Technical University of Denmark

DTU
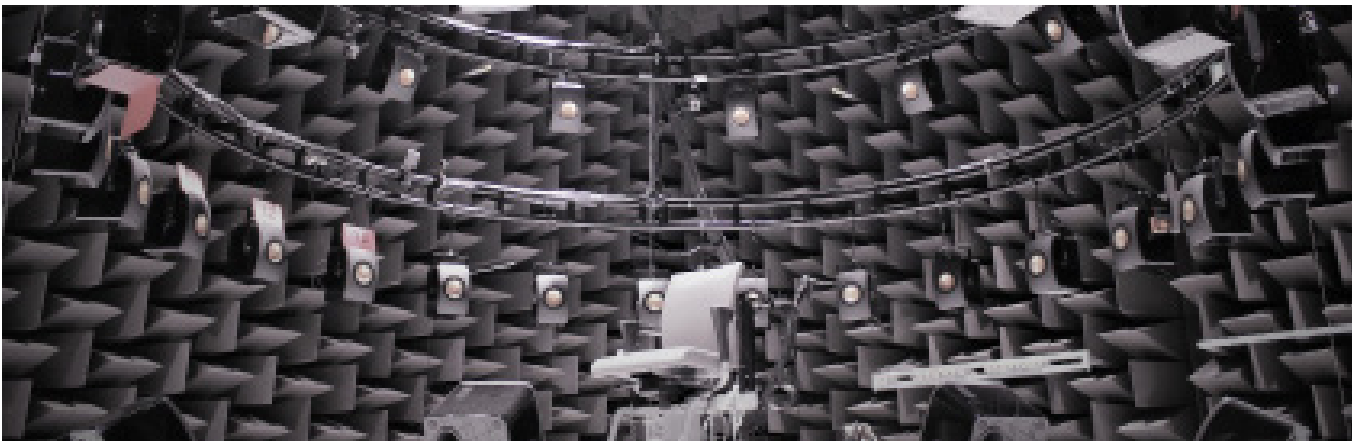
NEWSLETTER

HEARING SYSTEMS IN PROFILE

August   2019

HEARING SYSTEMS

CONTENTS

News, awards and prizes

Audio Visual Immersion Lab. Photo: Naim Mansour

10 MDKK to continue CHeSS

The Hearing Systems Section has received 10 million DKK from the William Demant Foundation for continuous support of the Oticon Centre of Excellence for Hearing and Speech Sciences (CHeSS). The new Centre will run for five years (2019-2024) and will be focused on auditory neuroscience and computational modeling. The centre will focus on fundamental questions about how the auditory system codes and represents sound in everyday acoustic environments. Using computational auditory modeling, a major goal is to provide a description of the transformations of acoustical input signals into their essential 'internal' representations in the brain. The center combines neuroimaging with psychophysics and computational modelling to understand the mechanisms that underlie the remarkable robustness of the normal-hearing auditory system in real-world situations and to understand how these mechanisms

are affected by hearing impairment. State-of-the-art models of hearing struggle to accurately predict auditory perception in complex real-life situations, such as speech recognition in a busy restaurant. There is a lack of knowledge about central representations of speech or other natural sounds in higher-order brain processing. A central goal of the centre is to connect the 'missing link' between existing models of the auditory periphery, where a hearing impairment usually arises, and the later brain stages that describe the consequences in everyday perception. The activities will be in collaboration with Prof. Laurel Carney from the University of Rochester (USA), Prof. Lars Kai Hansen from the Department of Applied Mathematics and Computer Science at DTU and Prof. Hartwig Siebner from the Danish Research Center for Magnetic Resonance at the Copenhagen University Hospital Hvidovre.

DTU Health Tech
Department of Health Technology

News, awards and prizes

Congratulations to Hearing Systems for winning best section activity (Cocktail party and other demonstrations in the lab) at the Health Tech Summer event. With the award comes a price of DKK 10.000.
Photo Jesper Scheel, DTU Health Tech

Best Health Tech Section Activity

In June, the summer event at the new Health Tech department took place. The Health Tech Department consists of 10 sections, several centres and support staff related to administration, innovation and education, all together about 300 employees. All sections were encouraged to show a demo of their research area. Thanks to a creative team, Hearing Systems succeeded in winning the best section activity (Cocktail party and other demonstrations in the lab). With the award comes a price of DKK 10.000.
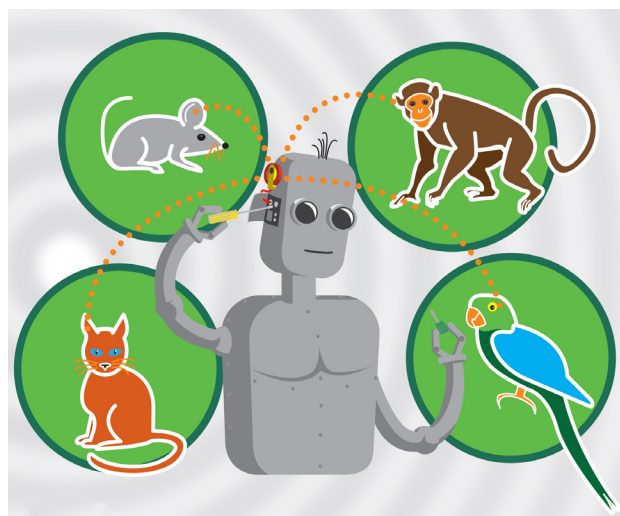

Illustration: Helene Ingerslev

ISAAR 2019

On August 21-23, the 7th International Symposium on Auditory and Audiological Research ISAAR, supported by GN Hearing, took place in Nyborg. This year's topic was auditory learning in biological and artificial systems. More information about the conference can be found at our webpage and on www.isaar.eu.

News, awards and prizes

New research activities at Rigshospitalet

With a grant of 40 million Danish kroner from William Demant Foundation, the Capital Region of Denmark can now join all specialized treatment and research within hearing loss and balance treatment at Rigshospitalet. The donation provides a unique opportunity to combine daily treatment with intensified research collaboration between the clinical and the medical technology world which DTU also is a part of. At present, the highly specialized audiological treatment takes place in Gentofte (children and adults with cochlear implant needs), while classical hearing aid treatment takes place at Bispebjerg Hospital. Patients with complicated audiological profiles can now look forward to a combined surgical and non-surgical treatment in the new center, which also will provide engineering in the field of medical technology research. "It is quite unique that we have the opportunity to contribute to our own medico-technical valley with world-class research in this area. As a small country, we must make use of the areas where we are truly competent for the benefit of our patients and the Danish society," says Mads Klokker, Head of Department of Otorhinolaryngology, Head and Neck Surgery & Audiology at Rigshospitalet. The donation will allow research projects, for example designing language-specific sound processing strategies for cochlear implants.

Currently, the north wing at Rigshospitalet is being expanded for the new center and research activities in collaboration with DTU. The construction is expected to be completed by 2020. Photo: Rigshospitalet.

Other important research areas will be virtual ear surgery for possible future robot surgery, hearing adaptation strategies for hearing aid patients and diagnosis and treatment strategies for loss of balance and unsteadiness. Several researchers from Hearing Systems are already working part time at Rigshospitalet and Bispebjerg and it is expectetd that more researchers will be come part of the new centre at Rigshospitalet next year.

Staff news

Photo: Jesper Scheel DTU Health Tech
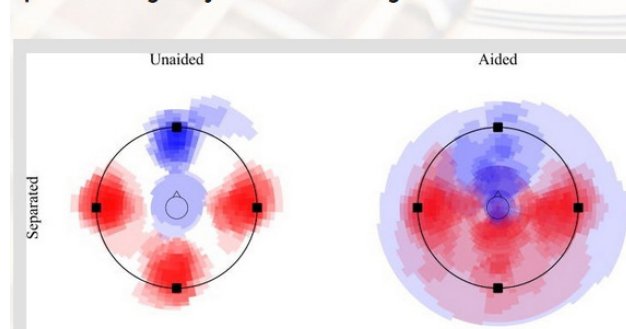
New Assistant Professor

Since March 15, Abigail Kressner has started a new joint position as Assistant Professor in the Hearing Systems Section at DTU Health Tech and the Department of Otorhinolaryngology, Head and Neck Surgery & Audiology at Rigshospitalet. Abigail Kressner, who originates from Chicago (US), has been working as a postdoc at DTU, specializing in signal processing and cochlear implants. "I think this particular position is quite unique because it is shared between DTU and the hospital, which has clinics within each of the three hospitals in the Copenhagen area (Rigshospitalet, Bispebjerg, Gentofte), and as such, there are so many possibilities. I'm still focused on signal processing as I have been in recent years, but I'm looking forward to having a broader clinical focus with this position, which will allow me to have a bit more focus on how we can actually help individuals in their everyday lives. I hope we can make this connection between the Hearing Systems Section and Rigshospitalet more visible in the coming years and benefit from the collaboration in a way that impacts society," Abigail Kressner says.

Visiting Professor from Seoul National University Hospital

Seung-ha Oh is a visiting professor from Seoul National University Hospital (SHUN). He came to visit DTU with an interest to observe the on-going research in Hearing Systems and hopes to make a future collaborative work between DTU and SNUH. Seung-Ha is a cochlear implant (CI) surgeon and has an interest in research regarding brain plasticity of CI patients.


Latest Technical Area Pick for Psychological and Physiological Acoustics

An article by the former Hearing Systems' researcher Jens Cubick, now at Widex, in collaboration with Jörg Buchholz, Virginia Best, Mathieu Lavandier and Torsten Dau titled "Listening through hearing aids affects spatial perception and speech intelligibility in normal-hearing listeners", has been chosen as the latest Technical Area Pick for Psychological and Physiological Acoustics in the Journal of the Acoustical Society of America (JASA).

PhD defences
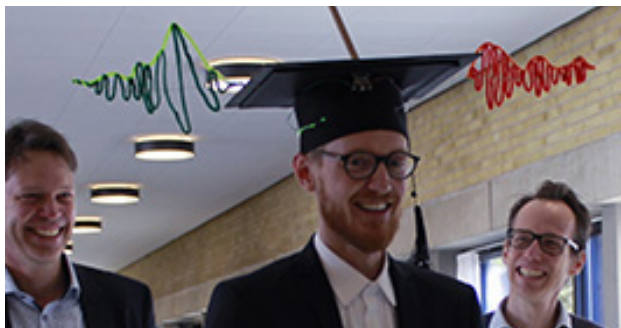
On February 27, Søren Fuglsang successfully defended his thesis 'Characterizing neural mechanisms of attention-driven speech processing'. Søren Fuglsang is now employed at Hvidovre Hospital as a postdoc and is a part of the UHEAL project.

On June 25, Axel Ahrens successfully defended his thesis "Characterizing auditory and audio-visual perception in virtual environments". Axel Ahrens is working in the group as a postdoc and will be involved with a virtual reality project in collaboration with Facebook.

On August 19, Niclas Alexander Janssen successfully defended his PhD thesis "Binaural Streaming in Cochlear Implant Patients".

On April 17, Borys Kowalewski successfully defended his thesis "Assessing the effects of hearing-aid dynamic-range compression on auditory signal processing and perception" and has recently been working as a postdoc, focusing on hearing-aid signal processing and computational modeling. On August 15, Borys Kowalewski started a new position at Widex.

On June 7, Helia Relaño Iborra successfully defended her thesis "Predicting speech perception of normal-hearing and hearing-impaired listeners". Helia Relaño Iborra is now employed at DTU Compute as a postdoc and is part of the PUPILS project on pupillometry.

New PhD projects

Physiological correlates of the audibility of masked signals at supra-threshold levels

Hyojin Kim

This project focuses on masking release to investigate how our auditory system makes use of cues from the auditory scene to segregate auditory objects. As a measure of masking release, objective measures are desirable. Thus, psychoacoustic and electrophysiological experiments will be conducted in parallel to provide links between behavioral measures and neuronal representations. The results from both experiments will provide us information about whether cortical auditory evoked potentials can be a biomarker of individual audibility of masked tones in complex acoustic conditions.

Probabilistic deep learning for hearing aid speech separation

Rasmus Malik Thaarup Høegh Bendsen

One of the most sought after improvements to hearing aids is improved intelligibility of speech in noise. Speech separation is the process of separating speech from interfering sound, and the performance of speech separation algorithms has seen advances with the introduction of deep learning methods. Current deep learning systems are, however, poor at performing in scenarios with speakers and noises that the system did not see during training. Modelling uncertainty - through probabilities - can help models learn from less data and generalize better, and so the project explores enabling deep learning models to perform well in unseen scenarios using probabilistic modelling.

Simultaneous electrophysiological measurements with auditory narrow-band stimuli: investigation of clinical consequences of interactions at the level of the auditory pathway

Sinnet Greve Bjerge Kristensen

This industrial PhD project is conducted in collaboration with Interacoustics A/S and will investigate an optimized electrophysiological method for faster hearing threshold estimation in infants. Electrophysiological methods for establishing the hearing thresholds are preferably performed in natural sleep, therefore the measurement must be time efficient. This project will investigate the balance between short testing time and diagnostic value using an approach of simultaneous stimulation in several frequency bands at once. After a 'proof of concept', the detailed consequences and interactions in the auditory pathway will be investigated in experimental work in populations with normal hearing and hearing loss.

Other research projects

Formation of auditory glimpses based on local similarities

Sarinah Sutojo, Guest PhD student from the University of Oldenburg

This project is concerned with the blind segregation of sound sources from an acoustic scene. A special focus lies on the source-independent segregation which is supposed to make little or no assumptions about the number and types of present sources. Our approach is to mainly rely on contrasts in the observed auditory features to form segments which are assumed to originate from the same source. Such segments are then further processed and joined depending on their feature similarities or feature progression. The goal of this approach is to achieve less source-dependence and thus more robustness to unknown acoustic scenes as compared to class-based systems.

The effect of hearing loss on sound texture perception

Oliver Scheuregger, Research Assistant

Sound textures offer an ecologically valid means of probing the auditory system, whose statistics are shaped by auditory processes. Previous studies have already explored the perception of sound textures in normal hearing listeners. However, no work has investigated how hearing-impaired listeners perceive textures. This project is a direct extension of his master's project, in which Oliver measured sound texture identification and discrimination performance in normal, impaired and aged listeners. The goal is to investigate if sound textures may be used to better understand and diagnose differences between normal hearing and hearing impaired listeners, with the ultimate goal of aiding in the development of new compensation strategies.

Characterizing comodulation masking release in hearing-impaired listeners

Jonathan Regev

This project investigates the consequences of hearing loss on CMR (Comodulation Masking Release). The aim is to identify the processes underlying the performance in CMR as well as possible limitations of listeners' supra-thresholds abilities in each of these. Ultimately, the goal is to use these findings to include new key processing stages in current computational models of the auditory system.

Jasper Ooster, Guest PhD Student from the University of Oldenburg

Jasper Ooster is doing his PhD at the Medical Physics Group, University of Oldenburg, where he is investigating the automatic conduction of speech intelligibility tests using automatic speech recognition (ASR). The ASR system is used for an unsupervised logging of the subject's responses during the measurement. While he was able to show promising results for the unsupervised conduction of the German matrix sentence test (OLSA), where no loss in measurement accuracy was found, he will investigate during his stay at DTU the suitability for automation of the Danish HINT as well as of the Danish matrix sentence first Dantale II.

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Publications (since January 2019)

Journal papers

Nielsen JB, Dau T (2019) A Danish nonsense word corpus for phoneme recognition measurements. Acta Acustica United With Acustica, 105 (1) P 183-194

Navntoft C, Marozeau J, Barkat T (2019) Cochlear implant surgery and electrically-evoked auditory brainstem response recordings in C57BL/6 mice. Journal of Visualized Experiments, 2019 (143)

Kressner A, May T, Dau T (2019) Effect of noise reduction gain errors on simulated cochlear implant speech intelligibility.
Trends in Hearing, 23

Bianchi F, Carney L, Dau T, Santurette S (2019) Effects of musical training and hearing loss on fundamental frequency discrimination and temporal fine structure processing . JARO - Journal of the Association for Research in Otolaryngology 20 (3) P 263-277

Encina-Llamas G, Harte J, Dau T Shinn-Cunningham B, Epp B (2019) Investigating the effect of cochlear synaptopathy on envelope following responses using a model of the auditory nerve. J A R O, 20 (4) P363-282

Ahrens A, Marschall M, Dau T (2019) Measuring and modeling speech intelligibility in real and loudspeaker-based virtual sound environments. Hearing Research, 377, P 307-317

Ahrens A, Lund K D, Marschall M, Dau T (2019) Sound source localization with varying amount of visual information in virtual reality. PLOS ONE, 14 (3)

Bentsen T, Mauger S J, Kressner A May T Dau T (2019) The impact of noise power estimation on speech intelligibility in cochlear-implant speech coding strategies. Journal of the Acoustical Society of America, 145(2) P 818-821

Bramhall N, Beach EF, Epp B, Coleen GL, Lopez-Poveda E, Plack C, Schaette R , Verhulst S, Canlon B (2019) The search for noise-induced cochlear synaptopathy in humans. Hearing Research, 377 P 88-103

SMK Madsen, M Marschall, T Dau, AJ Oxenham (2019) Speech perception is similar for musicians and non-musicians across a wide range of conditions. Scientific Reports, 9

Janssen NJ, Marozeau J, Bramslow L, Riis S (2019) A modification of the scale illusion into a detection task for assessment of binaural streaming. Journal of the Acoustical Society of America, 145 EL457

Paredes-Gallardo A, Dau T, Marozeau J (2019) Auditory stream segregation can be modeled by neural competition in cochlear implant listeners. Frontiers in Computational Neuroscience, 13

Marozeau J, Lamping W (2019) Timbre perception with cochlear implants in timbre: Acoustics, perception, and cognition. Springer Handbook of Auditory Research, New-York, 69, P273- 293

King A, Varnet L, Lorenzi C (2019) Accounting for masking of frequency modulation by amplitude modulation with the modulation filterbank concept. The Journal of the Acoustical Society of America, 145(4) P 2277-2293

Conference paper

Wendt F, Höldrich R, Marschall M (2019)
How binaural room impulse responses influence the externalization of speech. Fortschritte der Akustik - DAGA 2019

PhD thesis

Søren Fuglsang (2019) Characterizing neural mechanisms of attention-driven speech processing

Borys Kowalewski (2019) Assessing the effects of hearing-aid dynamic-range compression on auditory signal processing and perception

Axel Ahrens(2019) Characterizing auditory and audio-visual perception in virtual environments

Helia Relaño Iborra (2019) Predicting speech perception of normal-hearing and hearing-impaired listeners

Niclas Alexander Janßen (2019) Binaural Streaming in Cochlear Implant Patients

Master projects

Tanmayee Uday Pathre. Music emotion perception in Cochlear Implant (CI) users.
Supervisor: Jeremy Marozeau (DTU)

Sam David Watson. Investigation of Interaction Effects in Binaural Auditory Steady-State Response Measurements
Supervisors: Bastian Epp, Søren Laugesen (IRU)

Loïc Forma. Phonological Loop for Musical Sequences: The Effect of Timbre
Supervisors: Jeremy Marozeau, Alxandra Koprowska (DTU)

Alvaro Rodrigo Fuentes Cabrera . Continuous EEG elicited by speech stimuli and its relation to listening effort
Supervisors:Andreu Paredes Gallardo, Gerard Encina-Llamas (DTU),Thomas Lunner (Eriksholm) Mike Lind Rank (Widex)

Jonathan Regev. Characterizing Comodulation Masking Release in Hearing-Impaired Listeners.
Supervisors: Torsten Dau, Paolo Attilio Mesiano, Johannes Zaar (DTU)

Oliver Scheuregger. Sound texture perception in hearing-impaired listeners
Supervisors: Torsten Dau, Jens Hjortkær, Tobias May (DTU), Richard McWalter (MIT)

Alessandro Catania. BCI control of a hearing aid with audiovisual cues
Supervisors: Jens Hjortkær, Jonatan Märcher-Rørsted,Torsten Dau (DTU)

Kacper Kosikowski. Development and experimental veri cation of a Virtual Reality environment enabling spatial sound research
Supervisor:Jeremy Marozeau (DTU) Francois Patou, Bradford Backus (Oticon Medical)

Bachelor project

Jens Christian Thuren Lindahl. Interpreting psychoacoustically estimated processing mechanisms using a model of the auditory nerve and signal detection theory. Supervisors: Gerard Encina-Llamas, Bastian Epp (DTU)