

NEWSLETTER

HEARING SYSTEMS IN PROFILE

January 2018



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News, awards and prizes



New auditory research published in Cerebral Cortex

In a new study published in *Cerebral Cortex*, Senior Researcher Jens Hjortkjær together with colleagues from the Danish Research Centre for Magnetic Resonance (DRCMR) demonstrated a method to decode listeners' brain activity patterns to determine what sound source a person is listening to.

The researchers used functional magnetic resonance imaging (fMRI) to record neural activity while participants listened to recorded 'impact sounds'. The article describes how listeners' attention to specific aspects of a sound modulates auditory brain processing to highlight relevant features of a sound stimulus.

Jens Hjortkjær is part of the Oticon Centre of Excellence for Hearing and Speech Sciences (CHeSS) which focuses on basic auditory neuroscience. Jens Hjortkjær is also part of the Cognitive Control of a Hearing Aid (COCOHA) Horizon 2020 project that focuses on cognitive steering of hearing instruments.

Read the full article : www.bit.ly/2BZY81G

New interdisciplinary project supported by the Novo Nordisk Foundation

Novo Nordisk Foundation awards 15 mio DKK for an interdisciplinary synergy project on "hidden" hearing loss.

Exposure to noise over longer periods can cause nerve damage in the inner ear, which especially affects people's ability to understand speech in noisy situations. This type of synaptic nerve damage cannot be measured in humans and is not detected by the clinical hearing tests used today. This hidden hearing loss is presumably widespread, even among younger people. The new project "Uncovering hidden hearing loss" (UHEAL) will combine magnetic resonance imaging technology with audiology and neurophysiology to establish methods for measuring this nerve damage in humans. The project will develop imaging techniques to detect cell damage in the ear and examine how this affects hearing. This will enable diagnoses for this hearing disorder to be developed and thereby create opportunities for treatment. The project is led by Torsten Dau and his team and carried out in close collaboration with Hartwig Siebner and colleagues from the Danish Research Centre for Magnetic Resonance and Charles Liberman from Harvard Medical School.



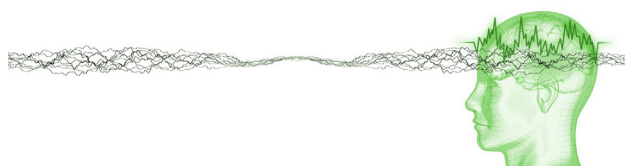
ISAAR 2017

Photo Niclas Alexander Janßen

Nearly two hundred hearing researchers from all over the world travelled to Nyborg on August 23-25 to participate in the 6th International Symposium on Auditory and Audiological Research (ISAAR), which was supported by GN Hearing. This time the focus was on different perspectives on adaptive processes in hearing. There were many different presentations, test results and conclusions circulating, which both impressed and inspired the participants.

Tobias Moser, University of Göttingen Medical Center, Germany held the talk: "Hearing the Light: Optogenetic Stimulation of the Auditory Nerve" and showed how cells can be made genetically light-sensitive to stimulate the auditory nerve. When hearing fails, speech comprehension can be partly restored by auditory prostheses. However, sound coding with current prostheses, based on electrical stimulation of the auditory nerve, has limited frequency resolution due to a broad current spread. Moser and his research group aim to improve frequency and intensity resolution of cochlear implant coding by establishing spatially confined optical stimulation of spiral ganglion neurons (SGN's). Jacques Grange, University's School of Psychology Cardiff University, held a talk on how cochlear implant users can use head orientation to improve their intelligibility of speech in noisy social settings. Their study showed that cochlear implant listeners in a noisy situation benefit from facing slightly away from the person they are listening to so that they can turn one

ear towards the speech. Actually being able to hear just a few decibels more by turning toward the talker can make a big difference in hearing. Participants were also fascinated by the talk "Parametric measurements of natural conversation behavior reveal effects of background noise level on speech, movement and gaze" by Owen Brimijoin from the Scottish Section of the MRC Institute of Hearing, Glasgow. By using head tracking, it is possible to figure out in which direction people will turn their heads. Laurel Carney, Biomedical Engineering & Neuroscience, University of Rochester, USA, who was a Visiting Professor at Hearing Systems earlier in 2017, gave a talk about modeling midbrain responses to simultaneous speech. Through computer modeling, it is possible to simulate background noise, different degrees of hearing loss, read the changes and decode the neural information in response to sound fluctuations. This work may be important for the development of hearing aids for listening in background noise.



Read more about the conference on our webpage
www.hee.elektro.dtu.dk/news (September 2017)
 Conference proceedings now available at www.isaar.eu



Hearing Systems Presentation Day

Photo Niclas Alexander Janßen

Friday, October 27th, Hearing Systems invited collaboration partners, colleagues and alumni for the annual Presentation Day. The event, which took place at the laboratory building, attracted 80 guests.

Torsten Dau provided an overview of the activities in the group. At the moment, the group consists of 40 academic staff members, including 17 PhD students, 12 postdocs, two guest researchers and two research assistants. Furthermore, the group consists of a coordinator, a project administrator, a journalist, two audiologists and two technicians.

The PhD students and Postdocs presented their current activities and research projects, either as a talk or a poster, covering topics within clinical diagnostics, hearing device signal processing as well as perception and cognition. During the poster sessions and breaks, there were many opportunities to discuss the topics and to network.

Furthermore, Torsten Dau presented the interdisciplinary approaches that are currently being used in the group (behavioral measures, auditory modelling, physiological measures), new employees, current funding sources and collaborations. In 2017, Tobias May was appointed an Assistant Professor in Speech Signal Processing and Hearing Technology. The Danish hearing aid companies Oticon, GN Hearing and Widex continue

to support the Centre for Applied Hearing Research (CAHR) for the period from 2017 to 2020. The Hearing Systems Group has also a close collaboration with international partners and is active in several EU projects, including COCOHA (Cognitive Control of a Hearing Aid Horizon 2020), in collaboration with the Oticon Eriksholm Research Centre, and the new innovative training network TIN-ACT on Tinnitus, in collaboration with Interacoustics Research Unit (IRU) and Widex. Major upcoming events include the International Symposium on Hearing which will take place in Elsinore in June 2018, and the next ISAAR in 2019 in Nyborg. The Mechanics of Hearing (MOH) conference dedicated to cochlear mechanics and hair-cell functioning, was also attracted to Denmark and will take place in Elsinore in 2020.

Read more about the event at our webpage: www.hee.elektro.dtu/news



Volunteers' day

Like last year, the Hearing Systems' researchers invited all people who have participated in the various listening tests and experiments in 2017.

The event, which took place in October, gave the researchers the opportunity to thank the test persons and to tell them more about the individual experiments they took part in. About fifty guests - volunteers, relatives and friends of the test persons - participated in the event which took place in the laboratories. Audiologist Rikke Sørensen welcomed all and thanked them for their contribution to the research, which is very important for the work on this field. All volunteers had the opportunity to take a tour through the lab and to learn more about some of the projects when the researchers explained their scientific posters.

Awards were given to Sanne Nielsen, Grete Boisen, Peter Nielsen and Mathias Bruun for their participation and their enthusiasm.

Read more about the event on our webpage:
www.hee.elektro.dtu.dk/news (October)

Rikke Sørensen, Audiologist, (rightmost) welcomed everybody.
Photos: Niclas Alexander Janßen



Peter Nielsen receives a volunteers award from Project Administrator Katrine Bang Termansen. Photos: Niclas Alexander Janßen

If you yourself want to be a volunteer or know someone, contact us by filling out the form on our webpage:
www.hee.elektro.dtu.dk/testforsoeg
- or call Rikke Sørensen 45253971 (on Thursdays 10-12).

Staff news

Associate Professor in Clinical Audiology and Hearing Rehabilitation.



Sébastien Santurette has been promoted to an Associate Professor in Clinical Audiology and Hearing Rehabilitation. His position is shared between Hearing Systems at DTU and the Ear, Nose and Throat & Audiology Clinic at Rigshospitalet. Sébastien Santurette will in his position facilitate the translation of research be-

tween clinical and university settings. He will work towards the translation of new advances in basic auditory science into an increased understanding of auditory dysfunction and pathophysiology and will provide insights that are useful for clinical and technical applications, such as hearing aids, cochlear implants, speech recognition systems and hearing diagnostics.

New participant screening Manager

In September 2017, Rikke Skovhøj Sørensen joined the Hearing Systems Group as a research audiologist. She will be assisting with various projects at both DTU, Bispebjerg Hospital and Rigshospitalet while managing the participant database and handling hearing screenings on new subjects.

Besides her master in audiology from SDU, Rikke has a background as sign language interpreter, which enables her to assist with test subjects who depend on signing.



Appointed Senior Researcher in Clinical Audiology

Jens Bo Nielsen has been appointed Senior Researcher in Clinical Audiology within the "Better Hearing Rehabilitation" (BEAR) project. The goal of this project is to improve the hearing rehabilitation for the growing part of the population that experiences a hearing impairment. Jens Bo's main responsibility will be the de-

velopment of a test battery for predicting the real-life performance of hearing aid users. Within the project, the test battery will be used for assessing whether the objective has been met. At a later stage, the tests will be adapted for use in hearing aid clinics as a control of the fittings that are performed.



PhD Defences

On August 29, Jens Cubick successfully defended his PhD thesis "Investigating distance perception, externalization and speech intelligibility in complex acoustic environments". Jens Cubick now works at Widex as a Specialist in Audiological Performance.



On November 7, Gerard Encina-Llamas successfully defended his PhD thesis "Characterizing cochlear hearing impairment using advanced electrophysiological methods". Gerard now works as a Postdoc in the group.

Visiting Professor at Hearing Systems

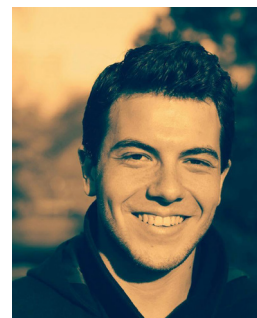


For half a year, Professor Ville Pulkki from Aalto University (Department of Signal Processing and Acoustics), Finland, will be staying as a Guest Professor in the Hearing Systems Group. Ville Pulkki's expertise is in spatial sound reproduction and perception. This is the third time Ville Pulkki is visiting the group for a longer period and the group is looking very much forward to his stay and the collaboration.

telligibility in listeners with sensorineural hearing loss. The general approach of this project is to design different auditory-training paradigms and assess their effect via behavioral, cortical and subcortical measures. Outcome measures should be performed at regular sessions throughout the training period, since plastic changes may occur at different timing along the auditory system and have different retention periods. This project is carried out in collaboration with Sivantos.

"Assessing hearing device benefit using virtual sound environments"

Naim Mansour



Currently, hearing devices are mainly evaluated and optimized using relatively simple sentence tests presented in noise. These laboratory-based tests typically do not capture features of real-world acoustic environments such as reverberation, nor do they consider the importance of cognitive processing and comprehension by the user. The consequence is that hearing devices could be working differently in the real world than manufacturers expect. This PhD project aims to bridge the gap between laboratory-based tests and real world listening by using virtual sound environments, and creating scenarios and tasks that are representative of the difficulties faced by hearing-device users in their daily lives. This project is carried out in collaboration with Widex.

New PhD projects



"Auditory-training strategies to improve speech intelligibility in hearing-impaired listeners"

Aleksandra Koprowska

Improving speech intelligibility in noise is a crucial challenge that clinicians need to consider, possibly also via complementary interventions to the provision of hearing aids. Among the possible complementary interventions, auditory training has been proposed as a powerful framework to improve speech intelligibility through the development of auditory perceptual skills and cognitive functions. However, it is unclear which training strategy may be most effective to improve speech in-

New Post Doc projects



“Characterizing supra-threshold processing and peripheral hidden damage using electrophysiological methods”

Gerard Encina Llamas

Pure-tone audiometry is the current gold-standard diagnostic method to characterize hearing. However, it is broadly accepted that hearing thresholds assessment is not sensitive to all types of damage in the peripheral hearing system. Novel diagnostic methods capable of detecting hidden damage are needed. This project proposes to use similar electrophysiological methods in human listeners and non-human mammals through international collaborations) to study supra-threshold hearing processing. Computational modeling will be used to relate the findings in different species. As a starting project, a mouse version of a computational model of the auditory nerve is already under execution.



“Multivariate timeseries analysis for EEG measures of attended speech”

Petteri Hyvärinen

Automatically steering a hearing aid towards an auditory target of interest requires real-time information about the internal intentions and mental efforts of the user. While it is, for example, already possible to have a hearing aid tuned in to a specific spatial location, the challenge in everyday situations is to know where exactly to point the focus. Petteri Hyvärinen will be working within the COCOHA project to find out how electrophysiological measures of brain activity (EEG) could be used for choosing and boosting only those sounds from the surrounding acoustic environment that are relevant to the user.

Other projects



“Integrating the visual in AVIL”

Kasper Duemose Lund,
Research Assistant

Kasper works on the integration of virtual reality in the Audio Visual Immersion Lab (AVIL). As of now, the AVIL does not have any permanent setup for providing visual stimulation to subjects participating in perceptual experiments. With this new HTC Vive based virtual reality implementation, researchers will have the ability to expose subjects to 3D visual environments corresponding to the played back audio environments of AVIL. A full synchronization of the existing audio engine and the new visual integration will be included. Audio-visual scenarios can therefore be presented in a highly controlled way. A protocol for constructing audio-visual perception experiments using this system will be developed.



“Attentional switching in a competitive speaker scenario”

Michael Noes Kiel
Andersen,
Research Assistant

A general problem with current hearing aids is that their beamformer enhances the auditory objects directly in front of the listener whereas objects from the sides are suppressed. The aim of this project, which is a part of COCOHA, is to investigate attentional switching by listeners in a competitive speaker scenario to see if we can extract a robust EEG-feature that indicates attentional switching since this feature would be essential in a neuro-steered hearing aid.

Publications (since August 2017)

Journal papers

Hjortkjær J, Kassuba T, Madsen, K, Skov M, Siebner H (2017) Task-modulated cortical representations of natural sound source categories. *Cerebral Cortex* 23(1) P 295-306

Maarefvand M, Blamey P, Marozeau J (2017) Pitch matching in bimodal cochlear implant patients: Effects of frequency, spectral envelope and level. *The Journal of the Acoustical Society of America*. 142(5) P 2854-2856

Paredes Gallardo A, Epp B, Dau T (2017) Can place-specific cochlear dispersion be represented by auditory steady state responses? *Hearing Research*.

Ohlenforst B, Zekveld A, Lunner T, Wendt D, Naylor G, Wang Y, Versfeld NJ, Kramer SE (2017) Impact of stimulus-related factors and hearing impairment on listening effort as indicated by pupil dilation. *Hearing Research*. 351 P 68-79

Relaño Iborra H, Chabot-Leclerc A, Scheidiger C, Zaar J, Dau T (2017) The speech-based envelope power spectrum model (sEPSM) family: Development, achievements, and current challenges. *The Journal of the Acoustical Society of America*. 141(5) P 3970

Madsen S, Whiteford K, Oxenham A (2017) Musicians do not benefit from differences in fundamental frequency when listening to speech in competing speech backgrounds. *Scientific Reports* 7:12624 P 1-9

Madsen S, M. Harte J, Elberling C, Dau T (2017) Accuracy of averaged auditory brainstem response amplitude and latency estimates *International Journal of Audiology*. P 1–9

Guérit F, Marozeau J, Epp B (2017) Linear combination of auditory steady-state responses evoked by co-modulated tones *The Journal of the Acoustical Society of America* 142(4) P 395-400

Strori D, Zaar J, Cooke M, Mattys S (2017) Sound specificity effects in spoken word recognition: The effect of integrality between words and sounds *Attention. Perception & Psychophysics*. P 1-20

May T (2017) Robust speech dereverberation with a neural network-based post-filter that exploits multi-conditional training of binaural cues. *IEEE - A C M Transactions on Audio, Speech, and Language Processing*. 26(2) P 406-414

Ma N, May T, Brown G, Guy J (2017) Exploiting Deep Neural Networks and Head Movements for Robust Binaural Localization of Multiple Sources in Reverberant Environments. *IEEE - A C M Transactions on Audio, Speech, and Language Processing* 25(12) 2444-2453

McWalter R, Dau T (2017) Cascaded Amplitude Modulations in Sound Texture Perception *Frontiers in Neuroscience*. 11 P 485

Verhey J, Mauermann Manfred, Epp B (2017) A Nonlinear Transmission Line Model of the Cochlea With Temporal Integration Accounts for Duration Effects in Threshold Fine Structure. *Acta Acustica United With Acustica* 103 (5) P 721-724

Conference Papers

Zaar J, Dau T (2017) Predicting effects of hearing-instrument signal processing on consonant recognition and confusions
Presented at: 43. Jahrestagung für Akustik DAGA 2017 Kiel. P 1438-1441

Bjerre L, Santurette S, Jeong C Relationship between overall comfort and combined thermal and acoustic conditions in urban recreational spaces. Presented at: Internoise 2017, Hong Kong.

PhD theses

Jens Cubick (2017) Investigating distance perception, externalization and speech intelligibility in complex acoustic environments.

Gerard Encina-Llamas (2017) Characterizing perceptual externalization in listeners with normal, impaired and aided-impaired hearing.

Master projects

Silje Grini Nielsen. Analyzing the impact of hearing-aid processing on listening effort using pupillometry.
Supervisors: Dorothea Wendt, Tobias May, Torsten Dau

Paolo Mesiano. Modeling effects of hearing loss on comodulation masking release.
Supervisors: Torsten Dau, Borys Kowalewski, Johannes Zar

Bertrand Hugues Smits. Behavioral and electrophysiological markers of hearing status in relation with occupational noise exposure.
Supervisors: Sébastien Santurette, Cheol-Ho Jeong, Pernille Holtegaard

Konstantinos Gkanos. Compression in cochlear implants. Supervisors: Abigail Anne Kressner, Tobias May, Torsten Dau

Paul Jules Arthur Arzelier. Music Similarity Navigation Systems for Contemporary Music.
Supervisors: Jan Larsen (DTU Compute), Tobias May



From the course 'Signals and linear systems in discrete time' with Associate Professor Bastian Epp. Photo: Niclas Alexander Janßen.

