

NEWSLETTER

HEARING SYSTEMS IN PROFILE

AUGUST 2014



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News, awards and prizes

Honory Award presented to Torsten Dau



From left: Nicolai Bisgaard, Vice president at GN ReSound; Torsten Dau; Graham Naylor Eriksholm Research Center; and Morten Nordahn, Innovation Process Manager at Widex. Photo: Katrine Krogh-Jeppesen.

In March, Professor Torsten Dau was celebrated at an award ceremony at DTU. The honorary award of Manufacturer Ulrik Brinch and his wife Marie Brinch is given to a younger scientist as an acknowledgment for outstanding scientific work in medicine, engineering or agricultural science.

"Within only ten years Professor Torsten Dau and the Hearing Systems team has brought the level of research to the highest international level. Torsten Dau has established the Centre for Applied Hearing Research, Hearing Systems, and the centre is now a central factor in hearing research and the hearing aid industry," said Vice President at DTU Henrik Wegener.

With the honorary award followed 80,000 DKK. Colleagues and partners from DTU, representatives from the hearing aid industry, family and friends all congratulated Torsten Dau, who was honoured by the recognition:

"I am very proud that the Award Committee has selected me

this year. It means a lot to me, because among the many tasks we have here the University, it is in particular the opportunity to do research and contribute with new knowledge to society, which is the driving force in my work," Torsten Dau said.

Talented student honored at Elite Research Award



Congratulations to Federica Bianchi in between HRH Crown Princess Mary and the Minister of Education and Research Sofie Carsten Nielsen (R)

Federica Bianchi, PhD student at Hearing Systems, received the Travel Grant Fellowship at the Elite Research Conference 2014 that was held in February at Ny Carlsberg Glyptotek.

"Denmark must be an open-minded country, attracting international talents, and there should be more women in top positions within the field of research," said the Minister of Education and Research Sofie Carsten Nielsen (R) at the celebration. "New knowledge does not come by itself. There are people behind, and we can not do without curious researchers," she concluded. Federica Bianchi has received 300,000 DKK for travel expenses in relation to her research and is currently at a six month stay at the International Laboratory for Brain, Music and Sound Research at McGill University, Montréal, Canada,



About Hearing Systems

A substantial part of the centres' research is carried out by our PhD students. Most of the PhD projects are supported by the hearing-aid industry, the Danish Research Foundation, private foundations and DTU. The research group was established in 2003 and 16 PhD theses have since been completed.

Hearing Systems currently has 18 running PhD projects. Each student has his/her own project, but since everybody conducts research within hearing, there are great opportunities to discuss ideas, approaches and results with other students and colleagues. Besides being financially supported by the industry, there are also possibilities to collaborate with national and international industrial partners and hospitals.

Hearing research is a very multidisciplinary field and the group provides a large and high-quality international network to other research groups. Hearing Systems is involved in several formalized European networks and it is common for the students to spend some time abroad (typically in Europe or the USA) as a part of their studies.

Collaboration strengthens hearing research

When the Centre for Applied Hearing Research (CAHR) was established at DTU in 2003, it employed a staff of three. Nowadays, the centre plays a central role in the global hearing-aid industry and scientific circles and currently employs 30 staff

members in the Hearing Systems group which is part of DTU Electrical Engineering. The latest addition to the group is the new Oticon Centre of Excellence for Hearing and Speech Sciences (CHeSS) which conducts in-depth interdisciplinary basic research projects. At the same time, the centre is initiating several applied research projects supported by the Danish hearing aid-sector.

Even though modern sophisticated hearing aids can recognize speech in noisy environments and be individually customized, the problem of filtering out unwanted information and noise in large gatherings remains unsolved:

"You only find the key if you truly collaborate and try something new. In Denmark, we enjoy unique partnerships with hearing aid manufacturers and share common ideas and visions despite mutual competition, which makes it more interesting to work here," says Torsten Dau, who originates from Germany.

The Hearing Systems staff is in the process of establishing what will become one of the world's most sophisticated laboratories with state of the art facilities for audiological research.

Hearing Systems shares facilities with the Acoustic Tenology group and the Interacoustics Research Unit, which conducts research in different methods for diagnosing hearing loss. In January, a brand new research centre for acoustic micromedical

systems (CAMP) financed by DTU and the hearing aid manufacturers Oticon, Widex and GN ReSound opened its doors as part of the Acoustic Technology group, and Hearing Systems welcomes CAMP for further cooperation. Innovation project manager Karsten Bo Rasmussen from Oticon says this about the new research centres at DTU:

"Hearing Systems concerns itself with signal processing and with what goes on in the inner ear and brain, while CAMP focuses on the interplay between mechanics and acoustics. The unique acoustic and hearing research environment at DTU with its different approaches assures Denmark a central role in a global research environment. It's fantastic for us to gain access to a professional foundation of this calibre, which will benefit all three hearing aid manufacturers."

Topping out ceremony for the new laboratories

For the Hearing Systems Group, the biggest news of the past year was the establishment of the Oticon Centre of Excellence for Hearing and Speech Sciences (CHeSS). The architects, the contractors, the Director of DTU and the Head of Campus Service, the construction direktor, the construction workers as well as the researchers from the Hearing Systems group all showed up on Thursday 19th June to celebrate the topping out ceremony for the new laboratories.

Director of DTU, Claus Nielsen opened the session:

"A unique facility is happening here. Thanks to a generous donation from the Oticon Foundation, we are very happy and proud to establish the new Oticon Centre of Excellence for Hearing and Speech Sciences at DTU. It's amazing to see how the hearing aid industry in particular is supporting the new developments that are happening at DTU and work together with researchers. I wish the center every success and happiness," Claus Nielsen said.

Terkel Jespersen, Project Manager DTU at Campus Service and Jan Stysiek, Construction Director at C.C. Brun Enterprise



agreed, and Jan Stysiek congratulated the client DTU and the researchers with the new facilities and in particular acknowledged the good collaboration between the client DTU Campus Service, architects, engineers, subcontractors and construction workers.

The research focus of the new centre is on fundamental aspects of hearing research. One of the new labs is an audiovisual immersion lab where the researchers are able to simulate both visual and acoustic cues in different rooms and spaces.

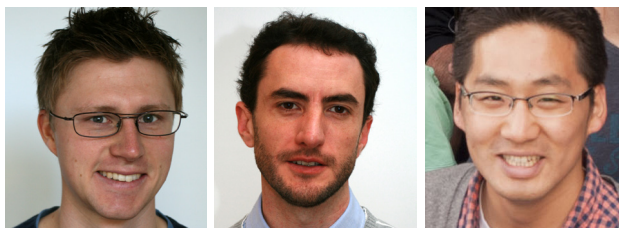
With this system, it will be possible to examine fundamental questions regarding the interaction of spatial hearing and the integration of auditory and visual stimuli and the impact this has on listening in complex, real-world situations. Over the first five years, the centre will support 8 PhD students and 4 postdocs.

Illustration Rørbæk og Møller Arkitekter



Hearing Systems staff news

We have to say goodbye to



Søren Jørgensen (PhD) and Nicolas Le Goff (Postdoc) have been offered positions as researchers at Oticon in April.

Jiho Chang started at Samsung, Korea in February.

Guest student from Oldenburg



At the moment David Hülsmeir, MSc from University of Oldenburg, Germany, is doing a two months internship in the Hearing Systems group (Supervisor: Bastian Epp)

Professor on guest stay



In June, Professor Ville Pulkki from the Department of Signal processing at Aalto University, Finland stayed as a guest at Hearing Systems for the second time in a year. During his stay, he presented his work and gave talks about spatial sound reproduction and perception. The Spatial Sound Research team at Aalto consists of 18 researchers (one professor, one postdoc, 12 PhD students and 4 MSc students). The work by the team can be divided roughly into research on spatial sound technologies and spatial audio perception.



We welcome a new staff member



On August 15, Jeremy Marozeau joined the faculty in Hearing Systems as an Associate Professor. Dr. Marozeau comes from a position as Research Fellow at the Bionics Institute, Australia. His research focuses on the perception of music and voice pitch information for people with a cochlear implants.

Visiting student from MIT



As part of the Erasmus Mundus fellowship program, Golbarg Mehraei, PhD student from Massachusetts Institute of Technology, USA, has joined the Hearing Systems' research group for the next six months.

Golbarg is a 4th year PhD student in the Harvard MIT-Program in Speech and Hearing Bioscience and Technology and works in the Auditory Neuroscience Lab at Boston University.

EU projects

Hearing Systems is part of two European Marie Curie Initial Training Networks on “Investigating Speech Processing in Realistic Environments” (INSPIRE) and “Improved Communication through Applied Hearing Research” (ICanHear). In addition, Hearing Systems received funding for the European Collaborative Project “Reading the world with Two Ears” (Two!Ears), as well as support for external research stays of Ph.D. students at North American Universities through the Erasmus Mundus Program “Auditory Cognitive Neuroscience” (ACN).

These networks are particularly valuable and we expect that we will be able to continuously attract excellent researchers to the Hearing Systems group.

Erasmus Mundus Network meeting

The Hearing Systems Group was represented by several members at the kick-off meeting of the Erasmus Mundus Student Exchange Network in Auditory Cognitive Neuroscience coordinated by the University of Leipzig on April 25-27.

The Auditory Cognitive Neuroscience network is funded by the EU and aims to increase the mobility of researchers between North America and Europe.

Besides presentations by all the fellows and scientific presentations about cognitive auditory neuroscience, one highlight was a music-science lecture by Professor Altenmüller from the University of Hannover in Germany, guiding through 30.000 years of music history with corresponding instruments and neurobiological explanations about the connection between music and emotion.

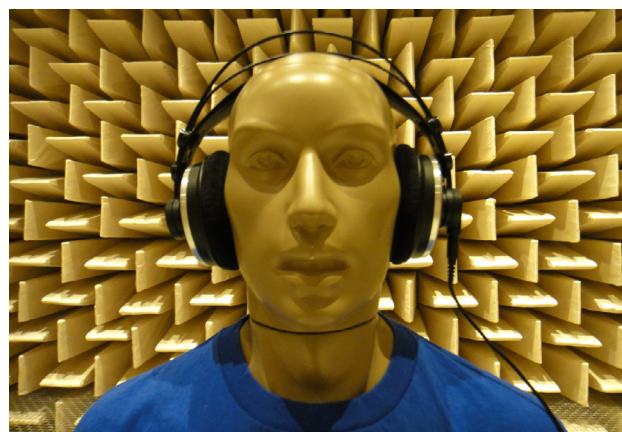
This broad network extends the international connections of the Hearing Systems Group all over Europe and North America and provides promising opportunities for collaboration.

Federica Bianchi, one of Hearing Systems’ PhD students was awarded a fellowship to visit the International Laboratory for Brain, Music and Sound Research at McGill University Montréal Canada and the group of Professor Zatorre, where she will be working for six months. This exchange is funded by the Erasmus Mundus program and her own travel grant.

www.uni-leipzig.de/~acn/



26 partners and associates from Europe, Canada and the USA joined forces for the Erasmus Mundus network



TWO!EARS: How do humans hear?

The international consortium has set the goal to improve computer models and develop an intelligent, active model of auditory perception and experience.

Up to now, computer models of human hearing have tended to focus on the evaluation of the signals received at the two ears – in other words, they are signal-driven. In the new TWO!EARS approach, the prediction of human understanding and action will be improved by including hypothesis-driven processing where the human listener is seen as a multimodal agent who develops a world model through interactive listening and viewing. The TWO!EARS system will be realized on a robotic system which is capable of actively exploring its physical environment, to orient itself and move around.

The system is based on an open architecture which allows easy modification and extension.

www.twoears.eu

ICanHear: Improved Communication through Applied Hearing Research

A distinctive feature of this project is the tight integration of academic and industrial partners. Fellows will be trained to use rapid prototyping tools to implement and to test their newly developed solutions. Thus they will become familiar with the various stages of product development and also contribute by providing suggestions for improvement of such tools and future product development platforms. The proposed network includes strong translational focus, by providing fellows with motivation and skills to move from purely academic research to product development.

www.icanhear.eu/

INSPIRE: Investigating Speech Processing In Realistic Environments

Started in January 2012, the Marie Curie Initial Training Network "Investigating Speech Processing In Realistic Environments" (INSPIRE) provides research opportunities for 13 PhD students (Early Stage Researchers) and 3 postdocs (Experienced Researchers) to study speech communication in real-world conditions.

The network consists of 10 European research institutes and 7 associated partners (5 companies and 2 academic hospitals). The senior researchers in the network are academics in computer science, engineering, psychology, linguistics, hearing science, as well as Research and Development scientists from leading businesses in acoustics and hearing instruments, and ear nose, and throat specialists.

www.inspire-itn.eu

EU student on guest stay (INSPIRE)



As a part of her Initial training network, Huarda Valdés-Laribi, PhD student from the University of York, UK, was a guest researcher at Hearing Systems for a month. Huarda is trained as a speech and language therapist, and is now working on her PhD project that focuses on the cognitive factors that influence our ability to understand speech in adverse conditions. Several of the PhD students and postdocs at Hearing Systems are also part of the INSPIRE European training network. The purpose with the European network is to get trained in various skills in order to get as many competencies as possible during the PhD studying period. Every half year the network arranges meetings, lately in Copenhagen.

"What really is interesting is the unique training the network provides, for instance the workshops in collaboration with industrial partners and other academic institutions. Through the workshops we are getting trained in specific aspects, we wouldn't be able to acquire at the same level at our own institutions, or at least not as easily," Huarda Valdés-Laribi says.

The INSPIRE Network group



Postdoc projects



Computational speech segregation based on monaural cues

Tobias May

One of the most impressive abilities of the human auditory system is that it is able to focus on a desired target source and to segregate it from competing talkers and interfering background noise. The main goal of this project, supported by ICanHear and Two!Ears is to develop a machine-based segregation system that is able to segregate speech in noisy environments by combining knowledge about auditory processing with modern signal processing strategies. The computational segregation system first decomposes the noisy speech mixture into individual time-frequency units. In a second step, the system attempts to classify these units into either speech-dominated or noise-dominated units by exploiting a variety of monaural cues, among them amplitude modulation and periodicity.



A new Danish intelligibility test based on non-sense speech materials

Jens Bo Nielsen

Hearing aid processing algorithms aimed at improving speech intelligibility impact the speech signal in more profound ways than mere amplification. Compressing or transposing frequency bands are examples of possible signal manipulations. This project develops a speech test that allows for a detailed analysis of how listeners' perception of individual speech sounds is affected by processing algorithms. For example, whether a processing scheme intended for improving the perception of high-frequency sounds has an impact on people's ability to identify high-frequency phonemes.



Analyzing sentence processing using the eyes

Dorothea Wendt

The goal of this work is to achieve individualized measures of cognitive capacity that predict variations in speech processing that may be used for individualized hearing aids and optimized hearing-aid fitting. Hearing loss decreases speech recognition performance, which has traditionally been predicted using standard audiometry. Hearing-impaired people, in particular, often complain about greater processing effort required to recognize speech in noisy environments, which may lead to fatigue. This project develops objective measures of individual cognitive effort during online speech processing in noisy environments. Eye-fixations and pupil response are measured as indicators of cognitive processing effort in audio-visual speech scenarios.



Decoding attention-driven speech source separation in human cortex

Jens Hjortkjær

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. This project uses magnetic resonance imaging and scalp encephalography to measure cortical activity patterns involved in attention-driven segregation of speech sounds in normal-hearing listeners. The aim is to develop methods for robust identification of a listener's attentional focus from the neural data. The 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.



Auditory features in complex natural scenes – a modeling framework

Rémi Decorsière

The recently established European project “TwoEars” investigates a novel modelling approach to predict auditory localization that is not only inspired by the physiology of the human ear but also by the cognitive processes in the human brain. A related project focuses on the development of an auditory modeling toolbox. The toolbox represents a compilation of various established auditory models that are implemented in a coherent and modular fashion. With its focus towards results’ reproducibility and internal compatibility, it provides a simple and efficient way for members of the auditory research community to make practical implementations available to their fellows.

PhD projects



Computational speech segregation inspired by principles of auditory processing

Thomas Bentsen

The auditory system is remarkably robust in separating the contribution of individual sound sources by analyzing only the acoustic input received by the two ears. However, computational approaches are not nearly as effective in segregating a target speech signal from interfering noise signals. Recently, promising results have been reported by combining acoustic feature extraction with machine-based classification routines. Therefore, the goal of this project is to improve the performance of computational approaches by employing principles of auditory processing.



Pitch representations in the impaired auditory system and implications for music perception

Federica Bianchi

Understanding the underlying mechanisms of pitch coding is a crucial step towards restoring accurate pitch perception in hearing-impaired subjects by means of hearing devices. In this project, hearing-impaired listeners will participate in both behavioral and objective measures of pitch-perception. The outcomes of the behavioral experiments will be compared to objective measures of brain activation obtained via functional magnetic-resonance imaging (fMRI) techniques. The aim in this project is to investigate how different abilities in spectral and temporal resolution are reflected at a cortical level.



Computational auditory scene analysis based on a model of human binaural processing

Alexandre Chabot-Leclerc

Computational auditory scene analysis is a field of hearing science that models how the human auditory system parses an acoustic scene. The approach is to combine various acoustic and perceptual cues and determine their relative importance in the perception of an acoustic scene, such as evaluating the direction of a sound source. This project focuses on predicting speech intelligibility in realistic environments. The aim is to extend a monaural model of speech intelligibility to the binaural domain. The binaural model is first evaluated for normal-hearing listeners and later combined with a model of impaired hearing to establish a general framework for testing the effect of hearing-aid signal processing on speech intelligibility in realistic environments. A model of speech intelligibility may help investigating the critical cues for speech understanding in adverse everyday environments, such as train stations and public spaces.



Distance perception in impaired and aided-impaired hearing

Jasmina Catic

This PhD project is concerned with distance perception (in particular externalization) research and its implications for modern binaural hearing aid technologies. The main research goals are: To better understand the main auditory mechanisms, cues, and signal features that are involved in distance perception, to clarify the influence of hearing impairment on distance perception, to analyse the impact of modern (binaural/bilateral) hearing aids on distance perception in aided HI listeners, and to advice on methods for optimizing distance perception in aided HI listeners and thereby to minimize the occurrence of internalization.



Improvement of cochlear implant stimulation strategies using auditory modeling

Suyash Narendra Joshi

Cochlear implants electrically stimulate the auditory-nerve bypassing the cochlea, allowing deaf patients to receive and process sounds and speech to a certain degree. In this project, a model of auditory nerve responses to electrical stimulation is developed based on single neuron recordings. The model will be evaluated for its ability to reproduce nerve population responses to various pulse shapes used in cochlear implants, as well as for modeling performance of implanted patients in psychophysical tasks. Use of physiological data and computational neuroscience techniques to identify the key parameters that affect listener's performance will provide us a platform for development of beneficial stimulation strategies for cochlear implants and a unique perspective on basic mechanisms of hearing.



Characterizing the auditory cues for the processing and perception of spatial sounds

Jens Cubick

Listening in natural environments, normal-hearing (NH) listeners usually perceive sounds at the place of their origin. This phenomenon is called externalisation and it probably helps to organize the acoustic soundscape and segregate it into different perceptual streams. The opposite phenomenon is called internalisation and describes a situation where sound sources are perceived inside the listener's head. Some hearing-impaired listeners seem to externalise sounds less than NH listeners. This degradation of the auditory perception could potentially affect the listening performance. This project investigates, if and how externalisation is affected by hearing impairment and by hearing-aid processing. This knowledge may help specify hearing-aid signal processing strategies to limit or compensate for the degradation of the externalisation percept.



Characterizing cochlear hearing impairment using advanced electrophysiological methods

Gerard Encina Llamas

Hearing impairment has traditionally been defined according to the increased threshold for pure tones through an audiogram measurement. However, compensating for the hearing loss by amplification does not lift the listening performance to the level of normal hearing. The challenge of this PhD project is to find electrophysiological methods for characterizing hearing impairment that complement the traditional pure-tone threshold measurements. These methods are inspired by recent results from invasive animal studies as well as human psychoacoustical studies. This project will be carried out in collaboration with Interacoustics Research Unit.



Neural and Perceptual aspects of audiovisual speech

Kasper Eskelund

When we listen to somebody talking, we not only rely on hearing, we also rely on speech. Talking faces carry speech information, which is helpful when the acoustic information is degraded, e.g. in noisy surroundings, or for hearing impaired. In the so-called McGurk effect, visual lip movements change the way we hear an acoustic speech token. This is a phenomenon of audiovisual integration, that changes the phonetic percept. But is this due to vision changing the way the brain processes sensory input from our ears, or, is it due to an integration of two conflicting pieces of phonetic information? This project investigates what actually happens when vision changes the way we hear. To measure this, EEG is the perfect method, as it allows accurate tracking of brain processes down to the millisecond. The aim is to be able to map where hearing and vision meet in the brain and how they interact.

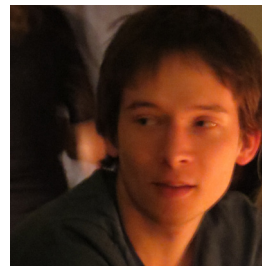


Individualized hearing aid fitting based on behavioral estimates of the inner-ear input/output function

Michal Fereczkowski

Modern integrated circuit technology has allowed for compensation for hearing loss by means of digital hearing aids. However, multiple fitting sessions are usually required in order to obtain high user satisfaction. One of the limitations is the way the hearing devices are adjusted to the user.

In this project, time-efficient experiments will be designed that measure audibility and temporal resolution at various frequencies. The specific design allows the behavioural estimation of the amount of compression of the inner-ear's (cochlear) input/output function, as well as the estimation of the function's knee-point between linear and compressive processing. The results will provide more detailed information about the state of the inner ear than traditional measures.



Spectral and temporal processing in electric hearing

François Guérit

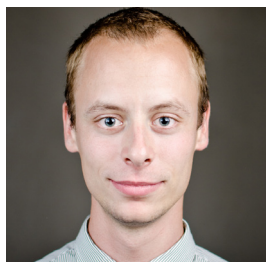
The cochlear implant (CI) is a prosthesis that allows deaf patients to communicate, by activating the auditory nerve electrically. Yet it remains very difficult to predict to what extent each patient will benefit from a CI, and there is a lack of reliable clinical tools to evaluate and optimize individual CI fittings. In this project, existing objective electrophysiological measures will be adapted for compatibility with CI stimulation. Estimates from these objective measures will be compared with basic psychoacoustic tasks as well as speech and music outcomes. The developed methods will be assessed for individualized auditory profiling and CI fitting. The project combines fundamental research aspects by investigating spectro-temporal processing of sound in CI users, with the aim to encourage the use of such fundamental knowledge in the development of clinical applications.



The role of temporal coherence in auditory stream segregation

Simon Krogholt Christiansen

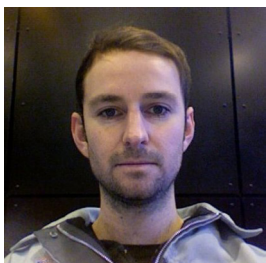
One of the most fascinating capabilities of the human auditory system is its ability to robustly segregate sound sources in complex acoustic environments. This allows us to selectively attend to a single sound source and, to some extent, ignore the competing acoustic information present at the same time. However, this ability is often reduced in hearing-impaired listeners, making it difficult to follow a conversation in a noisy room. In this project, a model of auditory stream segregation is developed and evaluated. Parallel to the modelling, experimental work is carried out to quantify the influence of different acoustic cues on stream segregation in normal-hearing listeners. Modelling stream segregation can help us to understand how we perceptually segregate sound sources and, in turn, why this is particularly difficult for the hearing impaired.



Characterization and prediction of the perceptual consequences of individual hearing loss

Gusztav Locsei

Traditionally, hearing aids are fitted based on an individual's audiogram, a simple measure of absolute sensitivity to tones of different frequencies. However, the performance of listeners fitted with hearing aids can vary enormously across individuals, since other processing deficits significantly influence an individual's ability to understand speech in difficult conditions. The goal of this project is the development of an auditory profile that characterizes an individual's hearing loss by measuring different aspects of auditory processing (e.g., sensitivity, amplitude compression, cognitive capacities, etc.). Once developed, we will characterize the relationship between the individuals' auditory profile and their ability to process speech in a variety of situations. The results of this project are expected to have substantial practical relevance in the development of hearing instruments, and clinical importance in evaluation and fitting of hearing aids.



Analysis of the auditory system via synthesis of natural sounds, speech and music

Richard Ian McWalter

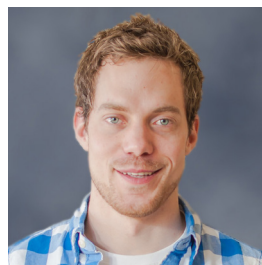
This PhD project is geared towards investigating the auditory system and the higher level processing stages of a broad range of sounds. The work will make use of physical and functional models of the peripheral auditory system, functional models of mid-level processing and further investigation into the auditory cortex and perceptual stages of the brain. The project will bring together the strong foundation of auditory modeling, along with aspects of computational audition and neuroscience in an attempt to validate theories identified by psychophysical experiments. The resulting work will then be targeted towards practical applications such as speech, natural sound and music synthesis, assistive listening algorithms, sound classification, or auditory scene source separation.



Capturing and reproducing realistic acoustic scenes for hearing research

Marton Marschall

Complex acoustic environments with many sound sources and reverberation present challenging listening conditions, especially for hearing-impaired individuals. This project focuses on developing techniques to create complex, realistic acoustic scenes ("cocktail-party" scenarios) around a listener in a laboratory setting. A spherical microphone array is developed to capture spatial recordings of real sound scenes, which can then be played back in a virtual auditory environment over an array of loudspeakers. Scenes of different complexities are constructed to enable listening tests in realistic, yet controlled settings. The results of the project are expected to provide new methods for evaluating the performance of normal-hearing and hearing-impaired listeners in challenging environments.



Predicting the consequences of hearing loss and hearing-aid signal processing on speech intelligibility

Christoph Scheidiger

This PhD project improves understanding of the auditory processes underlying reduced speech intelligibility in hearing-impaired individuals. The primary aim is to model impaired speech perception by integrating existent models of normal-hearing (NH) and hearing-impaired (HI) auditory processing. The model should be able to account for perceptual data of speech experiments in a variety of adverse listening conditions. Project results will contribute to an increased understanding of the essential "auditory features" for speech intelligibility and will provide insights into the consequences of specific auditory deficits on speech intelligibility. Furthermore, the results may have substantial practical relevance in terms of technical applications within hearing-instrument development, evaluation and fitting.



Effects of hearing-aid signal processing on temporal auditory perception

Alan Wiinberg

In this project, it will be explored how nonlinear hearing-aid signal processing, such as dynamic range compression, will affect the auditory perception in three experiments related to auditory temporal processing; (a) Modulation detection, (b) co-modulation masking release and (c) temporal synchrony in auditory scene analysis. These are chosen since they are all thought to be related to robust speech perception in complex acoustic environments.

We expect that the outcome of this study can be applied to realistic signal processing settings by hearing-aid developers and, therefore, may have large impact for hearing-aid users.



Modeling the consequences of hearing loss and hearing-aid processing on consonant perception

Johannes Zaar

Speech consists of consecutive units such as consonants and vowels which convey important information on a “short-term” scale. One of the challenges of current hearing research is to understand how these short-term acoustic features are related to human speech perception. This project aims at developing a consistent modeling framework that predicts consonant confusions made by normal-hearing and hearing-impaired listeners based on the acoustic stimuli. Furthermore, the effects of hearing-aid processing on consonant perception will be investigated. To do so, the important cues that lead to a specific percept are to be identified in terms of the spectral energy and modulation energy distributions. Understanding the physical correlates of short-term speech perception and how they are affected by auditory deficits can have substantial relevance for hearing-aid development.

Other projects



Modulation domain processing for enhanced speech intelligibility

Andreas Thelander Berthelsen

Speech modulations are often corrupted in complex listening environments such as multiple-speakers scenarios.

Extracting the target modulations will improve the speech intelligibility of the corrupted speech.

This project examines speech processed in the traditional time-frequency domain and modulation-domain under ideal conditions.

These methods are compared and evaluated based on their ability to extract the target speech modulations from the noisy speech.



Individual Differences in Auditory Brainstem Response Latency in Noise: A Measure of Auditory Nerve Fiber Deafferentation?

Golbarg Mehraei

Communication difficulties in noisy environments in “normal” listeners is thought to arise from more central sites of the auditory system with the assumption that sound encoding at the auditory nerve is robust. Despite this common assumption, recent animal studies have shown that temporary noise exposure can preferentially reduce the number of low-spontaneous rate auditory nerve fibers (low-SR fibers), leaving normal detection thresholds but degraded encoding of supra-threshold sound. Here we hypothesize that the number of low-SR fibers-thought to be important in communication in noisy environments- varies among normal hearing listeners and in turn, affects how the auditory brainstem response (ABR) wave-V latency changes when measured in different levels of noise.

Recent publications

Recent articles

Abdala C, Guérit, F, Luo P, Shera CA (2014) Distortion-product otoacoustic emission reflection-component delays and cochlear tuning: Estimates from across the human lifespan.

Journal of the Acoustical Society of America, 135 (4), 1950–1958

Chabot-Leclerc A, Jørgensen S, Dau T (2014) The role of auditory spectro-temporal modulation filtering and the decision metric for speech intelligibility prediction.

Journal of the Acoustical Society of America, 135 (6) 3502–3512

Christiansen SK, Oxenham (2014) Assessing the effects of temporal coherence on auditory stream formation through comodulation masking release.

Journal of the Acoustical Society of America 135 (6) 3520–3529

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

Jeong C-H, Lee D, Santurette S, Ih J-G (2014) Influence of impedance phase angle on sound pressures and reverberation times in a rectangular room.

Journal of the Acoustical Society of America, 135 (2), 712–723

Jepsen ML, Dau T, Ghitza O (2014) Refining a model of hearing impairment using speech psychophysics.

Journal of the Acoustical Society of America, 135 (4), EL179-EL85.

Mitsuya T, MacDonald EN, Munhall KG (2014) Temporal control and compensation for perturbed voicing feedback.

Journal of the Acoustical Society of America, 135 (5), 2986-2994

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

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

Hjortkjær J, Walther-Hansen M (2014) Perceptual Effects of Dynamic Range Compression in Popular Music Recordings

Journal of Audio Engineering Society, 62 (1/2) 37-41

Wendt D, Brand T, Kollmeier B (2014) An Eye-Tracking Paradigm for Analyzing the Processing Time of Sentences with Different Linguistic Complexities.

Plos One 9 (6)

PhD theses

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

Jørgensen S (2014) Modeling speech intelligibility based on the signal-to-noise envelope power ratio.

Book chapters

Alsius A, MacDonald EN, Munhall KG (2013) Multimodal speech perception.

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Käsbach J, May T, Le Goff N, Dau T (2014) The importance of binaural cues for the perception of apparent source width at different sound pressure levels *DAGA Oldenburg*

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MSc Projects 2014

Behavioural measures and neural modelling of musical interval perception.

Marc Rasmussen. Supervisors: Ewen MacDonald, Sébastien Santurette. Completed April 2014.

Modulation domain processing for enhanced speech intelligibility.

Andreas Thelander Bertelsen. Supervisors: Torsten Dau, Søren Jørgensen, Jesper Boldt (GN Resound). Completed May 2014.

Effects of harmonic roving on pitch discrimination.

Mathilde Le Gal de Kerangal. Supervisors: Sébastien Santurette, Suyash Joshi. Expected completion: Sept. 2014

Objective measures of cochlear dispersion

Andrea Paredes Gallardo Supervisors: Torsten Dau, Bastian Epp Expected completion: Sept. 2014

Spectral weighting and combination of binaural cues across frequency bands.

Axel Ahrens. Supervisors: Bastian Epp, Suyash Joshi. Expected completion: Sept. 2014.

Reproduction of realistic background noise for testing telecommunication devices.

Juan David Gil Corrales. Supervisors: Ewen MacDonald, Woo-Keun Song (B&K). Expected completion: Sept. 2014

The role of frequency selectivity and harmonic resolvability for pitch discrimination.

Wiebke Lamping. Supervisors: Sébastien Santurette, Ewen MacDonald. Expected completion: Oct. 2014



