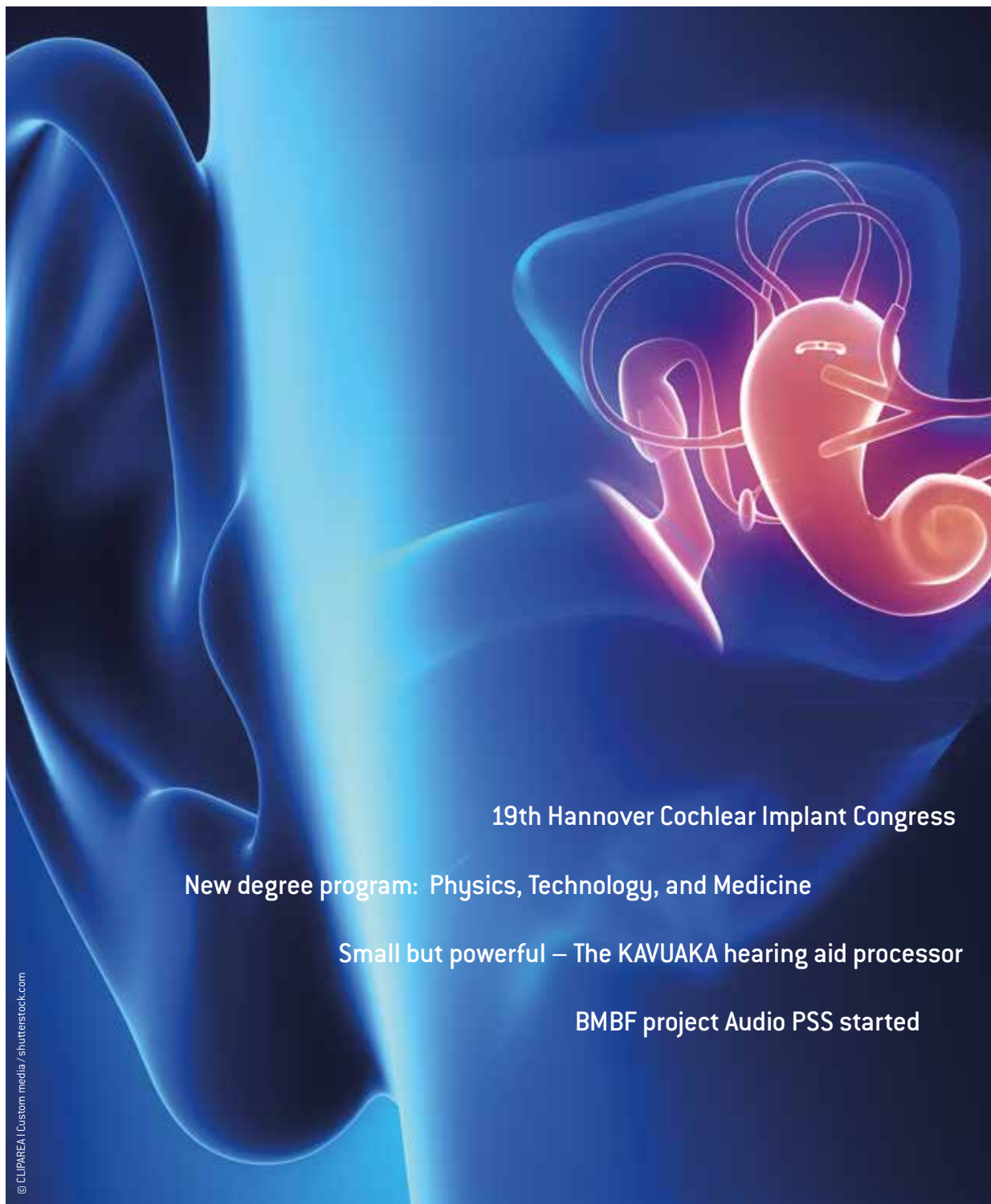


CLICK

News from the Auditory Valley



Hearing for all. All people, all situations, all sectors.



19th Hannover Cochlear Implant Congress

New degree program: Physics, Technology, and Medicine

Small but powerful – The KAVUAKA hearing aid processor

BMBF project Audio PSS started

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Future Hearing: Under this motto, the Auditory Valley research and development network is bundling many kinds of hearing expertise. With this magazine, we take you regularly into the fascinating and varied world of the researchers. The "Sonic Boom" section in this issue looks at the new degree program in Physics, Technology and Medicine at the University of Oldenburg as well as the 19th Hannover Cochlear Implant Congress and Inner Ear Biology 2017 meeting held in Hannover. Under "Directional Filters," we present the BMBF "Audio-PSS" project, which is developing product service systems for tele-audiology. A colorful mix of research news and event reports are presented in our "Pink Noise" section. Once again, this issue will also focus on the developments and results obtained by Hearing4all, the cluster of excellence at Auditory Valley. We are particularly pleased to announce that the University of Oldenburg, Hannover Medical School, and Leibniz University of Hannover have taken the first hurdles as part of the Excellence Strategy, the successor program to the Federal/State Excellence Initiative, and are now working hard on completing the full application for the Cluster's next phase.

We hope you enjoy reading this issue of CLICK!
The CLICK Editorial Team

P.S. Would you prefer to receive CLICK as a PDF in your inbox? Just send us an email at info@auditory-valley.com and we will amend your subscription.

INHALT

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Prof. Dr. Katia Parodi, President of the German Society for Medical Physics (DGMP e.V.)

Dear Readers,

The German Society for Medical Physics (DGMP) is broadly positioned at the interface between basic physics research and its medical applications such as diagnostic procedures (mostly X-ray diagnostics and advanced tomographies using ultrasound, CT, MRI and PET), therapeutic procedures (mostly radiotherapy and nuclear medicine therapy), and medical measurement technologies. Audiology is assigned to this latter category at DGMP.

Together with the German Society for Biomedical Engineering and its chairman Professor Dr. Thomas Lenarz, the DGMP and its sister organizations in Austria and Switzerland welcomed over 1,300 participants to their conference held in Dresden September 10-13, 2017. As DGMP President, it was a special pleasure and honor for me to award this year's Glocker medal for special services to medical physics to the speaker of the Hearing4all Cluster of Excellence, Professor Dr. Dr. Birger Kollmeier and to give him the opportunity to share the Cluster's excellent work with a broader specialist audience from the fields of medical physics and biomedical engineering.

The Cluster's work represents major strides in knowledge and an excellent extension of our field of expertise, for which audiology and the increasingly important treatment of hearing impairment has to date only played a minimal role. I was even more pleased to hear that the Hearing4all Cluster of Excellence had in September of this year passed the first hurdle to continue and extend its work under the federal Excellence Strategy and was asked to submit a full application. Hearing4all is thus one of the outstanding projects being undertaken by members of our society. I wish all those involved much success for what is certain to be a strenuous application round and am particularly pleased that this award presented to Professor Kollmeier may provide a little extra tailwind to this project!

Yours,

A handwritten signature in dark ink, appearing to read 'Katia Parodi'.

Prof. Dr. Katia Parodi

Physics, Technology, and Medicine: University of Oldenburg establishes new degree program

Starting with the 2017/18 winter semester, the University of Oldenburg is offering a novel, interdisciplinary Bachelor's and Master's degree program. It's called "Physics, Technology and Medicine" (PTM) and is aimed at technology enthusiasts with an interest in the natural sciences who see their future in medicine and medical technology. The program was designed by Future Prize winner, physicist and medical doctor Prof. Dr. Birger Kollmeier, Dr. Stefan Uppenkamp, and physicist Prof. Dr. Volker Hohmann, also a winner of the German Future Prize, together with other Oldenburg physicists, engineers, and medical school faculty.

The new curriculum combines hands-on, interdisciplinary content from the fields of physics and electrical engineering with theoretical knowledge from the fields of medicine, biology, and psychology. "With PTM, we have created a great alternative to classical physics and medical school programs," explains Kollmeier. Anyone who finds pure physics too dry, but finds medicine going too little into the scientific and technical details, will find a good fit with PTM.

Bachelor's Degree in Physics, Technology and Medicine

The problems in modern medicine can only be solved through interdisciplinary collaboration between scientists and clinicians. The bachelor's degree program in Physics, Technology and Medicine (PTM) teaches the right mix of theory and practice, physics and medicine, technology, and life sciences to master the challenges in research, industry, and clinical practice.

The program is aimed at students with a love for technology and medical issues, but with a primary focus on the science. It closes a gap between the fundamental physical and engineering fields (physics, electrical engineering, acoustics, signal processing) and the life sciences (medicine, biology, psychology) and offers the optimal qualifications to enter into a research field with a great future and many career options in industry, clinical practice, or the academic world.

The new program will be housed in the Faculty of Mathematics and Natural Sciences in cooperation with the new Faculty of Medicine and Health Sciences at the University of Oldenburg. "We took the unique opportunity to set up an interdisciplinary degree program. It integrates important elements of our human medicine program at the European Medical School at Oldenburg-Groningen to prepare graduates for future research in medicine and medical technology," emphasizes Kollmeier. Particularly successful students from a comparable bachelor's degree at the partner university in Groningen can even switch to the medical school after a transition year. "We are striving for a similar kind of close exchange between the disciplines in Oldenburg," says Kollmeier. Graduates of the bachelor's degree program will be high-





ly qualified in the field of applied physics and medical technology and have excellent career and development opportunities due to the high demand for skilled workers in this area.

They will also have very good prerequisites for transitioning to other medical engineering-related programs in Germany and abroad. The field is comparable to a bachelor's degree in medical technology, allowing them to work with medical technology in clinical settings or in industry with a focus on measuring technology, signal processing, and medical IT.

Master's Degree in Physics, Technology and Medicine

A career as a scientist in medical research, industry, or in clinical practice with a focus on medical technology, neuroscience, or acoustics requires education with an appropriate mix of theory and practice. The master's degree program in "Physics, Technology, and Medicine" (PTM) teaches and combines practical and interdisciplinary skills in physics and electrical engineering with theo-

retical knowledge in medicine, biology, and psychology. With its focus on hearing and language research as well as neurophysics, neurotechnology, and medicine, the program provides an excellent education in medical technology, one of the fastest-growing industries in Germany and one which offers graduates diverse career options.

The program ties in with the Hearing4all Cluster of Excellence and features a high degree of interdisciplinarity between physics, medicine, acoustics, and neuroscience. It offers early research contacts and the opportunity to collaborate with university and non-university institutes such as Hearing, Speech and Audio Technology Project Group at Fraunhofer IDMT, HörTech, and Hörzentrum Oldenburg.

More information is available at www.uni-oldenburg.de/ptm/



Two top-class events in Hannover

The Hannover Medical School (MHH) and the Cluster of Excellence Hearing4all hosted two top-class events in Hanover in September. The 19th Hannoversche Cochlea Implant Congress and the 54th Workshop and Symposium of Inner Ear Biology attracted a large number of international experts to the capital of Lower Saxony.

19th Hannover Cochlear Implant Congress

With the invitation to the 19th Hannover Cochlear Implant Congress to discuss "Cochlear Implants: Responsibility and Reality," the ENT Clinic and the Deutsches HörZentrum in Hannover set the main themes of this year's congress: We have been responsible for investigating and discussing the lessons learned in recent years and want to translate these into the reality of current care. The focus was on the fact that we now have a broad base of experience after 30 years of using cochlear implants, but we have to handle it responsibly. We doctors now need to provide our patients with defined quality controls, not only to ensure that individual needs are being met, but also to develop guidelines for new CI patients who are unable on their own to sift through the accumulated information that's out there. That, too, is a part of the reality: there is a lot of information and many places providing information, but we need to address the lack of orientation based on widely known, reliably documented quality standards.

Consequently, we started the congress by presenting the medical/surgical focus of CI care. The presentations on the first day of the congress dealt addressed such issues as progressive deafness, residual hearing, cochlear implants, and reimplantation. Topics covered in the sessions on adult counseling and therapy included music

therapy for adult wearers of cochlear implants and seven presentations on providing sexual assault counseling to girls and women with hearing impairments. At the end there was an open discussion between the speakers and the audience on the quality of care available in Germany. Topics on the second day addressed the therapeutic aspects of CI care, including the factors for successful hearing and speech development in children with CIs, the influence of age and hearing loss on speech processing neuronal mechanisms, audiological and neuropsychological test batteries, and the inclusion of seniors. In sessions on single-sided deafness, speakers addressed such aspects as the current indications and outcomes for unilaterally deaf patients with CIs and the provision of equipment or the counseling and therapy of children and adolescents with single-sided deafness.

The 20th Hannover Cochlear Implant Congress is currently scheduled to take place September 7-8, 2018. Many doctors, therapists, professionals, researchers, patients, and other interested parties are expected to come together to learn, exchange ideas and experiences, and engage in discussions.



Inner Ear Biology 2017

About 250 researchers from all parts of the world accepted the invitation of the Hearing4all Cluster of Excellence to come to Hannover for the 54th Inner Ear Biology workshop and symposium. Over four days, the Hannover Medical School turned its attention to hearing research. The numbers are impressive: around 60 lectures at the workshops, 15 lectures at the symposium "Interventions in the ear: From inner ear biology to advanced therapy of hearing loss", and 110 research posters all demonstrated the technical depth and importance of this area of hearing research. Congress leaders were ENT Clinic Director Prof. Thomas Lenarz and ENT Research Director Prof. Andrej Kral of the Hannover Medical School.

Highlights included the "Hearing and Light" session on Day 1, as well as the symposium on "Developmental consequences of hearing loss" organized by the Association for Research in Otolaryngology (ARO) with lectures by Edwin W Rubel (USA), Dan Sanes (USA), Douglas Hartley (GB), and Yusuf Prasandhya from the ENT Clinic at Hannover. Further sessions of the three-day workshops were organized into the following broad themes: "Development and genetics," "Inner ear biology," "Auditory prostheses," "Protection and regeneration," "Bioinspired signal processing," and "Therapeutic interventions." A special feature at this IEB was also the live transmission of a cochlear

implantation procedure from the ENT Clinic's operating room to the lecture hall. This allowed participants to follow along as ENT Clinic Director Prof. Lenarz placed a cochlear implant in this highly specialized microsurgery. Guided tours were also offered through the laboratories of the Institute for AudioNeuroTechnology (VIANNA) and the Deutsches HörZentrum Hannover. Both institutions are home to research groups that belong to the Hearing4all Cluster of Excellence. The symposium "Interventions in the ear: From inner ear biology to advanced therapy of hearing loss" covered a range of topics from the morphology of the cochlea, the delivery of medications, inner ear regeneration, biohybrid and active cochlear implants, middle ear implants, and the new generations of central auditory implants. Speakers included such leading international researchers as Helge Rask-Andersen, Anne Schilder, Dyan Ramekers, Lawrence Lustig, Stefan Heller, Christine Petit, Hinrich Staecker, Jim Patrick, Douglas Fitzpatrick, Philine Wangemann, Ad Snik, Alex Huber, Hubert Lim, and Daniel Lee. Participant Einat Shapira received the Spoendlin Junior Award, a prize worth €1,000 for the best paper by a young scientist. The conference was made possible thanks to the support of the Association for Research in Otolaryngology (ARO), the German Research Foundation (DFG), Advanced Bionics, Cochlear, MED-EL, Oticon Medical, and Zeiss.



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Robots are just one sample application for acoustic recognition and monitoring systems and human-machine interaction via spoken language.

On personal terms with Mr. Roboto

"Please collect 3 kg of hexagonal screws and bring them to the packaging department." This command will no longer be sent to an employee working in warehouse logistics, but instead to a voice-controlled robot. And thanks to the integrated acoustic event detection, the robot can tell whether the right type of screw is being filled into the container.

The Fraunhofer Institute for Digital Media Technology (IDMT) has developed a technology for voice-based machine control and acoustic detection of materials and process conditions. The Institute is thus showing how voice controls can be used to manage the human-machine interaction of the future. In the production context, it is also interesting that the robot's speech recognition also works in noisy environments and with greater distance between the speaker and the machine. Using the example of an industrial robotic platform used in automated manufacturing environments, the developers show how well the recognition system differentiates speech and other sounds to implement commands.

"In principle, our speech recognition and control system can be adapted to any individual use, from simple controls commands with just a few words to complex dialog-based interaction with robots," explains Dr.-Ing. Stefan Goetze of Fraunhofer IDMT in Oldenburg. "Our focus at Fraunhofer IDMT in Oldenburg is on hearing, speech, and

audio technology. The applications are diverse, but not just for the industrial sector. In the area of speech recognition, we are also developing systems to recognize calls for help, for example," adds Goetze.

Acoustic final inspections for Production 4.0

The intelligent speech recognition algorithms can be used not only for speech detection and voice controls in industry, but also for acoustic process monitoring or final inspections. In this way, filling processes or product selection can be monitored based on how they sound when placed in a container, for example.

User-centered design seeks to promote collaboration among product designers, developers, and users from the very start. User-friendliness is important for a product's success, both in private and industrial environments. This includes audio and speech recognition.

As an intelligent assistive system for the industry, it must be easy to use and, if possible, not create any barriers. Intuitive human-machine interaction is also key. Ideally, the systems will be self-explanatory and the benefits perceived as 100% positive. This includes that they function on a self-learning and forward-looking basis and can be controlled by humans without having to get hands-on. That's why voice control and recognition is becoming increasingly important.

Oldenburg hearing researcher receives Glocker Medal for outstanding service

As a society for the promotion of specialist research, the German Society for Medical Physics (DGMP) once again presented a series of prizes and awards during its annual conference in Dresden, September 10-13, 2017, honoring scientists who have made great contributions to the field. The Glocker Medal is the highest honor bestowed by the DGMP and is named in memory of its first honorary member, Prof. Dr. Richard Glocker. At the most recent conference, it was awarded to Oldenburg physicist and physician Prof. Dr. Dr. Birger Kollmeier for his outstanding achievements in the field of medical physics in both research and clinical practice. Kollmeier is Director of the Department of Medical Physics and Acoustics at the University of Oldenburg and Spokesperson for the Hearing4all Cluster of Excellence. He is also the Scientific Director of Hörzentrum Oldenburg GmbH, HörTech gGmbH, and the Fraunhofer Project Group for Hearing, Speech, and Audio Technology. On the occasion of the award ceremony, Kollmeier gave the Glocker Lecture entitled "Hearing4all: from empirical hearing research to modern precision audiology."

The Glocker Lecture provided a lively insight into current hearing research being carried out at the Hearing4all Cluster of Excellence, where researchers use approaches in physics, communications engineering, medicine, and neuroscience for everyone's mutual benefit. "The effects of a hearing impairment can be traced back to a few factors which can be precisely characterized in the hearing model. By setting the goal of individualized 'precision audiology,' we can now accurately predict the expected success of a hearing aid solution for each patient," Kollmeier explained.



Prof. Dr. Dr. Kollmeier is Director of the Department of Medical Physics and Acoustics at the University of Oldenburg and Spokesperson for the Hearing4all Cluster of Excellence.

"In addition, the hearing aids of the future will be individually designed and adapted to the patient's specific situation to allow trouble-free hearing in both quiet and noise-filled environments. Binaural hearing plays a special role in suppressing reverberation and locating both background noise and useful sound. In order to communicate the user's listening intention in a complex acoustic scenario to the device, brain-computer interfaces are used to focus the brainwaves derived from near the ear towards the target sound. This thus moves us one step closer to meeting the goal of individualized, precise diagnostics and treatment of hearing impairment with the long-term goal of hearing 4 all: all people, all places, at all times."

The joint annual meeting of the German Society for Biomedical Engineering (DGBMT) and the medical physics societies of Germany, Austria, and Switzerland (DGMP, ÖGMP, and SGSMP) brought about 1,300 participants to the International Congress Center in Dresden for high-caliber presentations on innovative applications in diagnostics and therapy. For more information, go to www.dgbmt-dgmp.de

Background of the Glocker Medal:

Since 2002, the Glocker Medal has been awarded annually by the German Society for Medical Physics (DGMP) as part of its annual conference to outstanding scientists who have distinguished themselves through their outstanding scientific achievements.

Richard Glocker (1890-1978) was the last doctoral student to complete his dissertation under Wilhelm Conrad Röntgen. His topic was "Interference of X-rays and Crystal Structure." He became a professor at Stuttgart in 1925, researching X-ray technology, radiological physics, dosimetry, radiation biology, radiation protection, and quality control.



Barn owls do not become hard-of-hearing as they age. The Oldenburg study also investigated the barn owl known as Grün (Green).

Eternally young ears?

As we age, we all eventually suffer some hearing loss because the sensory hair cells and nerve connections in the inner ear are irretrievably lost over time. Birds, on the other hand, are known to regenerate the cells. Whether this might be the case with aging animals had yet to be investigated in depth. A team around zoologist Dr. Ulrike Langemann at the University of Oldenburg has now shown that barn owls do not suffer hearing loss as they age. The researchers have published their findings in the current issue of the "Proceedings of the Royal Society B."

By the age of 65, five out of ten people have lost so much hearing sensitivity that their ability to comprehend speech and enjoy music may be affected. Such age-related deafness is also known in other mammals. Birds, on the other hand, have preserved the ability to form new hair cells in their inner ears to replace lost or damaged cells.

In order to better treat hearing loss in our aging society, scientists want to understand how this regeneration functions in birds. To date, there has been little research into whether this type of regeneration continues as the birds age and whether they continue to hear well with, so to speak "forever young ears."

For a songbird, the local starling, the team around Prof. Dr. Georg Klump and Dr. med. Ulrike Langemann from the Department of Neuroscience were able to show some

time ago that it did not suffer age-related hearing loss. Together with Prof. Christine Köppl, they have now been able to confirm this finding with a study funded by the German Research Foundation: the scientists trained barn owls of different ages using food rewards and compared their hearing ability. They found no difference in the hearing sensitivity of very old and young birds. "The lifelong ability to regenerate functional hair cells is probably a general, robust characteristic of birds," concludes Klump.

Barn owls have an extremely good sensitivity due to shape of their faces, which allows them to locate sound sources much more accurately than any other animal. Both help barn owls to locate and catch their prey, mostly mice. The hair cells in the inner ear are particularly specialized in these birds. The star of the Oldenburg study was the old owl Weiss (White), who has been a part of the lab there for 24 years. "She has since become very sedate," says researcher Bianca Krumm, who works with Weiss every day, "but she still has excellent hearing."



Clinical Innovation Center picks up speed

KIZMO, the Clinical Innovation Center for Medical Technology Oldenburg, is one of the newest institutions in the Oldenburg University Medical Center and Oldenburg Hearing Research. As a subsidiary of the Evangelisches Krankenhaus and Hörzentrum Oldenburg, KIZMO hopes to create a bridge between manufacturers of medical devices and clinical users. Last year, KIZMO won the BMBF Industry-in-Clinic Platforms Contest with its user-involvement concept where physicians and hospital staff are involved in the development of medical devices. Since summer 2017, the focus of the current work has been the establishment of the operating company, with BMBF funding, to develop service innovations. Managing Director Michael Buschermöhle reports: "The core of KIZMO's service offering is to integrate users into the development process. We also take the user or customer-centric approach seriously when developing our own services. The services are developed in close cooperation with potential customers, so that we can offer exactly what our clients will want later on."

KIZMO relies on a close-knit network, which includes the European Medical School and the University of Oldenburg in particular. This network is constantly being expanded. Particularly in the context of upcoming model projects, KIZMO expects to intensify its contacts with partners from industry and science. Projects in the fields of audiology, surgery, pneumology, and surgical equipment are being prepared. Contacts in the clinical and medical fields are also being expanded. Doctors and medical staff are invited to contact KIZMO if interested in participating in the development of innovative medical technologies. Being close to Oldenburg is not required. "Our contacts already go far beyond the local region and now extend to all regions of Germany," says Dr. Buschermöhle.

In recent months, KIZMO has been on tour presenting its work regionally and across Germany. At an Chamber of

Commerce & Industry event in the "Business meets Science" series held in August, with a focus on human-technology interaction, KIZMO contributed to the topics "Joy of Use" and "User-Centered Design" in medical devices. KIZMO was also on hand to provide feedback at a prototype presentation organized by the Oldenburg Start-Up and Innovation Center. At the annual meeting of the German Society for Biomedical Engineering in Dresden this September, KIZMO presented its first practical experiences as an industry-in-clinical practice platform.

KIZMO has since completed its first projects, including a project with Hamburg-based audiometer manufacturer AURITEC to optimize the presentation of complex measurement data for use with later users. Currently, a project in the field of sound design for health-related applications is also underway. As part of the Cluster of Excellence, KIZMO has also been able to contribute to the improvement of testing procedures for audiology. In the near future, another project will be launched to create a planning tool for ENT specialists.

At KIZMO, designers, programmers, and usability experts work hand-in-hand. Among other things, with clinical experts they are creating tool boxes for the rapid development of user interfaces. "Working at the interface between research and clinical application makes me feel like I'm making an important contribution to accelerating the delivery of medical technology to patients," says clinical software engineer Tobias Feith. Clinical usability designer Nils Raveling adds: "When we design user interfaces in conversations with clinicians, using paper prototypes and then translating them into software, the spark of enthusiasm jumps quickly." Overall, KIZMO's work can improve the marketability of new medical devices and avoid innovation failures. This not only strengthens medical research in Oldenburg, but also strengthens technological innovation across Germany.

Another scientific accolade for the ENT Clinic and hearing research at Hannover Medical School: Prof. Dr. Dr. Andrej Kral was named to the Leopoldina

A special honor and award was given to ENT research director Prof. Dr. Dr. Andrej Kral when the members of the Leopoldina elected him to their National Academy of Sciences. The Leopoldina counts nearly 200 Nobel Prize winners among its members.

The Leopoldina was founded in 1652 and is one of the oldest science academies in the world. It is committed to free science for the benefit of humankind and the shaping of the future. With around 1500 members, the Leopoldina brings together outstanding scientists from Germany, Austria, Switzerland, and numerous other countries.

As the National Academy of Germany, the Leopoldina has represented German science in international committees since 2008 and offers independent opinions on the scientific foundations of political and social issues. Together with other German, European and international academies, the Leopoldina develops public statements on current topics in interdisciplinary expert groups.



*Prof. Dr. Dr. Andrej Kral,
Head of Experimental Otology and Head VIANNA*

The Leopoldina promotes scientific and public discussion, supports the work of young scientists, grants awards, carries out research projects, and works to protect the human rights of persecuted scientists.

Prof. Dr. Thomas Lenarz was named to the Leopoldina in 2013, meaning that with the naming of Professor Kral this year, Hannover Medical School's ENT clinic now has two scientists in this highly respected academy.

Richard Paluch receives 2017 ISAAR grant

Hearing is a multi-dimensional field. It affects the whole body and influences both interpersonal conversations as well as human balance and movement. However, it remains an open question whether and how everyday life is influenced by the use of modern hearing aids with complex signal processing options. To answer this question, Richard Paluch's study "Ethnographic research: the connection between spatial awareness, everyday life/laboratory environments, and the effects of hearing aids" for the Hearing4all Cluster of Excellence addresses how modern hearing aids shape the behavior of their users and how this can be scientifically assessed. Melanie Krüger, Maartje Hendrikse, Dr. Giso Grimm, Prof. Dr. Volker Hohmann, and Dr. Markus Meis participated in the study.

The study, which takes place at Hörzentrum Oldenburg, is based on a research design using multiple methodologies. The research work being done by Paluch et al. includes both qualitative and quantitative analysis steps. They are investigating how people with and without hearing aids move in different situations and comparing the results.

First, a driving study was conducted to analyze behavior in road traffic. Second, conversations in a restaurant were observed and encoded based on the forms of conversation. In the planned second part of the study, both situations will be realistically, yet virtually, replicated in the Gesture Lab, an advanced laboratory at the laboratory building NeSSy, University of Oldenburg, to test the assumptions identified during the qualitative research. This will not only provide a check of the results under controlled conditions, but also highlight the authenticity of technical simulations in modern laboratories like the Gesture Lab. Richard Paluch received a grant for this research work in 2017 from the International Symposium on Auditory and Audiological Research (ISAAR) which was held August 23-25 in Nyborg, Denmark. The main topic at this year's ISAAR Symposium was adaptive processes in hearing.



The participants of the Hearing Aid Developers Forum at the listening garden at Oldenburg's Haus des Hörens

Hearing Aid Developers Forum: When the world listens to Oldenburg

For the eighth time, HörTech gGmbH, the competence center for hearing aid systems technology, and the Hearing4all Cluster of Excellence invited the elite of international hearing aid developers to Oldenburg on June 1-2. Engineers from renowned companies and top-class audiologists from all over the world discussed the current challenges and trends of the industry together with the Oldenburg scientists, and developed approaches to be pursued in pre-competitive consortia.

Harvey Dillon (National Acoustic Laboratories, Sydney) addressed the question "Are good results driven by good equipment, good clinicians, or good customers?" The latest research findings on model-based prediction of hearing aid results were presented by Marc Rene Schädler (University of Oldenburg). Walter Karlen (ETH Zurich) addressed the importance of user-oriented design of hearing aid apps.

The benefits, prospects, and possible risks of open source solutions and publicly accessible development platforms for hearing aid research were discussed in a session with Volker Hohmann (University of Oldenburg) and Chas Pavlovic (Palo Alto).

The session on "Binaural Hearing Aid Adjustment" highlighted the advantages and challenges of this technology under real conditions. The focus was on identifying suitable candidates and appropriate situations for using this technology.

A discussion of laboratory simulations of real environments and behaviors was facilitated by Gin Best (Boston

University) and Bernhard Seeber (TU Munich). The focus was on the need for and the route to testing that can realistically assess the difficulties caused by hearing loss and realistically model the benefits that hearing aids can offer.

Tom Francart (KU Leuven) and Stefan Debener (University of Oldenburg) addressed the reading of brain activity and other physiological signals as a way to control hearing aids, a field of research that has been challenging and competitive for years. Which signals can be used and how should they be recorded? How can certain brain conditions (such as increased hearing effort or physical activity) be monitored in a manner accessible to hearing aids? Can they be influenced by external activities or triggers?

"Discussing and further developing our concepts from fundamental research with international luminaries in hearing research, but also in particular with leading developers of international hearing aid and hearing technology companies, always gives us new approaches and thus promotes the innovative and market-oriented further development of hearing research in Oldenburg," says organizer Prof. Dr. Dr. Kollmeier, physicist and medical doctor at the University of Oldenburg and Spokesperson for the Hearing4all Cluster of Excellence.

Many of the participants also took advantage of the opportunity to gain an insight into the application-oriented Oldenburg hearing research at the company showcase & barbecue hosted by HörTech gGmbH, Hörzentrum Oldenburg GmbH, and the Hearing, Speech and Audio Technology Project Group at Fraunhofer IDMT.

Hearing for the world in Oldenburg and Emden

Listening test results from Oldenburg and Emden are included in the ISO 7029 international standard. This standard describes the changes in hearing ability in healthy women and men as they age. The data from northwestern German was collected as part of the 2010-2012 HÖRSTAT study at Jade Hochschule.

The ISO 7029 international standard provides an important frame of reference for estimating normal, age-related hearing loss for patients up to the age of 80 and forms the basis for further international standards. For example, the harmful influence of noise is estimated by comparing results with the standards set in ISO 7029. These definitions have far-reaching significance. The international preparatory work which led to the revised version of ISO 7029 took about ten years. The data from Oldenburg and Emden were the German contribution to the work. In addition to study results from Japan, Norway, and the UK, they form the data set used to determine the most important parameters in the new standard.

A total of 1903 adults participated in the HÖRSTAT study. They were randomly selected from residents registered with local authorities. The study was carried out in two study locations in order to approximate the national proportions of employment in industry and the trades and thus achieve a more representative sample by age and sex.

However, not all participants were included in the new standard. Lead researchers Petra von Gablenz and Prof. Dr. Holube published the data distribution for adults of different ages in the "International Journal of Audiology." The calculations for the international standard only included the data for those men and women for whom excessive noise exposure, previous or acute ear disorders, poor general health conditions could, with reasonable certainty, be excluded.

The data from HÖRSTAT has already made it possible to extrapolate statistics on the number of adults suffering from hearing loss in Germany. The fact that the study results are now reflected in the international standard for healthy age-related hearing loss reflects the extensive amount of work that went into the research funded by the European Research Fund (ERDF) and the Lower Saxony Ministry of Science and Culture. For their part, both researchers thank the study participants, who volunteered to go to the universities of Oldenburg and Emden for about an hour each for the testing. Without them and the 23 student workers who helped with the researcher, this additional international success for Oldenburg hearing research would not have been possible.





EEG research lab opened in Pakistan

Researchers from the University of Oldenburg and the National University of Science and Technology at Islamabad, Pakistan (NUST) will be collaborating to help diagnose epilepsy, regardless of the distance to the nearest specialist. For this purpose, researchers from the team of Oldenburg neuropsychologist Prof. Dr. Stefan Debener are setting up the first research laboratory for electroencephalography (EEG) at the School of Electrical Engineering and Computer Science in Islamabad. EEG technology developed in Oldenburg makes it possible to record human brain activity outside the laboratory. This should help provide better access to epilepsy diagnostics in rural areas. The plan is to put the research laboratory into operation later this year so that initial clinical trials and other technical developments can begin in 2018.

Personal contacts among the scientists are what got the cooperation project rolling. During a lecture tour in Pakistan, Debener realized that "the scientists are well trained there, but the technical equipment at the universities is in real need of improvement." Even greater differences exist in the medical care on offer in Pakistan: "There is only about one neurologist per 1.4 million inhabitants in Pakistan; in Europe, that ratio is about 1 for every 10,000 people. In many neurologically relevant diseases such as epilepsy, patients in Pakistan have little chance of receiving adequate medical care," says Debener. The situation is problematic, especially in rural areas.

Modern technology should help to improve this situation in the future: As part of the Hearing4all Cluster of Excellence in Oldenburg, Debener and his team are researching mobile, wireless EEG systems that are inexpensive, can be worn on the body, and operate using relatively affordable smartphone technology. The EEG can record

human brain activity using sensors attached to the scalp. "Normally, the wires are attached to electrode covers. Wearing these quickly becomes uncomfortable for the patient. They also find the many cables disruptive," explains Debener. His team has developed miniaturized electrodes that can be stuck behind the ear. This makes the technology increasingly transparent and hardly noticed by the wearer or those around him. Originally designed to control hearing aids, Debener hopes that these mobile EEG systems might also be used for other applications, such as diagnosing epilepsy.

The vision: coupling mobile EEG systems with modern communication methods, the data could be recorded in remote regions with little technical effort and sent via the cloud to a remote clinic for diagnosis without requiring a visit to a specialist. Nurses in rural communities could then implement treatment recommendations based on remote diagnostics. For this vision to become reality, several questions still have to be answered: Reliable recording of biosignals under everyday conditions, taking into consideration factors such as temperature and movement is a must. To this end, the Oldenburg psychologists are working together with the engineers and computer scientists in Islamabad to adapt and further develop the hardware and software of the devices. Debener has succeeded in getting several German companies to sign up for the project and make substantial donations in kind. He was recently able to deliver the equipment for the EEG research laboratory in Pakistan to Maryam Saeed, Research Associate at NUST.



THERESIA - Digital therapy system for people with severe hearing impairments

At the end of the year, the THERESIA project, funded by the Federal Ministry of Education and Research (BMBF), will be launched. Under the direction of HörTech gGmbH, the consortium is developing a digital therapy system for people with severe hearing impairments.

Speech is the essential medium for human communication and is closely related to hearing. The ability to speak is a core skill for being able to participate in society. Limitations to speech and/or hearing abilities are common and carries the risk of social isolation for many. Measures to maintain or restore the ability to communicate are thus making a highly relevant contribution to social inclusion. Hearing is a central function for the development and expression of spoken language and language comprehension. It also serves humans as self-feedback in voice and speech control. When the sense of hearing is impaired, problems in comprehension, speech, and language can result. In addition, hearing impairment can

lead to impaired participation in daily life and social-emotional developmental disorders. The gold standard in the treatment of deaf and other patients with severe hearing impairments has been set by cochlear implants (CI), a hearing prosthesis that electrically stimulates the auditory nerve directly. After the implantation of a CI, the success of the therapy largely depends on individual adaptation of the CI's speech processor by doctors and speech therapists, subsequent listening training, and the patient's own motivation.

The goal of the THERESIA project is to develop a speech and pronunciation training system for use with people

with severe hearing impairments newly fitted with CIs or hearing aids. The system should offer patients the option of performing therapeutic exercises at home or away from the clinic more frequently and whenever they want. At the same time, treating physicians and speech therapists in (postoperative) clinical therapy will receive assistance with new, objective diagnostic functions, including the easier tracking and evaluation of progress. The overall digital system being developed by the project consists of software modules to analyze pronunciation and conduct listening and speaking exercises on a computer or tablet with headset and a connected electromyograph (EMG) as well as a special self-adapting training program.

Through the combination of acoustic and visual feedback, the patient can independently complete hearing, speech comprehension, and speech training. This goes far beyond the previous approaches used in audiothe-
rapy and allows targeted training of speech production and listening and thus increases the chances of significantly better outcomes. The project aims to develop dedicated speech therapy exercises that exploit THERESIA's possibilities and feedback (visual and auditory) to provide users with personalized, targeted guidance to improve their pronunciation. In addition to these therapeutic aspects, motivation enhancements are integrated to stimulate the patient's willingness to do the exercises and thus increase the frequency beyond what is possible in conventional therapy sessions. Game-like elements [Deterding et al., 2011] will be used to maintain a high level of motivation over the long term.

Using algorithms for the automatic assessment of pronunciation on the basis of speech recognition technologies developed by the Fraunhofer Institute for Digital Media Technology IDMT will enable precise, objectifiable feedback on pronunciation training based on parameters for voice and speech control such as volume, speech rate, intelligibility, and hoarseness. Electromyography (EMG) allows the recording of muscle movements (face and neck) to provide additional valuable information about the functioning of the muscular vocal tract of the hearing-impaired patient. By comparing these movements with the muscle movements made by people without language restrictions, the treating physicians and speech therapists will receive even more detailed information that will allow them to create an individual repertoire of exercises for specific muscle groups. As an additional modality, the EMG data can also be used to

expand and improve the algorithms being developed. In particular, the recording of the EMG data across therapy sessions will allow visualization of the speech therapy progress. The digital recording of the training parameters also allows an automatic evaluation of the learning progress. In this way, physicians and therapists will more readily be able to identify the required focus areas for individual training and determine the individual learning and training progress among in-patient therapy groups (e.g. group speech therapies).

By actively integrating the patient into the therapy and asking them to assume responsibility, the active contribution of the patients to their rehabilitation is increased. Working on their own, rapidly identifying their individual training needs, and adapting the therapy to those needs will also be able to increase the efficiency of training in group sessions. Post-operative in-patient treatment periods will be shortened and costs saved. In addition, patients' communication will stabilize much faster and thus reduce the risk of social exclusion.

The users of the training system can be divided into three groups: First, there are people with severe hearing impairments with associated language development disorders, who, with a cochlear implant, are receiving for the first time a hearing device that works for their needs. These patients will have acquired errors in pronunciation, as they experienced hearing loss because they had to speak without auditory feedback and their phonological discrimination had been limited. The second user will be those patients who have suffered an acute loss of hearing after having acquired spoken language, for example, through such neurological disorders such as meningitis. Here, the focus will be on fast training of the patients' listening skills to prevent speech impairment. The third group of users will be speech therapists and physicians who will use the data collected by the automated training system for their own diagnostics and to create individually tailored treatment plans.

Funding

Federal Ministry of Education and Research (BMBF)

Project Partners

HörTech gGmbH

Hörzentrum Oldenburg GmbH

Hearing, Speech and Audio Technology Project Group,
Fraunhofer IDMT

Evangelisches Krankenhaus Oldenburg

Bochum University of Health (Prof. Kerstin Bilda)



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For the study, 15 adults between the ages of 25 and 55 were invited to measurements taken in the Sound Technologies Lab at Fraunhofer IDMT in Oldenburg.

Fraunhofer IDMT study shows Soundbar reduces effort required to hear

The Fraunhofer Institute for Digital Media Technology IDMT in Oldenburg has compared the speech intelligibility and the sound quality of the Samsung Smart TV (Model No. UE65MU6179UXZG) and the Samsung Soundbar (Model No. HW-MS650) in a study commissioned by the manufacturer. The results show that the use of the Soundbar significantly reduces the effort required to hear programming compared to using the TV's speakers alone.

"If speech and background noise are equally loud, then the subjectively perceived effort to hear the sound is 15% with the Soundbar compared to the Smart TV," explains Dr. Jan Rennies-Hochmuth, Head of the Personal Hearing Systems Group at Fraunhofer IDMT. The target variables measured included the subjectively perceived speech quality, speech comprehension, effort required to hear, and general sound quality. The investigation was supported by Hörzentrum Oldenburg GmbH.

Kai Hillebrandt, Vice President of Consumer Electronics at Samsung Electronics GmbH, explains the relevance of speech intelligibility for the TV market: "With the increasing diversity and popularity of streaming offerings, viewers' needs and their demands for good sound are also changing. So we wanted to explore the question of whether viewers watching long, action-packed series and movies could follow the action in a more relaxed way with our Soundbar compared to watching the show with sound only coming through the TV's built-in speakers. With the Fraunhofer IDMT and the Hörzentrum Oldenburg, we have found competent partners to answer this ques-

tion with well-founded science. The experts at the Institute have specialized in exactly such applications."

For the study, 15 adults between the ages of 25 and 55 were invited to measurements taken in the Sound Technologies Lab at Fraunhofer IDMT in Oldenburg. The study consisted of two evaluation phases. First, the level of effort required to hear was determined using the ACALES measurement method developed by Hörzentrum Oldenburg. Second, the sound quality of the TV and of the Soundbar was evaluated with the help of a questionnaire.

Sound Technologies Lab

The Sound Technologies Lab at Fraunhofer IDMT in Oldenburg is a smart home environment used to evaluate new technologies and operating concepts together with partners from industry and research. The laboratory is certified per DIN 18041 "Acoustic Behavior in Small to Medium Rooms." In the Sound Technologies Lab, acoustic localization and speech and event detection technologies are used to simulate different application scenarios. The control of multimedia, lighting, and home technology via speech are standard here as is acoustic speaker localization. In addition, intelligent sound monitors and emergency call systems can be tested and demonstrated here.

European Federation of Audiological Societies (EFAS) meets in Interlaken

For the first time in ten years, the top meeting of European audiologists was held in a German-speaking country. The conference venue Interlaken provided an appropriate framework for the scientific event, which covered a broad spectrum of topics from basic audiological research to hearing diagnostics to rehabilitative audiology with conventional and implantable hearing aids. The influence of German-speaking audiology was not only reflected in the increased attention paid by the attendance of more than 450 conference participants, the largest group of which came from Germany. It was also reflected in the fact that German-speaking audiology, in particular, the Hearing4all Cluster of Excellence was extensively represented at the plenary lectures, the structured sessions, and the free contributions, a development that would have been far from predictable when EFAS was founded twenty years ago.

The pre-conference symposium "Hearing4all: Developments from the Cluster of Excellence in Audiology in Europe" provided information about the most important results of the DFG-funded Hearing4all Cluster of Excellence. The Spokesperson for the Cluster, Prof. Birger Kollmeier (University of Oldenburg) first gave an overview of the cluster's global goals in the three research areas of diagnostics, hearing aids, and assistive audio technologies. He mainly emphasized a framework for precision audiology, which makes it possible to make very accurate, individualized predictions of the results of auditory per-

ception experiments, in particular speech intelligibility. Prof. Andreas Büchner (Hannover Medical School) then reported on the major medical and technical advances in the provision of cochlear implants and other implantable hearing aids, proudly announcing that the first auditory brainstem implant was successfully implanted in Hannover at the beginning of June. In her lecture on multilingual matrix tests, Dr. Anna Warzybok (University of Oldenburg) pointed to the very high international comparability of these sentence tests, which are now available in over 17 languages. In the last lecture, Prof. Simon Doclo (University of Oldenburg) reported about the algorithmic and technical breakthroughs in hearing aids and hearables, in particular with respect to binaural algorithms for the suppression of background noise and reverberation, voice controls using deep neural networks, and a novel, acoustically transparent ear piece for hearing aids.

Another highlight for German audiology was the election of Oldenburg physicist and physician Prof. Dr. Dr. Birger Kollmeier as the incoming president of the European Federation of Audiological Societies (EFAS). In the past six years, Kollmeier has already helped shape the work of the federation as its secretary general. The Oldenburg researcher will now be a member of the EFAS board for another six years. In two years, he will assume the office of President, and after another two years as past president, he will fill the role of advisory board member.



Room acoustics can be planned

Dr. Nocke, the fact that noise, especially in open-space offices, has an effect on employee health and well-being, was already explained to us by Dr. Markus Meis in the last issue. But how do you know if the acoustics in a room are good or bad?

Nocke: Good or bad are not really the right terms for the acoustics of a room. The acoustics of a room mean its suitability for certain sound performances. Music basically requires something different than speech, for example. And, in terms of speech, a large multi-person office or open-space office has different requirements than a meeting or conference room. The individual assessment and perception of the acoustics in a space is a process influenced by many technical as well as subjective factors. Physics, psychoacoustics, architecture, interior design, and the furnishings all contribute to whether the acoustics of a room are successful and ultimately fit for purpose.

Is it possible to measure these factors and then plan accordingly?

Nocke: Generally yes, even if it is still widely assumed that room acoustics cannot be planned. Smaller and simply structured rooms, i.e. most of the spaces we live our everyday lives in, can generally be evaluated and planned with sufficient accuracy based on the reverberation time. Measurements are always possible if the room already exists. However, sufficiently accurate methods do exist for planning. While a multi-person office with many workstations, technical fixtures, and equipment might justify the use of a three-dimensional simulation program similar to that used for concert halls and opera houses, most everyday spaces can be calculated roughly and yet accurately enough using the well-known Sabine reverberation formula. There are also some basic rules to consider for the arrangement and distribution of sound-absorbing surfaces.

What kinds of measures make it possible to optimize a room's acoustics?

Nocke: Listing all of the possible measures would certainly go beyond the scope here. What's important is the way all of the elements interact. In addition to classic acoustic ceilings made of various mineral fibers, sound absorbers in the form of murals, furniture, lamps, and other furnishings are now commercially available. Floor coverings have also helped a lot in recent years; special acoustic carpets with special felt pads are now available, for example. Sound-absorbing cabinet fronts, lighted ceilings that absorb sound while creating the room's ambience are just some of the latest developments. However, acousticians often do not consider which materials and which measures to use. Design and budget considerations are often too much in the foreground.

There are all kinds of different types of offices. For example, in a large office, do other aspects need to be considered than in a smaller office?

Nocke: Especially in multi-person offices, sound isolation and zoning are important issues. Unlike in performance rooms or lecture halls, the goal is not to provide a listener with direct sound, but instead an adequate reduction of the direct proportion of sound. The optimization seeks to reduce speech comprehension, which may seem counterintuitive, but psychoacoustics has been saying for quite some time that the real annoyance in offices is caused by unwanted overhearing and comprehending what others are saying. But no matter if it's a single office or an open-plan office: an optimally balanced room acoustics creates added value for all sides!

Are there other areas in the work environment in which the room acoustics play a role?

Nocke: Apart from production facilities, workplace canteens are also very important for the well-being of employees, especially at lunchtime. Not only are healthy and balanced meals needed here, but also a "listening-friendly" atmosphere. To ensure this, every employer and client needs to bring in acoustic professionals. Only if the room acoustics are optimal will the workforce find the necessary break from the stresses of the job. All in all, this investment can be seen one-to-one in the sales figures.

www.forum-office-acoustics.com



As a manufacturer-independent acoustics expert, Dr. Christian Nocke (Akustikbüro Oldenburg) together with Dr. med. Markus Meis (Hörzentrum Oldenburg GmbH) leads Forum Office Acoustics.

Kai Siedenburg, from the Signal Processing Working Group of the Department of Medical Physics and Acoustics at the University of Oldenburg.



Double success for Kai Siedenburg in musical signal processing

Kai Siedenburg, from the Signal Processing Working Group of the Department of Medical Physics and Acoustics at the University of Oldenburg, has had two sets of good news in recent months. He first received the Best Paper Award at the 20th International Conference on Digital Audio Effects in Edinburgh, Scotland. In his paper, he developed an algorithm for separating transient and stationary signal components, making it possible to separate certain "signal molecules" from others. This tool allows questions about the perception of sounds to be addressed with a higher acoustic resolution than before. Siedenburg is particularly interested in the role of transient components in the identification of musical instruments. However, the algorithm as such is also useful for many other audio applications.

A very special success for Siedenburg, however, was receiving a Marie Skłodowska Curie Grant for his project "TIMPANI: Test, Predict, and Improve Musical Scene Perception of Hearing Impaired Listeners", a part of the European Commission's Horizon 2020 Framework Program.

Music is an integral part of human social life and has a positive effect on cognitive performance, social cooperation, and physical and emotional well-being. Despite recent advances in hearing technology, listening to music remains a challenge for many hearing-impaired people. At a classical concert, for example, the majority of people in the audience are usually over 50 years old. An increasing proportion of these music lovers are using hearing aids to optimize their speech perception. How does their changed hearing affect their experience of the music? Are they still able to follow a solo violinist or to hear a voice when accompanied by an orchestra? Since one in two people over the age of 65 are affected by hearing loss, with an even higher prevalence among musicians, we need to better understand the consequences of hear-

ing impairment for music appreciation. At the same time, there is a growing demand for high quality listening to music with hearing aids beyond current music programs. The main goal of the TIMPANI project is to test the effects of hearing loss on music perception skills and to develop sound processing algorithms for better listening to music with hearing aids.

In both speech and music perception, the hearing system breaks down tones that overlap in time and frequency into different perceptual events and streams, a process referred to as auditory scene analysis (ASA). People with hearing loss suffer from severely impaired ASA. Although the central role of ASA in the musical experience is widely recognized, e.g. in picking out sounds from multiple instruments or the melody line in singing or accompaniment, the role of hearing loss in musical scene perception remains largely unexplored. At the same time, hearing aids are typically intended for speech perception, not music perception. Given this transdisciplinary approach that uses methods from music perception, auditory modeling, and signal processing, TIMPANI aims to test, predict, and improve the musical scene perception of the hearing impaired. First, a series of music perception tasks will be designed to assess the effects of hearing loss on the listener's ability to perceive the musical scene. Second, an auditory model will be developed to predict how people with normal hearing and people with hearing impairments will do on a series of ASA tasks. Finally, algorithms for intentional music mixing will be developed to improve the music perception of hearing device users. This research addresses the H2020 challenges to better serve the changing demographic and general well-being in European societies. The increase in hearing loss requires scientific and technological breakthroughs to include the hearing-impaired in the cultural resource of listening to and making music.

DIRECTIONAL FILTER





Audio PSS: launch of BMBF project for the development of remote audiology product service systems

Declining hearing is one of the most common functional limitations in old age. It represents a significant restriction on communication and social participation for those affected and can lead to dramatic changes in the senior's health and quality of life. Modern hearing aids provide assistance, but require weeks of stressful adjustment. All of those sounds that users had not heard for a long time are suddenly perceptible again. Using the device use in different listening situations is initially new and unfamiliar. Often users do not experience hearing success, which explains the high dropout rates (> 30%). To solve this problem, manual hearing aid fittings are performed as part of acclimatization stages.

Current, networked hearing systems, which connect the hearing aid to smartphones, are providing new solutions to this issue, but are also leading to fundamental changes to traditional business models for hearing aid acoustics. The digitalization of services creates special opportunities and risks for the healthcare sector. The active involvement of patients in health care and prevention and an increased orientation of processes on patients are key factors in ensuring a successful and efficient healthcare system over the long term. As a result, a wide range of digital health data is now available. These range from activity data for individual prevention and fitness to implanted and networked medical devices. What these technologies have in common is the trend towards networking with external services, which is an important, new feature and also applies to established devices (e.g. hearing aids).

The aim of the Audio PSS project is to establish a platform for hearing aid-associated sensor technology based on the experience gained in the development of telemedicine concepts and the technical progress made in recent years in the field of hearing systems. This should make it possible to implement and test data-driven product service systems, as well as to develop further concepts

for the use of this data for services outside of the health care market (cross-industry innovations). The validation of such data-based services should help hearing device professionals further develop their profession. The field of hearing device professionals represents an opportunity not only to deal with digitalization, but also to ensure long-term viability through digital business models.

Based on the users' experienced listening situations and experiences of other users, hearing aid wearers are supported in the acclimation and in long-term use of the devices at all times and in all places. In addition, additional services can be realized. For example, restaurants and cultural sites with good acoustics could be listed and noise maps can be created for environmental research or urban planning. Using the example of hearing aid acoustics, the project demonstrates how the digital transformation can be successfully shaped through personal service offerings.

The acceptance and comfort of modern hearing systems for the hearing impaired will be increased, while new business models for the hearing aid industry are under investigation.

Funding

Federal Ministry of Education and Research (BMBF)

Project Partners

Christian-Albrechts-University Kiel, Chair of Technology Management

KIND Hörgeräte GmbH & Co. KG

audifon GmbH & Co. KG

HörTech gGmbH

OFFIS e. V.

Project duration

August 2017 to July 2020

Hearing4all clears first hurdle on the way to its successor program

The University of Oldenburg, the Hannover Medical School, and the Leibniz University of Hannover have cleared the first hurdle within the framework of the Excellence Strategy, the successor program to Germany's federal/state Excellence Initiative. The Cluster's application "Hearing4all: Research for personalized treatment of hearing deficits" has been positively evaluated. The Oldenburg and Hannover hearing researchers collaborated on the application, based on the results of the existing Cluster of Excellence.

The full application must now be submitted to the Deutsche Forschungsgemeinschaft by February 2018 and an international commission will make final grant decisions in September 2018. Altogether 88 of the 195 preliminary applications submitted cleared this hurdle. "This positive news is a great success for our university. The Deutsche Forschungsgemeinschaft and the Science Council are acknowledging the outstanding work of our Oldenburg audiologists. Now it's up to us and our strong partners to use our scientific expertise to meet our ambitious goal and work intensively on the full proposal," says University of Oldenburg President, Prof. Dr. Dr. Hans Michael Piper.

"In the current Cluster of Excellence, we have developed important building blocks for better diagnostics, hearing systems, and assistive technologies," says the Spokesperson for the Cluster, Oldenburg-based physicist and physician Prof. Dr. Dr. Birger Kollmeier. "We are now using these results to develop solutions specifically tailored to the needs of those affected by all forms of hearing impairment. We are thus coming from an empirical, subjective approach to modern, data-driven science and precision medicine with a high standard." Clinical spokesperson for the planned cluster will be Prof. Dr. Thomas Lenarz, Director of the ENT Clinic at Hannover Medical School.



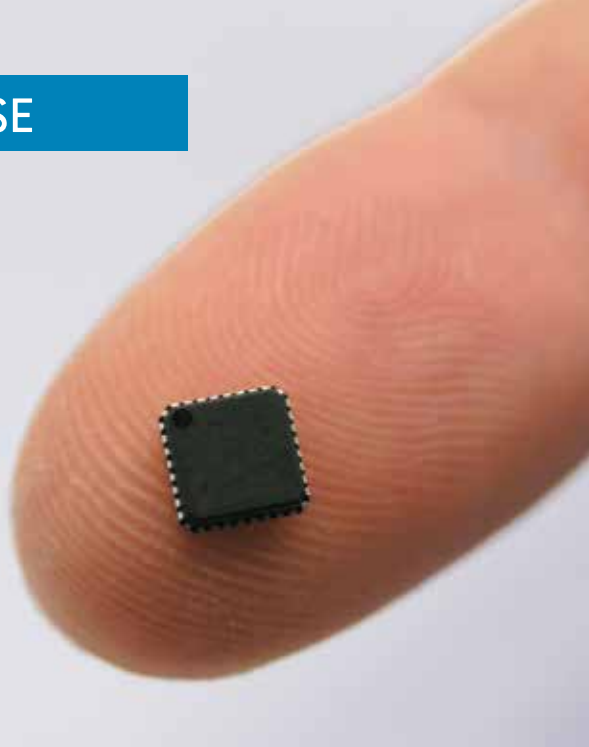
In the future, the audiologists want to bundle their work into four research strands that will, on the one hand, map the development chain from basic research to hearing technology and, on the other hand, map the severity of hearing impairment. The first strand will use modern neuroscientific methods to better understand the complex interplay between hearing, perception, and processing in the brain as it plays out over a person's lifetime. The second will involve IT-based research aimed at building a virtual multilingual hearing clinic. In the third strand, the researchers will develop individually targeted diagnostic and treatment procedures for patients with moderate to severe hearing loss and for patients who are completely deaf. Based on these scientific and technical findings, the fourth strand will create fundamentally new system technologies for the hearing aids of the future.

The currently planned project involves 25 leading neuroscientists, physicians, psychologists, linguists, phys-

icists, and engineers from the Universities of Oldenburg and Hannover as well as the Hannover Medical School. In addition, Jade University, HörTech gGmbH, the hearing centers in Oldenburg and Hanover, the Fraunhofer Project Group for Hearing, Speech and Audio Technology, and Fraunhofer ITEM are project partners. Hearing4all is one of the world's leading centers in medical technology, hearing research, audiology, medical diagnostics, and therapy. About 80% of all hearing aids in use around the world are based on research conducted in Oldenburg. The current Cluster of Excellence was among the winners of the Excellence Initiative in 2012 and has since received almost €30 million in grant funding. In addition, the Lower Saxony Ministry of Science and the Volkswagen Foundation have provided the Cluster with €1 million in funding.

About the Excellence Strategy:

With the Excellence Strategy, the federal and state governments in Germany want to continue and further develop the university-based projects funded with the Excellence Initiative between 2005 and 2017. Specifically, it promotes top-level science, building reputations and research cooperation in order to strengthen Germany as a center for research excellence. There are two funding lines: The Cluster of Excellence and Excellence Universities. The funding for Clusters of Excellence will begin January 1, 2019 for a term of seven years.



The chip has an area of about 3.5 mm².

Small but powerful – The KAVUAKA hearing aid processor

Continuous research and new technological developments are making signal processors for digital hearing systems increasingly more performant and energy-efficient. This facilitates the use of novel, computationally intensive algorithms for effective signal processing. The hearing aid of the future will become more intelligent, for example, by recognizing and filtering out relevant speakers from complex acoustic environments to further improve the user's individual hearing ability. In order for such a hearing aid system to provide the required computing power under such limiting factors as low battery life and the necessary small form factor of such devices, the Hearing4all Cluster of Excellence has explored how to design and optimize the processor architecture of a hearing aid system based on algorithms.

The KAVUAKA hearing aid processor developed in this project is a so-called application-specific instruction set processor (ASIP). The generic base processor architecture has been adapted and optimized based on the algorithms developed in the Cluster. The adaptation was achieved by inserting complex, adapted instructions into the basic instruction set. Noteworthy enhancements include a multiplication-addition unit that can handle both real and complex numbers, architectures designed to counter losses in power when listening to different registers, and a low-latency audio interface. During the development phase of the KAVUAKA, many design space investigations were carried out with the help of simulations in an effort to apply various algorithms to optimize the processing power and reduce power loss. It was shown that KAVUAKA calculates more efficiently than comparable hearing aid processors. Since the computing power,

power loss, and chip size can be optimized in different ways depending on the priorities set, this project developed a system-on-chip (SoC).

The SoC offers four different optimizations of the KAVUAKA processor. These can be activated separately or simultaneously in order to increase the computing power or minimize loss in performance. To avoid flaws in the architecture, the SoC was tested under real conditions with the Cluster's algorithms by connecting the SoC to dummy hearing aids and simulating typical listening situations.

In this case, the entire SoC was emulated using a rapid prototyping system and coupled with the Cluster's in-house hearing aid development platform in order to test the overall functionality. To prepare the SoC as a chip, it can be tested with the development platform and dummy hearing aids in battery mode. The development platform offers a Bluetooth interface for wireless communication with the hearing aid via smartphone or tablet. In this way, the algorithms, for example, can be controlled. There is also the possibility of calculating the processor's current power consumption during its operation.

In the final phase of the project, the SoC with the four KAVUAKA processors will be manufactured as a chip. The chip technology used has been designed for low power dissipation and has a structure size of 40 nm. The chip has an area of about 3.5 mm². The power consumption will be just a few thousandths of a watt. The research carried out in this project and their future usefulness for hearing aid processors can be seen in the chip as a finished product.



"MusIC 3.0:" Hearing4all Cluster of Excellence making music pleasurable for CI users

Another concert especially for CI users: that's exactly what the Deutsches HörZentrum (DHZ) at Hannover Medical School is currently preparing together with Hannover University of Music, Drama and Media (HMTMH) and Hörregion Hannover. After the great success of 2015, the concert is now titled "musIC 3.0" and took place on Friday, December 1, 2017 at 6 pm in the Forum Sparkassenverband in Hannover. The concert was conceived by Professor Waldo Nogueira from the Deutsches HörZentrum (DHZ) at Hannover Medical School and the Hearing4all Cluster of Excellence. The world premiere took place four years ago in Barcelona and the second concert was held in Hannover in 2015 (then called "musIC 2.0").

More than 30 years' clinical experience with the auditory prosthesis known as the cochlear implant (CI) has proven how well speech can be understood. Music, however, remains a challenge for many CI users and therefore has received more attention in research. "With the musIC 3.0 project, we once again want to create music that is a pleasure for people with and without cochlear implants. We also expect to find out how we can improve the technology to allow us to transmit this complex system of music with elements such as tone, interval, melody, rhythm, harmony, and the individual sounds of the instruments so that CI wearers can enjoy it," explains Initiator Prof. Waldo Nogueira of the ENT Clinic at Hannover Medical School. ENT Clinic Director Prof. Lenarz and Prof. Nogueira found a welcome audience for this initiative back in 2015. A group of about 25 CI wearers quickly coalesced to work with the composers in workshops for three afternoons. This year's workshop group has also received considerable interest. Once again, the project benefits from the fact that the group is made up very different in-

dividuals, ranging from amateur musicians to those who know little about music.

The title of the concert has been chosen deliberately: "As with Web 2.0, which is a new stage in the evolution of the World Wide Web, we think that we need new music that is suitable for listening to with CIs. Our project also relies on the collaboration of CI users and musicians," says Prof. Nogueira. Both groups work together to identify which sounds, instruments, tone sequences, and pitches can be identified well by CIs. The CI users are thus shaping the compositions significantly. In addition, the title "musIC" contains the letters IC referring to the cochlear implant. The addition of "3.0" takes into account the fact that the musIC is strongly influenced by technology.

All CI users, family, and friends as well as music enthusiasts and other interested parties were invited to the musIC 3.0 concert, which took place on Friday, December 1, 2017 at 6 pm in the Forum of the Sparkassenverband at Schiffgraben 6-8 in Hannover.

Admission to the concert was free, but due to the limited number of seats, tickets had to be reserved in advance. Please contact Daniela Beyer of the ENT Department at Hannover Medical School, beyer.daniela@mh-hannover.de, Tel. +49 (0) 511 532 3016.

Understanding hearing: models and diagnostic methods for the hearing systems of the future

Audiology is rooted in both medicine and the life sciences, as well as engineering and the natural sciences. It is precisely at this interface between empiricism and exact, theory-driven science where the Hearing4all Cluster of Excellence is driving research. Just as with the successful interaction between experimental, theoretical, and applied physics which set the pace for science in the last century, the interplay between hearing experiments, hearing models, and their application to hearing systems is intended to create the breakthrough for functional "hearing systems for the future." At the same time, the sound models developed in the Cluster interact at very different levels of description.

Dr. Go Ashida (of the Kretzberg working group) is addressing the behavior of the neurons in the auditory nerve, the brainstem, the midbrain and cortex when stimulated with defined acoustic stimuli, to find out which cellular properties and mechanisms are responsible for the fact that our brain can reach such a high spatial resolution for different sound incident directions. This highly accurate description of neuronal representations of acoustic signals is also important for coding and customizing implantable hearing systems such as cochlear implants. The Nogueira working group, for example, is developing optimal patterns for direct electrical stimulation of the auditory nerve with cochlear implants, with the goal of producing a natural hearing impression for CI users, even for music!

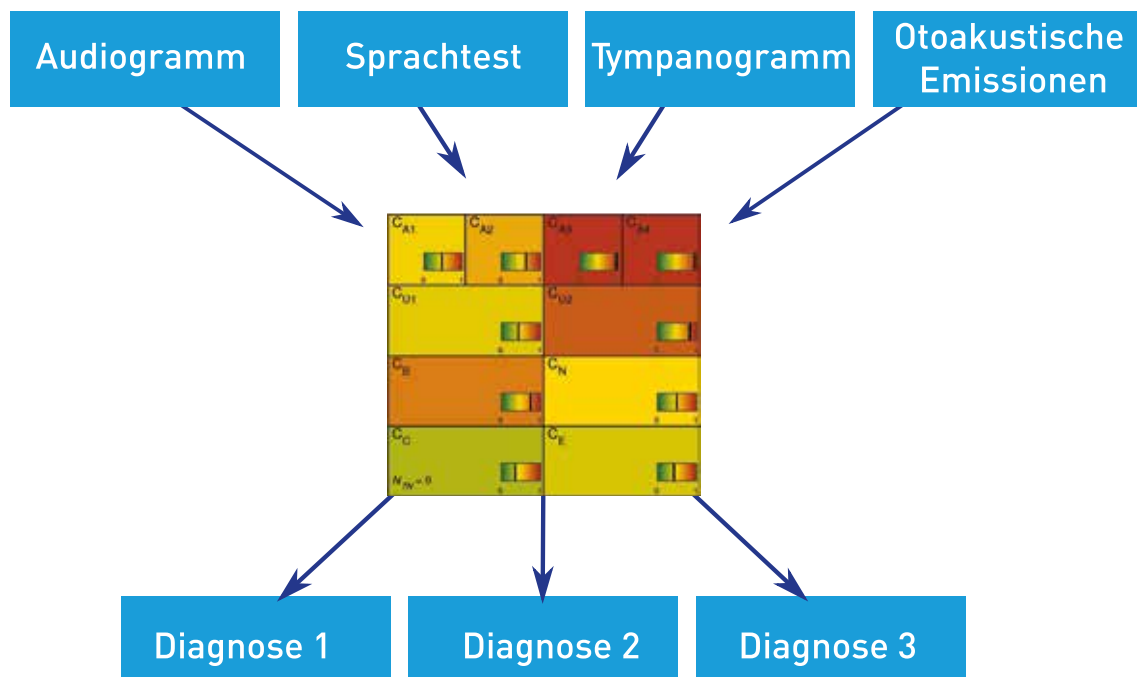
By contrast, "effective" models of auditory signal processing, in which sound processing in the ear is accompanied by a series of nonlinear processes of human physiology, psychoacoustics, and audiology, aim less at exact neuronal coding than an exact description of human perception. These "effective" models thus describe the overall function of the human hearing system without modeling each individual neuron or neuron group. They are particularly well suited for later integration into an intelligent hearing aid or hearing implant. Dr. Thomas Brand and doctoral student Christopher Hauth (of the Kollmeier working group) are investigating specific binaural signal processing, i.e. how the brain processes incoming auditory signals from the left and right ears, suppressing background noise, and intentionally amplifying useful sounds for better speech intelligibility. This is partly based on physiological hearing function models developed by Dr. Mathias Dietz, now of the University

of Western Ontario in Canada. These models developed while Dr. Dietz was in Oldenburg are already being integrated into hearing aids to help users automatically differentiate the direction of different speakers.

In order to be able to describe the different hearing model approaches and the reaction of the human hearing system to different acoustic signals (speech, noise, test tones, but also environmental sounds and music), a special integration effort is needed. A large research network such as the Hearing4all Cluster of Excellence provides the best conditions for such work. The FADE model (Framework for Auditory Discrimination Experiments), developed here largely by Junior Professor Marc René Schädler to combine elements from psychoacoustics, speech perception research, and automatic speech recognition with machine learning, covers a whole range of hearing functions with the same model approach based on just a few, generally accepted hearing principles with astonishingly high accuracy. For example, the hearing loss experienced by the individual patient in the inner ear can now be divided into several components, each of which has a specific influence on hearing and require different rehabilitation strategies. Attenuation loss can be compensated with frequency-dependent amplification. The distortion effect, which is a restriction of the dynamic range with a simultaneous deterioration of the intensity resolution, can now be measured as internal noise or volume uncertainty for each patient. In addition, there are also the binaural components of hearing mentioned above and the associated loss of this interaction between the two ears. The hearing aid of the future will be able to compensate for all of these different functional components.

But how precisely can we diagnose these individual components of hearing loss? For this purpose, new clinical diagnostic procedures, such as the Oldenburg Sentence Test against background noise, or binaural volume scaling, are being combined with a number of other clinical audiological measurement methods and statistically evaluated with clinical diagnostic models.

Doctoral students Meike Thaden and Anja Gieseler (of the Colonius and Thiel working group) are identifying those components showing the greatest differences in audiological findings in a large clinical sample of patients. These components should be measured as accurately



CAFPAs a IT-based method to assist doctors in diagnosis and treatment

as possible since they will be the most important components of future hearing diagnostics.

The Büchner working group has taken a similar approach. A paper by Dr. med. Sabine Haumann has shown that it is even possible to predict the success of a cochlear implant operation and subsequent rehabilitation measures in adults not only based on a few pieces of audiological accurate measurement data, such as hearing in background noise before surgery, but also the socioeconomic background of the patient.

In order to achieve precision audiological medicine over the long term, with exact, individualized diagnostics and the combination of incomplete audiological data from different clinics into a Big Data concept, doctoral student Mareike Buhl (of the Kollmeier and Lücke working group) is tracing the new CAFPA concept (Common Audiological Functional Parameters). CAFPAs will use a few, meaningful intermediate variables to obtain a universal, compact representation of audiological findings from a wide variety of data sets. It will then serve as the basis for targeted hearing diagnostics, recommendations, and predictions of success for a specific treatment such as a prescription for a hearing aid.

Overall, in the individual areas of neuronal, "effective", speech intelligibility-related, and diagnostic hearing modeling, hearing modeling has made significant progress during the first phase of Hearing4all's work. With the FADE framework, we are even on the threshold of being able to offer a universal, and precise predictive system for clinical hearing diagnostics. However, this is only the beginning for the development of better hearing aids.

The medium- to long-term goal of the Cluster is to integrate all of these modeling developments into intelligent, situation-adaptive, and individually adaptable hearing solutions, which will function according to the "Model in the Loop" principle. They will be able to predict the next steps to be taken by the hearing aid to serve the user's needs based on the specific hearing situation. For such hearing systems of tomorrow, the hearing models being developed and validated today are indispensable prerequisites, together with the associated hearing diagnostics.

Summer School of the Joint Research Academy

The annual summer schools of the Joint Research Academy in Biomedical Engineering and Science of Hearing and Sensory Systems (JRA) are aimed at helping junior researchers in the Cluster to create networks and engage in interdisciplinary cooperation. Young researchers such as doctoral students and recent graduates will not only be able to present and discuss their own research work, but will also be actively involved in the organization and design of the event. Each year, the Leibniz University of Hannover, the Hannover Medical School, and the University of Oldenburg invite a team of six young scientists to organize the summer school program for the following year.

The highlights of each summer school are the lectures by top-class international scientists from the various research areas represented in the Cluster of Excellence followed by discussion groups. The international scientists are selected by the organizing team on the basis of popularity surveys/wish lists completed by the doctoral students. They are then invited to the event and personally accompanied on-site. With their lectures, they give insight into their individual research work. They are also available for the discussion groups, joint projects, and evening events, giving the junior scientists the opportunity to make direct contact and exchange ideas. Lon-

ger-term contacts, future collaborations on research projects, or mentoring relationships are all possible goals of this event.

The experienced scientists from the Cluster of Excellence also contribute to the success of the event. Professors give tutorials on their specific topics in which the summer school participants are actively involved. Junior professors and more experienced postdoctoral researchers present their work areas in order to give all young scientists an overview of the entire spectrum of research activities within the Cluster. And, for the first time this year, a former colleague will be presenting his work. This reflects a desire to highlight the work of alumni, to show the young scientists other career options outside of academia, provide relevant contacts, and thus contribute decisively to their career development.

With their own contributions, such as highlight talks and poster sessions, doctoral students and postdocs also get to present their own research, engage in conversation with one another, and plan new collaborations.

Each year, a "soft skills" event is also offered as part of the Summer School to give young scientists an insight into the importance of interpersonal skills. Topics for the Summer School are selected using wish lists. For example, there have already been workshops on "Scientific Presentations," "German Sign Language," and "Debating."

The social events during the Summer School provide a common framework and an opportunity to relax in the evenings. Barbecues, paddling, or bike rides help seal not only new research ideas, but also new friendships.



Events and Training at Auditory Valley

November 4, 2017

Consensus Meeting on Auditory Implants, Hannover International Workshop for invited experts For questions, please contact Mueller.Regina@mh-hannover.de

November 6–8, 2017

International Congress on Biomedical Engineering, ENT Clinic (Hannover Medical School) and Leibniz University of Hannover

November 10, 2017

HörTech Seminar: "Basics of hearing loss" for health-care professionals and caregivers This seminar will help participants to identify hearing loss and address hearing loss, hearing aids, and assistive technologies. www.hoertech.de

November 29, 2017

Information Event "It's in the genes: Hereditary Hearing Loss." Deutsches HörZentrum Hannover

December 1, 2017

"musIC 3.0": A concert especially for CI users
All CI users, family, and friends as well as music enthusiasts and other interested parties are cordially invited to the musIC 3.0 concert, which will take place on Friday, December 1, 2017 at 6 pm in the Forum of the Sparkassenverband at Schiffgraben 6-8 in Hannover. Admission to the concert is free, but due to the limited number of seats, tickets must be reserved in advance. Please contact Daniela Beyer of the ENT Department at Hannover Medical School, beyer.daniela@mh-hannover.de, Tel. +49 (0) 511 532 3016.

December 4, 2017

Test Listeners Café, Haus des Hörens, Oldenburg

December 5, 2017

Patient University: "Getting the right scent: what our noses do for us every day" More information at <http://www.patienten-universitaet.de>

December 18, 2017

Test Listeners Café, Haus des Hörens, Oldenburg

January 18- 20, 2018

HörTech Seminar "Intensive Audiological Technologies for Beginners"

The aim of this intensive course is to provide an overview of the methods and procedures used in this field and to promote understanding of the most important problems and conditions. The knowledge serves as a comprehensive and competent introduction to the subject for new employees of hearing aid, CI, and measuring device manufacturers, among others. Further information: www.hoertech.de

February 2, 2018

Winter plenary meeting of the Hearing4all Cluster of Excellence in Bremen

February 28 - March 2, 2018

21st Annual Meeting of the German Society for Audiology (DGA) in Halle

The topic of the conference "Hearing: from sound-waves to cognition" builds a bridge from fundamental basic signal theory to subjective and objective audiological diagnostics to cognitive aspects of hearing processing and perception. It also reflects the research focus in epidemiology and healthcare research of the medical school going back more than 500 years. www.dga-ev.com

March 8- 10, 2018

HörTech Seminar "Compact knowledge for audiometrists"

March 11-16, 2018

Winter School of DGMP and DGA on Audiology in Pichl, Austria

Information at www.dgmp.de

March 20-22, 2018

DAGA 2018: Annual Conference of the German Society for Acoustics in Munich. www.2018.daga-tagung.de



Auditory Valley offices

The offices act as the contacts and coordinators for all Auditory Valley work. The offices have a broad range of tasks as active coordinators and points of contact for Auditory Valley. The team of staff from HörTech gGmbH and the Hanover Medical School research topics and trends, bring innovative minds together, determine Auditory Valley's strategic orientation, make sure the activities have a focus and work to give the region's expertise a clear profile.

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