

A correlation metric in the envelope power spectrum domain for speech intelligibility prediction
Period: 2017
Helia Relano Iborra (Guest lecturer)
Department of Electrical Engineering
Hearing Systems

Description
A powerful tool to investigate speech perception is the use of speech intelligibility prediction models. Recently, a model was presented, termed correlation-based speech-based envelope power spectrum model (sEPSMcorr), that uses a correlation-based back end at the output of an audio-frequency and modulation-frequency selective auditory preprocessing (Relaño-Iborra et al., 2016). The use of the correlation back-end extended the predictive power of earlier versions of the sEPSM framework (e.g. Jørgensen et al. 2013) towards conditions of non-linear signal processing, such as phase jitter and ideal binary mask processing. Moreover, the model was shown to account for conditions with fluctuating interferers, unlike other correlation-based models.

Here, the back end of the sEPSMcorr was combined with a more realistic auditory pre-processing front end adopted from the computational auditory signal processing and perception model (CASP; Jepsen et al., 2008). The preprocessing contains outer- and middle-ear filtering and a non-linear auditory filterbank (DRNL, López-Poveda and Meddis, 2001), followed by inner hair-cell transduction, adaptation and a modulation filterbank. The predictions were compared to measured data in conditions of additive masking noise, phase jitter distortions, reverberation and noise-reduction algorithms. The effects of the back end as well as the different preprocessing stages on the predicted results were analyzed. The modelling framework could be useful for the design and evaluation of, e.g. speech transmission algorithms or hearing-instrument algorithms.

Documents:
spin_helia_final_v2

Related event
9th Speech in Noise Workshop
05/01/2017 → 06/01/2017
Oldenburg, Germany
Activity: Talks and presentations › Talks and presentations in private or public companies and organisations

A correlation metric in the envelope power spectrum domain for speech intelligibility prediction
Period: 2017
Helia Relano Iborra (Guest lecturer)
A speech intelligibility model, named sEPSMcorr, is presented, which uses a modulation-frequency selective processing based on the (multi-resolution) speech-based envelope power spectrum model (mr-sEPSM; Jørgensen et al. 2013) in combination with a cross-correlation based back end inspired by the short-time objective intelligibility measure (STOI; Taal et al., 2011). The model can accurately predict data obtained with normal-hearing (NH) listeners for a broad range of listening conditions, including effects of stationary and fluctuating additive interferers as well as effects of non-linear distortions, such as spectral subtraction, phase jitter and ideal binary mask (IBM) processing. The model has a larger predictive power than both the original mr-sEPSM (which fails in the phase-jitter and IBM conditions) and STOI (which fails to predict the influence of fluctuating interferers).

However, the sEPSMcorr preprocessing does not provide a flexible framework to predict individual speech intelligibility data from hearing impaired listeners. Thus, the back end of the sEPSMcorr was combined with a more realistic auditory pre-processing front end adopted from the computational auditory signal processing and perception model (CASP; Jepsen et al., 2008). The preprocessing contains outer- and middle-ear filtering and a non-linear auditory filterbank (DRNL, López-Poveda and Meddis, 2001), followed by inner hair-cell transduction, adaptation and a modulation filterbank.

The predictions of the sEPSM-based and the CASP-based models were compared with respect to measured data (NH) in conditions of additive masking noise, phase jitter distortions, reverberation and noise-reduction algorithms. The effects of the back end as well as the different preprocessing stages on the predicted results were analyzed. The resulting modelling framework could be useful for the design and evaluation of, e.g. speech transmission algorithms or hearing-instrument algorithms.

Documents:
ARCHES_poster_final3

Related event
ARCHES/ICANHEAR 2016: Audiological Research Cores in Europe (ARCHES) meeting and Improved Communication through Applied Hearing Research (ICanHear) conference
Zurich, Switzerland
Activity: Talks and presentations › Conference presentations

Extending a computational model of auditory processing towards speech intelligibility prediction
Period: 2017
Helia Relano Iborra (Guest lecturer)
Department of Electrical Engineering
Hearing Systems

A speech intelligibility model is presented, based on the computational auditory signal processing and perception model (CASP; Jepsen et al., 2008). CASP has previously been shown to successfully predict psychoacoustic data of normal hearing (NH) listeners obtained in conditions of, e.g., spectral masking, amplitude-modulation detection, and forward masking (Jepsen et al., 2008). Furthermore, CASP can be tuned to model data from individual hearing-impaired listeners in different behavioral experiments (Jepsen and Dau, 2011). In this study, the CASP model is investigated as a predictor of intelligibility for Danish sentences for NH listeners.

The model receives the clean and degraded speech as input. The signals are processed through outer- and middle-ear filtering, a non-linear auditory filterbank (DRNL, López-Poveda and Meddis, 2001), adaptation loops, and a modulation filterbank. The internal representations produced at the end of these stages are analyzed using a correlation-based back end.

Here, predictions of speech intelligibility obtained with the speech-based CASP implementation are presented and compared to speech intelligibility data measured in conditions of additive noise, phase jitter, spectral subtraction, ideal binary mask processing and reverberation.

Related event
International Symposium on Auditory and Audiological Research
23/08/2017 → 25/08/2017
Nyborg, Denmark
Activity: Talks and presentations › Conference presentations
Predicting speech intelligibility based on a correlation metric in the modulation power domain
Period: 5 Apr 2016
Helia Relano Iborra (Guest lecturer)
Department of Electrical Engineering
Hearing Systems
Documents:
heliaib_eriksholm_v3

Related external organisation
Eriksholm Research Centre
Denmark
Activity: Talks and presentations › Talks and presentations in private or public companies and organisations

Prizes:

ISAAR scholarship
Helia Relano Iborra (Recipient)
Department of Electrical Engineering, Hearing Systems
Description
The ISAAR committee offers a limited number of scholarships to young scientists that would like to participate with a scientific contribution at an ISAAR symposium. The scholarship covers the symposium fee for full participation and accommodation. Travel expenses are not covered. The ISAAR scholarships are intended for young scientists (e.g., PhD-students, post-doctoral students, and others) working in Auditory and Audiological Research or related areas.
Details
Awarded date: 2017
Prize: Prizes, scholarships, distinctions

Research Talent Pitch Battle
Helia Relano Iborra (Recipient)
Department of Electrical Engineering, Hearing Systems
Description
Nominated for the Research Talent Pitch Battle by the Danish Sound Network
Details
Awarded date: 2018
Degree of recognition: National
event: Danish Sound Day 2018
Prize: Prizes, scholarships, distinctions

Travel Grant
Helia Relano Iborra (Recipient)
Department of Electrical Engineering, Hearing Systems
Description
Awarded for activities related to PhD external stay
Details
Awarded date: 2018
Granting Organisations: Reinholdt W. Jorck og Hustrus Fond
Prize: Prizes, scholarships, distinctions