Technical University of Denmark

NEWSLETTER

HEARING SYSTEMS IN PROFILE

September 2021

HEARING SYSTEMS

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News, awards, prizes

Lecturer of the Year

Photo:Niclas Janßen

At DTU's Annual Commemoration Day, which was held virtually on April 23, Bastian Epp, Associate Professor at Hearing Sytems, Health Tech, was presented the award as DTU's Lecturer of the Year 2021. He was selected from 125 nominated candidates by the 'Polyteknisk Forening' (PF), DTU's student union.

"Bastian Epp is one of the most dedicated teachers I have ever had," one of the students expressed, and "Bastian puts a lot of emphasis on learning to understand the concepts", another student stated. The award came with DKK 25.000 and a gift from PF.

Watch the video about the nomination here.

Dr. Hjortkjær receives the AEG Elektron Award

Jens Hjortkjær with DTU Director Anders Bjarklev . Photo: Bente Hjortkjær

On September 6, Senior Researcher Jens Hjortkjær received the prestigious 'Elektronprisen 2021' from AEG Elektronfonden based on his outstanding and exciting scientific achievements within hearing technology and auditory neuroscience.

Together with colleagues from the European COCOHA project ('Cognitive Control of a Hearing Aid'), Jens Hjortkjær developed the world-wide first prototype of a neuro-steered hearing aid – a technology that integrates electrophysiology into hearing aids. He has a deep interest in interdisciplinary research to be able to tackle major societal challenges, such as the 'Cocktail-Party Problem' many people with a hearing loss suffer from. Specifically, Jens Hjortkjær and his students showed decoded attention from brain activity of elderly hearing-impaired listeners. Read more here.

News, awards, prizes

New Centre for Applied Hearing Research (CAHR) Consortium Agreement

A new CAHR Consortium has been established between DTU Health Tech, GN Hearing, Oticon and Widex for the period 2021-2025. Within this consortium, the major focus will be put on research projects that are of particular relevance for potential technical and clinical applications. The purpose is to further strengthen the collaboration with industry and to establish a stable framework at CAHR that enables and supports such effective collaboration. Similar to the previous consortia, the current initiative will provide a bridge between fundamental research and activities and developments in a more applied but still precompetitive context.

The research of the new CAHR will focus on characterizing and predicting listener behavior in complex environments. Despite decades of research in the area, there are many open questions regarding how the individual hearing impairment of the listener interacts with specific features of a complex acoustic scene, especially when considering active communication and interaction. The goal is to better understand how humans cope with adverse acoustic conditions, how hearing-aid signal processing affects these abilities, and to develop models that can predict listener behavior. These models can then be used to guide fitting, program selection, etc. to optimize individual aided outcomes.

Three PhD projects will soon be started around the core topics of CAHR: 'Computational modeling of the perceptual consequences of individual hearing loss', 'Characterizing listener behaviour in complex dynamic scenes' and 'Communication and interaction in adverse acoustic conditions'.

Best poster presentation Sinnet G. B. Kristensen

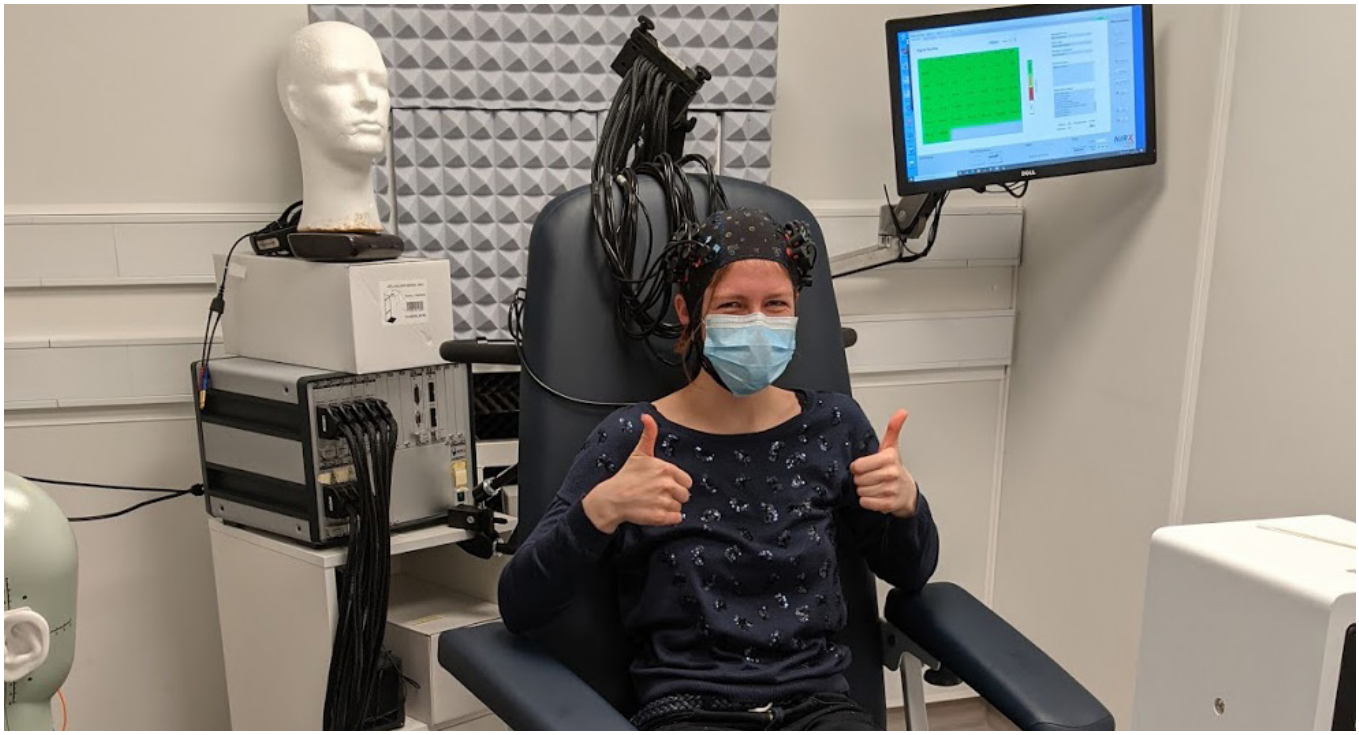
At the International Evoked Response Audiometry Study Group (IERASG) conference, Sinnet G. B. Kristensen was awarded the 1st price for the best student poster presentation. The conference was held online with more than 400 participants from 34 countries including 170 students. The poster presented a new method for calculating the auditory brainstem response grand average waveform, a method that Sinnet has been working on as part of her industrial PhD project in collaboration with the Interacoustics Research Unit (IRU).

Illustration: Helene Ingerslev

ISAAR 2021: The auditory system throughout life – Models, mechanisms and interventions

On August 23-27, the 8th International Symposium on Auditory and Audiological Research (ISAAR) took place supported by GN Hearing. This year's topic was "The auditory system throughout life – Models, mechanisms and interventions". The meeting was held online. This topic was considered from different perspectives, including current physiological concepts, perceptual measures and models, electrophysiology and neuroscience approaches, as well as implications for hearing devices and new technical applications. Besides the topics related to the main theme, contributions covered a wide range of other areas within auditory and audiological research. More information about ISAAR 2021 can be found at www.isaar.eu

News



The newly established research sound booth, which, in combination with the coming spatial sound lab, make up the DTU-dedicated research facilities at CHBC. Photo: Maaike Van Eeckhoutte

News from the Copenhagen Hearing and Balance Center (CHBC)

At the Copenhagen Hearing and Balance Center (CHBC) at Rigshospitalet, we are building bridges between daily clinical treatment and world-class MedTech research. A cornerstone of this center is a long-running collaboration between the clinicians at Rigshospitalet and the engineers at DTU Hearing Systems. This collaboration is facilitated by a small DTU research unit within CHBC that consists of jointly employed faculty and researchers together with brand new, DTU-dedicated state-of-the-art research facilities.

The dedicated research facilities at CHBC will consist of both a fully equipped sound booth and a clinically oriented spatial sound lab. Our initial efforts have been focused on the sound booth, where we, first and foremost, have designed a setup that mimics the functionalities of both the clinical booths at CHBC and the research booths at DTU in Lyngby, effectively facilitating synergies between the two domains. We go above and beyond this by outfitting the booth with equipment that will help to catalyze brand new, clinically oriented research streams.

The base setup includes an otoscope, a middle ear analyzer, and the Affinity Compact audiometer and hearing aid analyzer, as well as a loudspeaker and head and torso simulator (HATS) for free-field testing. On top of this, we have a Biosemi system supplemented with tiptrodes and tympanic membrane electrodes—making both electro-encephalography (EEG) and electrocochleography (ECochG) possible—as well as a NIRScout for functional near-infrared spectroscopy (fNIRS). Taken altogether, this modular setup allows for recording cortical, subcortical, and peripheral processes along the entire auditory pathway. We anticipate that by recording neural responses from different stages of the auditory system simultaneously, we can study the functional relationships between these stages in novel ways.

In the second phase of construction, we will be dedicated to outfitting the spatial sound lab. The aim of this lab space is to better link the work we do within the Audio Visual Immersion Lab (AVIL) and communication labs at DTU in Lyngby to the patients, giving us unparalleled possibilities to design, develop, and test novel ways to bring realism and ecological validity to the clinic.

News

Archive photo: BEAR Project

The BEAR project: Validation of new strategies

The Better Hearing Rehabilitation (BEAR) project, coordinated by Dorte Hammershøi from Aalborg University, will be officially concluding by the end of 2021. Running since 2016, this project has analysed the current hearing aid fitting process in Danish audiological clinics and developed new diagnostic and compensatory strategies in order to guide the process in the direction of more personalised and supportive fittings. A main contribution from Hearing Systems is a clinical test battery for diagnosing hearing deficits in more detail than possible with the audiogram alone. The outcome of these additional diagnostic tests enables a classification of patients into one of four auditory profiles. For each profile, a compensatory strategy has been tailored. A second test battery, a series of aided performance tests also developed at Hearing Systems, is intended to ensure the quality of each fitting and to assist the audiologist in fine-tuning of the hearing aid if required.

As an important part of the BEAR project, a large-scale clinical study was designed to validate the new fitting process. This study has been running with patients at two audiological clinics in Aalborg and Odense since Sept. 2020. The focus of the study is the clinical outcomes of the two test batteries (diagnostics and aided performance) and a validation of the BEAR compensatory strategy. For additional assessments of the hearing aid fittings, an online tool for registering the experiences of hearing aid users in real-life and several questionnaires are included in the study. Four visits are planned for each participant: 1) Hearing examination including basic hearing tests; 2) Auditory profiling based on the outcome of the clinical test battery; 3) Hearing aid fitting, real-ear measurements, and aided performance testing; and 4) A two-month follow-up with a retest of aided performance, real-ear measurements and, if required, hearing aid adjustments. At the last visit, participants are asked to fill in final questionnaires about their hearing disability and quality of life. The ongoing data collection will terminate in December 2021 while a preliminary data analysis has already started.

Prior to the launch of the main study, pilot testing of the two test batteries was conducted at the clinics in Aalborg and Odense and required changes and corrections were implemented. The results of the pilot study were presented at the International Symposium on Auditory and Audiological Research (ISAAR) hosted by Hearing Systems August 23-27 this year.

PhD defences

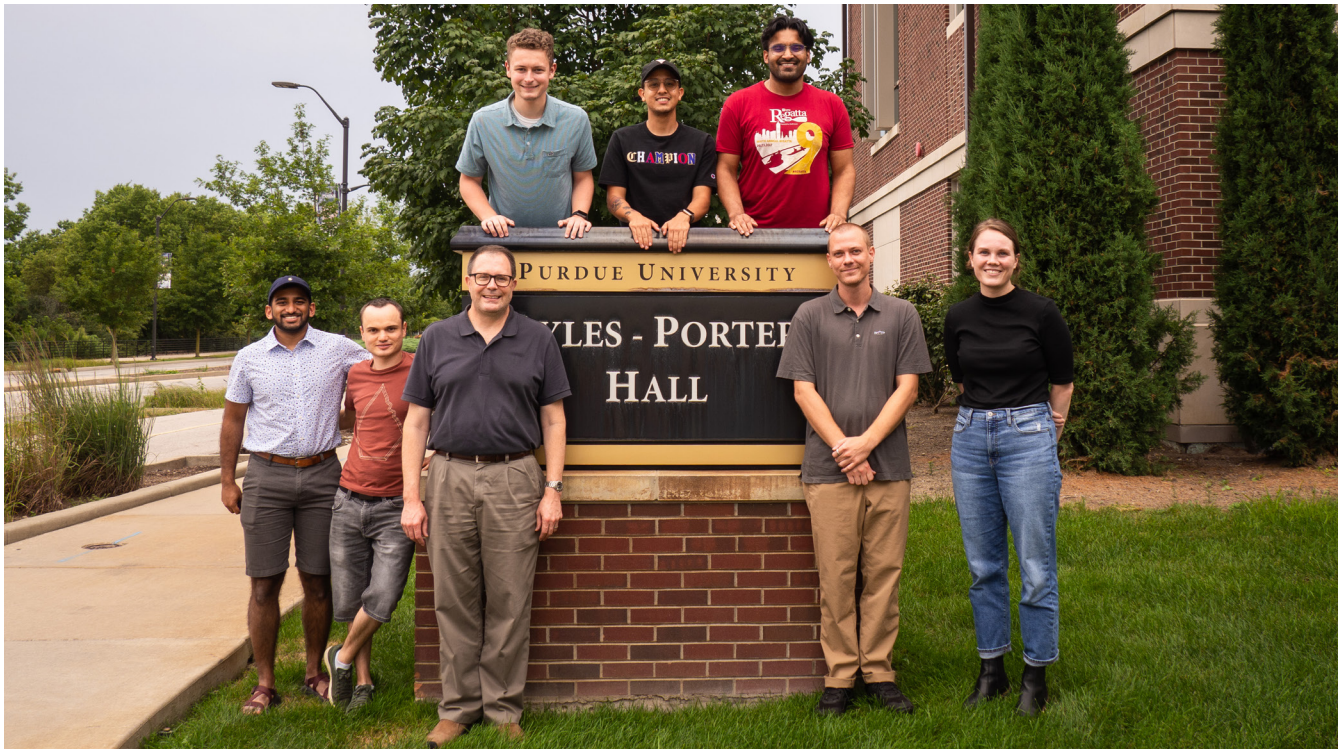
Left: Principal supervisor Bastian Epp and PhD Anna Josefine Munch Sørensen. Screen: The external examiners Prof. Martin Cooke, Co-supervisor Associate Professor Ewen MacDonald and Senior Scientist Bill Whitmer. Right: Head of the PhD assessment committee Associate Professor Jeremy Marozeau. Photo: Casper Munch Hansen.

On Wednesday, June 30, Anna Josefine Munch Sørensen successfully defended her PhD thesis "The effects of noise and hearing loss on conversational dynamics", supervised by Bastian Epp, Ewen MacDonald and Lars Bramsløw (Oticon Eriksholm). The defence was held partly online.
After her maternal leave, Josefine will be working as a scientist at Eriksholm Research Centre.

From the left to right: Co-supervisor Associate Professor Tobias May, PhD Naim Mansour and supervisor Professor Torsten Dau. Photo: Maria Asp.

On Friday, June 18, Naim Mansour successfully defended his PhD project on "Assessing hearing device benefit using virtual sound environments," supervised by Torsten Dau, Tobias May, Marton Marschall and Adam Westermann (WS Audiology). Since May 1, 2021, Naim is employed at WSA.

Staff news



PhD student Jonatan Märcher-Rørsted (second from right) at Purdue University where he enjoys his external stay in Prof. Michael Heinz''Auditory Neurophysiology and Modeling Lab'.

External stay

Jonatan Märcher-Rørsted

Since August 17, Jonatan Märcher-Rørsted has been a guest PhD student at Purdue University in the 'Auditory Neurophysiology and Modeling Lab' of Prof. Michael Heinz. Jonatan will be staying until November 2021. As part of this stay, he will investigate the connection between peripheral neural degeneration and steady-state electrophysiological responses phase locked to the carrier or modulation frequencies of an auditory stimulus. To investigate this, Jonatan will carry out a study that measures far-field frequency-following responses (FFR) in animal (chinchilla) models of auditory nerve (AN) degeneration. By selectively damaging the AN, it will be possible to examine the influence of peripheral neural degeneration on the central FFR response. The study would simultaneously measure/record the AN component of the electrocochleographic (ECochG) response from the ear canal and the FFR from scalp electrodes.

Marton Marshall at Aalto University, Finland

Since February 2021, Marton Marshall is a senior scientist at Aalto University. Marton developed during his time at Hearing Systems various methods to capture real-life acoustic scenes for experiments in hearing science and was strongly involved in the design and construction of the Audio-visual Immersion Lab (AVIL). He supervised and co-supervising numerous projects using AVIL, aiming to enhance realism in the evaluation of hearing ability. Marton will collaborate at Aalto University with Professor Ville Pulkki and his colleagues.

New PhD project

Lisbeth Birkelund Simonsen

New applications and test modalities for the Audible Contrast Threshold (ACT) test

In September 2021, Lisbeth Birkelund Simonsen started her industrial PhD project "New applications and test modalities for the Audible Contrast Threshold (ACT) test" that aims to improve individualisation of hearing-aid fitting and rehabilitation by diagnostic measures. The ACT test is a psychophysical (behavioural), fast, and language-independent listening test with high correlations to aided speech-in-noise performance. This PhD project will firstly explore electrophysiological response types to ACT stimulus paradigms, and secondly investigate how the ACT test in various forms can relate to standard speech audiometry. Furthermore, ACT as a potential measure of longitudinal hearing-aid benefit will be investigated. This industrial project is conducted in collaboration with Interacoustics and Oticon.

Other Research projects

Alejandro Saurí Suárez

New frameworks for communication and virtual reality research

Alex focuses on developing a new laboratory for studying communication behaviour. The increasing demand of virtual communication, and the experience that current video chat technologies do not transmit the same information as in "real" communication, require a better understanding of what information is needed for successful communication. To define this, outcome measures during a conversation need to be developed, such as acoustic features of speech as well as head-motion or eye-gaze trajectories. In parallel, Alex is also working on further developing a framework for perceptual research with virtual reality (VR) in the AVIL. VR is becoming more commonly used for multimodal perceptual research (e.g., sound source localization) and therefore, a standard application and protocol is required that allows researchers to easily integrate both visual information and interaction systems.

This project is supported by Facebook Reality Labs.

Publications

(Since February 2021)

Journal papers

Lehmann A, Limb CJ, Marozeau J (2021) Music and Cochlear Implants: Recent Developments and Continued Challenges, Frontiers in Neuroscience. 15 (3) P 736772

Bruzzone SEP, Haumann NT, Kliuchko M, Vuust P, Brattico E (2021) Applying Spike-density component analysis for high-accuracy auditory event-related potentials in children. Clinical Neurophysiology, 132 (8) P 1887-1896

Watson S, Laugesen S, Epp, Bastian (2021) Potential Destructive Binaural Interaction Effects in Auditory Steady-State Response Measurements. Trends in Hearing, 25

Wu M, Cañete OM, Schmidt JH, Fereczkowski M, NeherT (2021) Influence of Three Auditory Profiles on Aided Speech Perception in Different Noise Scenarios. Trends in Hearing, 25

Madsen SMK, Dau T, Oxenham, AJ (2021) No interaction between fundamental-frequency differences and spectral region when perceiving speech in a speech background PLOS ONE,16, 4, 11

Sanchez Lopez R, Dau T, Whitmer, WM (2021) Audiometric profiles and patterns of benefit: a data-driven analysis of subjective hearing difficulties and handicaps. International Journal of Audiology, 10

Glista D, O'Hagan R, Van Eeckhoutte M, Lai Y, Scollie S (2021) The use of ecological momentary assessment to evaluate real-world aided outcomes with children. International Journal of Audiology (11)

Mansour N, Marschall M, May T, Westermann A, Dau T (2021) Speech intelligibility in a realistic virtual sound environment. Journal of the Acoustical Society of America, 149 (4) P 2791-2801

Mansour N, Marschall M, May T, Westermann A Dau T (2021) A method for realistic, conversational signal-to-noise ratio estimation. Journal of the Acoustical Society of America, 149 (3) P 1559-1566

Encina-Llamas, G., Dau, T. & Epp, B (2021) On the use of envelope following responses to estimate peripheral level compression in the auditory system. Scientific Reports, 11 (1) 19 P 6962

Ahrens A, Cuevas-Rodriguez M, Brimijoin WO (2021) Speech intelligibility with various head-related transfer functions: A computational modelling approach J A S A Express Letters, 1 (3) 7 P 034401

Reveles Jensen KH, Navntoft CA, Sindahl CH, Cayé-Thomasen P, Jørgensen MB (2020) Cochlear implant should not be absolute contraindication for electroconvulsive therapy and transcranial magnetic stimulation. Brain Stimulation 13 (5) P 1464-1466

Conference paper

Örnolfsson I, Dau T, MaN, May T (2021) Exploiting Non-Negative Matrix Factorization for Binaural Sound Localization in the Presence of Directional Interference. Presented at IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), Canada

Book Chapter

Marozeau J. Why People with a Cochlear Implant Listen to Music (2021) Perception, Representations, Image, Sound, Music - 14th International Symposium, CMMR 2019, Revised Selected Papers. Springer, p. 409-421 Vol. 12631

PhD theses

Anna Josefine Munch Sørensen (2021) The effects of noise and hearing loss on conversational dynamics

Naim Mansour (2021)Assessing hearing device benefit using virtual sound environments

New Master projects

Simulating Perceptual Tasks With Deep Neural Networks To Improve Diagnostics Of Hearing Impairment. Jens C. Thuren Lindahl. Supervisors: Gerard Encina-Llamas. Hyojin Kim. Bastian Epp

Validation of a virtual reality sound environment - comparing binaural spatialized audio and physical loudspeaker array. Kirsten Mari Rico. Supervisors: Abigail Anne Kressner, Jeremy Marozeau

Perceptual evaluation of an audiotactile art installation for people with hearing impairment
Ali Borhan-Azad. Supervisor: Jeremy Marozeau

An audiotactile art installation for people with hearing impairment. Miguel Cua Sierra. Supervisor: Jeremy Marozeau

Correlation of electroacoustic parameters in headphones and perceived music quality. Magnús Or Dagsso. Supervisor:Jeremy Marozeau

Effects of minimum phase processing on speech and spatial perception in binaural hearing aids. Borgný Súsonnudóttir Hansen. Supervisors: Abigail Anne Kressner, Torsten Dau.

Bachelor Projects

Perceptual determination of cross-over frequency. Christina Kjær. Supervisors: Cheol-Ho Jeong, Jeremy Marozeau, Nikolas Borrel Jensen

Designing an Audio-Tactile Research Platform. Lars Ørum Ringdal. Supervisor: Jeremy Marozeau

Designing an Audio-Tactile Research Platform. Julius Galsgaard. Supervisor: Jeremy Marozeau