

NEWSLETTER

HEARING SYSTEMS IN PROFILE

FEBRUARY 2015



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News, awards and prizes

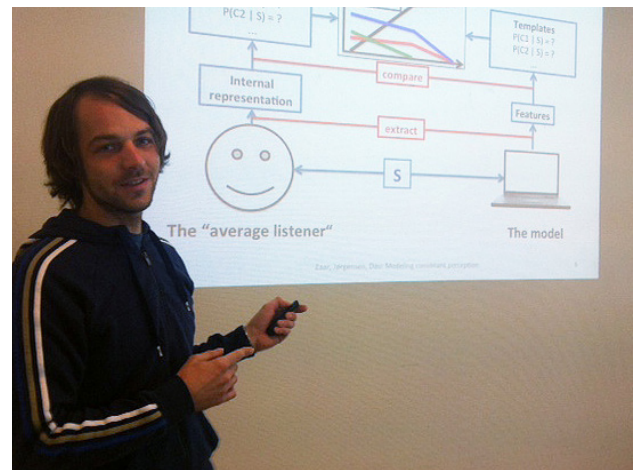


The "Colin Cherry Award" (named after the 'inventor' of the Cocktail Party Problem) was presented to Postdoc at Hearing Systems Jens Hjortkjær (left) by Gaston Hilkuysen. Photo by Alexandre Chabot-Leclerc

Best poster award at SPIN 2015

In January, the 7th Speech in Noise Workshop (SpiN) was held in Copenhagen. More than 85 researchers participated and contributed to the workshop that was organized by the Hearing Systems group in cooperation with Gaston Hilkuysen. This year, the poster award was assigned to Jens Hjortkjær and his poster about "Single-trial EEG measures of attention to speech in a multi-talker scenario".

Read more about Jens Hjortkjær's project on page 4



Johannes Zaar presenting his talk about "Modeling consonant perception in normal-hearing listeners."

Best paper and presentation award

At the 7th Forum Acusticum, which took place at AGH University of Science and Technology, Krakow, in September, PhD student Johannes Zaar received the "EAA Best paper and presentation awards for young researchers". The award came with a grant of 500 Euros. The conference, which is held every three years and organized by the European Acoustics Association, provides the opportunity for acousticians from all over the globe to meet and discuss recent advances in their fields of interest.



Photo by Anne-Sophie Poirier

New professor with experience in perception of music for people with cochlear implants

In August 2014, Jeremy Marozeau joined the faculty in Hearing Systems. Dr. Jeremy Marozeau comes from a position as a research fellow at the Bionics Institute, Australia. His research focuses on the perception of music and voice pitch information for people with a cochlear implant (CI). Originally Jeremy Marozeau is from France, but his work and engagement in science and music perception has brought him to many places in the world. He received his doctorate from the University of Paris-VI, Institute for Music/Acoustic Research and Coordination (IRCAM) where he discovered the field of psychoacoustics: "I thought it was really interesting because it brought the human element into the technical aspect. It was fascinating to be able to understand how the brain and the auditory system work and how we are able to distinguish the difference between the instruments for instance a piano and a guitar."

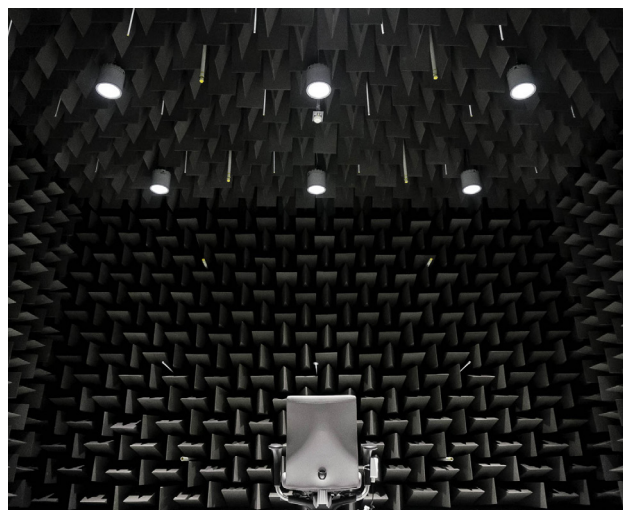
After his PhD, Jeremy Marozeau went to Marseille for a year and then to Boston, where he worked for three years as Research Fellow and also as a teacher.

"I changed the topic a bit and went to Boston in order to try to understand how people with hearing impairment perceive sounds. It really opened up to me the field of audiology, and I enjoyed dedicating my life to people in need," he says.

But after three years Jeremy Marozeau missed working in the music field, and then found a position in Melbourne (Bionics Institute) that was about improving music perception in people with CI. Jeremy Marozeau worked at the Institute and lived there with his family for six years and then thought it was time

for a change.

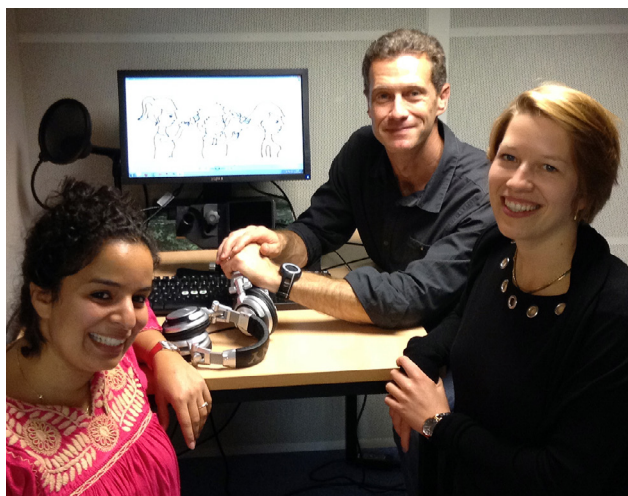
"I wanted to be in a University position and I also wanted to do more teaching, which I really enjoy. Coming back to Europe was also a wish. It is also great for research, because it is easier to collaborate with different groups here in Europe than in Australia," he explains.



Building construction complete

The infrastructure in the construction of the new buildings is now ready for use and various laboratories are being equipped: Four booths for psychoacoustic tests, two booths for physiology tests (EEG and OAE's), two for communication, a room for audiological screenings, and a new anechoic chamber for the Audio-visual Immersion lab. The new laboratories are donated by funds from the Oticon Foundation and DTU.

Illustration Rørbæk og Møller Arkitekter



The eye-tracking experiment that Dorothea Wendt (to the right) has been overseeing alongside Professor Sven Mattys. To the left Huarda Valdés-Laribi

On guest visit in York with eye-tracking facilities

As part of the European Marie Curie Initial Training Network 'INSPIRE', Postdoc Dorothea Wendt spent a week as a guest researcher at the University of York (UK). The purpose of her visit was to set up eye-tracking facilities and start testing an eye-tracking experiment. The experiment is a continuation of a study that was undertaken at DTU with Danish participants, aiming to investigate the effect of a competing talker on sentence comprehension. This study is part of a PhD project carried out by Huarda Valdés-Laribi, an Early Stage Researcher based at the University of York whose second host institution within the INSPIRE network is the Technical University of Denmark.

Hearing Colloquium Copenhagen

The Hearing Systems group at the Technical University of Denmark has since October 2014 been hosting the Hearing Colloquium Copenhagen.

The goal of this colloquium is to discuss current topics within the field of hearing research. Approximately every second month there will be a presentation by a leading researcher in the field and a possibility to discuss current and future developments. The mixture of international and national guests from both, academia and industry, will strengthen hearing research in Denmark and on an international level.



Photo by Alexandre Chabot-Leclerc

Great interest in the CAHR presentation day

Representatives from the hearing aid industry, colleagues from DTU and collaboration partners from audiological clinics came to attend the presentation day on Friday 24th October.

As in previous years, the researchers from Hearing Systems presented their current activities and research projects, mainly in the form of short talks and posters. These presentations described the results from current PhD, MSc and other research projects, which covered a broad range of topics including auditory processing and perception, speech science, audiology, spatial hearing, physiological acoustics and hearing instrument signal processing. After the presentations there was positive feedback from the guests. Many said that they were impressed; not only by the topics but also the way the PhD students, senior scientists and research assistants communicated their projects. The scientists themselves thought that it was interesting to attend each other's presentations and projects:

"It is very fascinating that so many people from around Copenhagen, CPH "the CaPital of Hearing", are gathered because of the same interest," research assistant [now PhD student] Axel Ahrens said with a smile.

Focus on the Cocktail Party Problem

Until now, the Danish Research Centre for Magnetic Resonance (DRCMR) at Hvidovre Hospital has had a tradition of working primarily with the sense of vision. However, interdisciplinary research projects, in collaboration with the new Oticon Centre of Excellence for Hearing and Speech Sciences (CHESS) at DTU, are exploring the link between the auditory system and brain activities.

How does your brain react to many different sound sources at the same time? And why are some people able to focus on one particular sound and isolate it from the rest, while others find it almost impossible, also known as the Cocktail Party Problem. A new research cooperation aims to answer these questions using the new audiovisual laboratory at DTU, which is expected to be ready later this year.

Normal-hearing listeners can focus on a particular speech source in complex multi-talker environments, the so-called 'Cocktail Party Problem', but most hearing-impaired listeners are severely challenged in this ability. The cortical mechanisms involved in attention-driven sound segregation are poorly understood and little is known about how these neural mechanisms adapt when hearing is impaired. Jens Hjortkjær's project uses magnetic resonance imaging (MRI) and scalp encephalography (EEG) to measure cortical activity patterns involved in attention-driven segregation of speech sounds in normal-hearing and hearing-impaired listeners. The aim is to develop methods for robust identification of a listener's attentional focus from the neural data.

The project also investigates functional and structural cortical changes associated with learning in new hearing-aid users. The



Postdoc at Hearing Systems and DRCMR Jens Hjortkjær (left) and head of DRCMR Hartwig Siebner with the MR-scanner that is used for this research project together with EEG-measurement equipment and the new facilities at the laboratories at DTU.

results of this work will shed light on the cortical mechanisms behind attention-driven speech sound separation, which may have implications for the future development of "intelligent hearing systems".

Jens Hjortkjær is featured in an article in "Hørelsen September 2014" the magazine for the Danish Association of Hard of Hearing. At DTAS' annual meeting in September 2014, Jens Hjortkjær presented his Postdoc project. At SpIN 2015 he received the "Colin Cherry Award" for his poster. The Postdoc project is supported by the Oticon Foundation.



Hearing Systems staff news

PhD Defences



On September 12th, Kasper Eskelund successfully defended his PhD project "Electrophysiological assessment of audiovisual integration in speech perception". While his home department was DTU Compute, Kasper conducted most of his experiments in collaboration with the Hearing Systems group.



On November 6th, Marton Marschall successfully defended his PhD project titled: "Capturing and reproducing realistic acoustic scenes for hearing research".



On November 28th, Simon Krogholt Christiansen successfully defended his PhD project titled "The role of temporal coherence in auditory stream segregation".



On December 8th, Jasmina Catic successfully defend her PhD project titled "Human Sound Externalization in Reverberant Environments".

Double researcher



Since October 2014, in addition to her research at DTU, Dorothea Wendt has started a part time position at Eriksholm Research Centre. That means that she now is both part of the Hearing Systems group and the Eriksholm research team and there is a close collaboration between the industry and the research at the university.

We have to say goodbye to:



Simon Krogholt Christiansen has started as DSP developer at GN Netcom in December 2014



Kasper Eskelund Has started as researcher and neuropsychologist at the Military Psychology Unit in April 2014



Jasmina Catic has started as technical engineer at Oticon in February 2015



We welcome new staff members



Sara Miay
Kim Madsen

Postdoc in
January 2015



Pernille
Holtegaard

Research
assistant and
audiologist
in February
2015

New Postdoc projects



“Creating realistic audio-visual environments for hearing research”

Marton Marschall

Complex environments with many sound sources and reverberation present a challenging communication situation, but one that which the healthy auditory system copes with exceptionally well. Individuals with hearing impairment on the other hand often find it very difficult to communicate under such conditions. This project focuses on bringing realistic audio and audio-visual scenes into the laboratory using spatial audio and virtual reality techniques in DTU's newly built Audio-visual Immersion Lab (AVIL). The aim is to increase our understanding of human perception in complex environments in general, and of the effects of hearing-impairment and audio-visual interactions in particular.

This project is supported by the COCOHA Horizon 2020 Project

About the COCOHA Horizon 2020 Project:

The Cognitive Control of a Hearing Aid (COCOHA) Horizon 2020 project has the ambitious aim of creating a hearing-aid system that can be mentally (cognitively) steered by the user. Advanced signal processing techniques, such as beamforming and source separation, have the potential of isolating and enhancing individual sound sources in a complex acoustic environment. However, selecting which source to enhance (i.e. steering the hearing-aid) presents a major challenge. In this project, methods and algorithms will be developed to decode brain signals picked up by EEG electrodes, and to extract attention and intention signals, matching them to acoustic sources in the environment. The hearing aid will then identify and enhance the sound source that is being attended. The results of the project are expected to shed light on the mechanisms and limits of auditory attention, and to provide a first step towards a wider application of advanced brain-computer interfaces (BCIs) in controlling prosthetic sensory systems.



“The role of resolvability and temporal cues in sequential stream segregation”

Sara Miay Kim Madsen

The ability to hear out different sounds from each other is important for being able to understand speech in a noisy environment, and for hearing out individual lines of music from others. Such tasks are typically more challenging for hearing-impaired than for normal-hearing people, and these difficulties cannot entirely be explained by loss of audibility. This project will investigate sound segregation for normal-hearing and hearing-impaired people using psychoacoustic experiments. Understanding how different aspects of hearing loss affect the ability to hear out individual sounds might be useful for the development of hearing aids and fitting procedures optimized for the individual hearing-aid user, with the aim to improve the ability to hear out individual sounds from others.

New PhD projects



“Assessing hearing-aid signal processing based on variations of the Turing test”

Borys Kowalewski

Hearing-impaired listeners experience difficulty regarding speech understanding in noisy environments, such as a loud restaurant, even when all sounds are audible.

This might be related to a dysfunction in their “auditory scene analysis” process caused by a degradation of the signals from their damaged auditory periphery. The effect of hearing impairment and hearing-aid processing on auditory scene analysis are not yet well understood. Algorithms such as multi-band compression and noise reduction can alter the acoustic features – and thus could impact auditory scene analysis ability. In this project, the goal is to analyse the interaction between hearing-aid processing and auditory dysfunction in various simple and more complex perceptual tasks.



“Characterizing auditory and audio-visual perception in virtual environments”

Axel Ahrens

One of the challenges in hearing research is to explain the human ability to understand speech in complex, noisy environments, commonly referred to as the Cocktail Party Problem. The healthy hearing system is remarkably good at focusing on a target sound while ignoring background noise. To evaluate such situations, the system is known to use not only the acoustic information but also visual information.

Since field studies are hard to exactly reproduce, very complicated and time consuming, it is convenient to get cocktail-party scenarios into the laboratory. To accomplish this, a virtual realistic environment for audio-visual experiments will be set up and evaluated, followed by investigations on the interactions of audio and visual information.

Other projects



“Evaluation of a fast psychoacoustic test of auditory spectral and temporal resolution”

Arne Pelzer

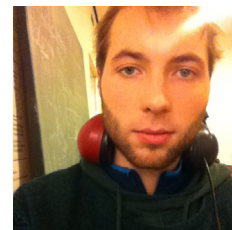
Bachelor Student from the University of Oldenburg

Although measures of spectral and temporal resolution abilities may be relevant for clinical purposes, traditional assessment methods are rather time consuming and are, therefore, not currently used in clinical practice.

To address this problem, a fast test to measure spectral and temporal resolution was designed by Larsby and Arlinger in 1998, referred to as FT-Test. Although a recent study investi-

gated correlations of the FT-Test with conventional measures of frequency and temporal resolution, it is still unclear to what extent this test is reliable and how it is related to traditional measures of basic auditory functions.

This project aims at improving the FT-Test by changing certain aspects of the measurement paradigm in order to disentangle contradictory cues and to make it more suitable for the task of assessing spectral and temporal resolution.



“Comparison of pitch and formants compensation to altered auditory feedback”

Andreas Eckey

Bachelor Student from the University of Oldenburg

While producing speech, talkers monitor both somatosensory and auditory feedback. Many studies have demonstrated that if auditory feedback is manipulated in real-time, subjects compensate by modifying their F0 in the direction opposite to the perturbation. However, shifting the entire frequency spectrum alters both F0 and formant frequencies. While compensations for real-time formant perturbations have been previously observed, these studies have used a paradigm that is very different from that of traditional pitch perturbation experiments. In the present study, compensations in both F0 and formant frequencies were compared for perturbations of sustained vowels using a traditional pitch-perturbation paradigm. Within a sustained utterance, the auditory feedback was shifted by a constant magnitude for a short duration.

Previous studies have suggested that the large variability in compensation across individuals may be due to individual differences in weighting somatosensory and auditory feedback. Following this hypothesis, individuals' compensations in F0 and formant frequency should be correlated.



“Objective measures of cochlear dispersion”

Andreu Paredes Gallardo

Research Assistant

The frequency-place transformation that characterizes the mammalian auditory system is established in the cochlea. The mechanical waves within the cochlea demonstrate dispersive behavior, with wavelengths and velocities varying with frequency and position. Traveling wave propagation occurs from the base to the apex of the cochlea, resulting in an increasing phase with distance from the cochlear base.

Direct measurements of cochlear dispersion are invasive and can only be measured in animals. Thus, only behavioral estimates of auditory filter phase response are available in humans. This project investigated dispersion at a particular cochlear location through electroencephalograms, via auditory steady-state responses.



“Combining behavioral tasks and objective measures”

Wiebke Lamping

Research Assistant

Wiebke Lamping performs behavioral tests concerning the perception of pitch in hearing impaired listeners. These tests are focused on the fundamental frequency difference limen and the temporal modulation transfer function.

(with Federica Bianchi)

She also uses objective measures such as eye-tracking and EEG to investigate the listening effort of speech in noise. Additionally, these measures are combined with cognitive tests to look into auditory working memory.

(with Jens Hjortkjær and Dorothea Wendt)

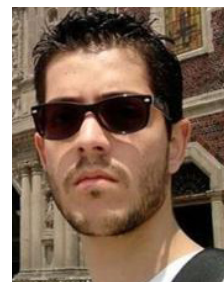


“Modelling the vocal effort for use with radio communication headsets”

Rachel Bou Serhal

Visiting PhD student from École de technologie supérieure, Université de Québec, Montréal, CA, until July 2015

To begin to resolve issues occurring when communicating in noise while wearing Hearing Protection Devices (HPD), a Radio Acoustical Virtual Environment (RAVE) is being developed. RAVE mimics a natural acoustical environment by transmitting the speaker's voice signal only to receivers within a given radius, the distance of which is calculated by considering the speaker's vocal effort and the level of background noise. To create a genuine RAVE, it is necessary to understand and model the speech production process in noise while wearing HPDs.



“Simulation of realistic background noise using multiple loudspeakers”

Juan David Gil Corrales

Research Assistant

Background noise makes part of every communication experience. Depending on its nature and on the means of communication, the background noise can become a critical obstacle. In telecommunications, devices such as mobile phones, headsets or hearing aids, have algorithms to control the background noise and enhance the target speech. Accurate reproduction of realistic background noise under laboratory conditions is necessary when testing the performance of such algorithms. One method for reproducing background noise is based on the calculation and optimization of inverse filters that compensate for the response of the reproduction system. It allows the reproduction of sound with high precision at the position of the device under test. In his current work, Juan David Corrales investigates how this method compares to the traditional ETSI method and to Higher-Order Ambisonics.

Recent publications

Recent articles

Eskelund K, MacDonald E, Andersen T (2014) Face configuration affects speech perception: Evidence from a McGurk mismatch negativity study.

Neuropsychologia, 66, 48-54

Guérit F, Santurette S, Chalupper J, Dau T (2014) Investigating Interaural Frequency-Place Mismatches via Bimodal Vowel Integration.

Trends in Hearing, 18, 1-10

Hansen R, Santurette S, Verhulst, S (2014) Effects of spontaneous otoacoustic emissions on pure-tone frequency difference limens.

Journal of the Acoustical Society of America, 136 (6) 3147–3158

Madsen S, Moore B (2014) Effects of compression and onset/offset asynchronies on the detection of one tone in the presence of another.

Journal of the Acoustical Society of America 135, 2902-2912

Madsen S, Moore B (2014) Music and hearing aids.

Trends in Hearing 18, 1-31

May T, Dau T (2014) Computational speech segregation based on an auditory-inspired modulation analysis.

Journal of the Acoustical Society of America 136 (6) 3350–3359

May T, Dau T (2014) Requirements for the evaluation of computational speech segregation systems.

Journal of the Acoustical Society of America, 136 (6) 398-404

Nielsen JB, Dau T, Neher T (2014) A Danish open-set speech corpus for competing-speech studies.

Journal of the Acoustical Society of America, 135 (1) 407-420

Vatti M, Santurette S, Pontoppidan NH, Dau T (2014) Perception of a Sung Vowel as a Function of Frequency-Modulation Rate and Excursion in Normal-Hearing and Hearing-Impaired Listeners.

Journal of Speech, Language, and Hearing Research 57, 1961 – 1971

Christiansen SK, Jepsen ML, Dau T (2014) Effects of tonotopicity, adaptation, modulation tuning, and temporal coherence in “primitive” auditory stream segregation.

Journal of the Acoustical Society of America, 135 (1), 323–333

PhD theses

Eskelund K (2014) Electrophysiological assessment of audiovisual integration in speech perception

Marschall M (2014) Capturing and reproducing realistic acoustic scenes for hearing research

Krogholt Christiansen S (2014) The role of temporal coherence in auditory stream segregation.

Catic J (2014) Human Sound Externalization in Reverberant Environments

Conference papers

Vatti M, Santurette S, Pontoppidan NH, Dau T (2014) Maximum Acceptable Vibrato Excursion as a Function of Vibrato Rate in Musicians and Non-musicians. Presented at: 166th Meeting of the Acoustical Society of America, 2013, San Francisco, CA
Part of Proceedings of Meetings on Acoustics, 2014, Acoustical Society of America

Agerkvist F, Torras Rosell A, McWalter R (2014) Eliminating transducer distortion in acoustic measurements. Presented at AES 137th Convention, 2014, Los Angeles, CA. *Part of Proceedings of the 137th AES Convention, 2014, Audio Engineering Society*

Bianchi, F, Santurette S, Wendt D, Dau T (2014) Objective correlates of pitch salience using pupillometry Presented at: 7th Forum Acusticum, 2014, Krakow. *Part of Proceedings of Forum Acusticum 2014*

Chabot-Leclerc A, Dau T (2014) Predicting speech release from masking through spatial separation in distance. Presented at 7th Forum Acusticum, 2014, Krakow. *Part of Proceedings of Forum Acusticum, 2014,*

Cubick J, Santurette S, Dau T (2014) Influence of high-frequency audibility on the perceived distance of sounds. Presented at 7th Forum Acusticum, 2014, Krakow. *Part of Proceedings of Forum Acusticum, 2014*

Cubick J, Santurette S, Laugesen S, Dau T (2014) Influence of High-Frequency Audibility on Distance Perception. Presented at DAGA 2014. *Part of proceedings of DAGA 2014, pp: 576-577, 2014, German Acoustical Society (DEGA),*

Joshi S, Dau T, Epp B (2014) Modeling auditory-nerve responses to electrical stimulation. Presented at 7th Forum Acusticum, 2014, Krakow
Part of Proceedings of Forum Acusticum, 2014

Käsbach J, May T, Oskarsdottir G, Jeong C, Chang J (2014) The effect of interaural-time-difference fluctuations on apparent source width. Presented at 7th Forum Acusticum, 2014, Krakow. *Part of Proceedings of Forum Acusticum, 2014*

Käsbach J, May T, Oskarsdottir G, Jeong C, Chang J (2014) The effect of interaural-time-difference fluctuations on apparent source width. Presented at 7th Forum Acusticum, Krakow 2014. *Part of Proceedings of Forum Acusticum, 2014,*

Locsei G, Santurette S, Dau T, MacDonald E (2014) Influence of acoustic complexity on spatial release from masking and lateralization. Presented at 7th Forum Acusticum, 2014, Krakow. *Part of Proceedings of Forum Acusticum 2014*

Conference posters

Hjortkjær J (2014) The shape of sounds: Audiovisual integration of visual shapes and musical sounds in the human brain
The Neurosciences and Music V - Cognitive Stimulation and Rehabilitatio, Dijon

Ohlenforst B, MacDonald E, Souza P (2014) Interaction of Working Memory, Compressor Speed and Background Noise Characteristics
Presented at 41st Annual Scientific and Technology Conference of the American Auditory Society, 2014, Scottsdale, Arizona

Valdés-Laribi H, Wendt D, Cooke M, MacDonald E, Mattys S (2014) Native and non-native sentence comprehension in the presence of a competing talker
Presented at 4th Annual Conference of the British Society of Audiology, 2013, Keele

Zaar J, Jørgensen S, Dau T (2014) Consonant confusions in frozen and random white noise
Presented at 6th Workshop on Speech in Noise, 2014, Marseille

MSc and Bachelor Projects 2015

Teaching a cochlear implant how to speak Danish. Veit Lukas Goßmann.
Supervisors: Jeremy Marozeau (DTU), Ewen MacDonald (DTU), David Morris (Co-supervisor KU)

The effect of cognitive load on auditory processing. Mhairi Riddet.
Supervisors: Ewen MacDonald (DTU) Torsten Dau (Co-supervisor DTU) Sven Mattys (The University of York)

Subjective and Objective Assessment of Vehicle Audio Systems. Álvaro Monreal Cantó.
Supervisors: Ewen MacDonald (DTU), Wookeun Song (B&K)

Modeling the intelligibility of time-compressed speech. Søren Fuglsang.
Supervisors: Oded Ghitza (Boston University), Torsten Dau, Johannes Zaar (DTU)

Analysis and synthesis of environmental sounds based on auditory processing principles. Jan David Brümmmerstedt.
Supervisors Torsten Dau and Richard McWalter (DTU)

Analysing the effects of auditory processing and the decision metric on speech intelligibility prediction. Helia Relano Iborra.
Supervisors Torsten Dau, Søren Jørgensen (Oticon) and Christoph Scheidiger (DTU)

Evaluation of a clinical auditory profile in hearing-aid candidates. Nikoline Thorup.
Supervisors Morten Friis (RH/KU), Sébastien Santurette (DTU), Erik Kjærboel (BBH), Søren Jørgensen (ex-DTU)

(Bachelor) Implications of articulatory variability for consonant perception modeling. Dmitry Vasilev.
Supervisors Johannes Zaar, Sébastien Santurette, Bastian Epp (DTU)

