AkuNet

Marts 2007

Nyhedsbrev

Nyt fra huset

Af Dorte Hammershøi, sektionsleder, Akustik, AAU

Reorganisering

I forbindelse med implementeringen af den nye universitetslov er der gennemført en række ændringer. For Afdeling for Akustik, AAU, har dette som en del af navne-harmoniseringen betydet et farvel til titlen som afdeling under Institut for Elektroniske Systemer. På engelsk hed vi Department of Acoustics at Institute of Electronic Systems, hvilket var misvisende ift. andre AAU institutter, som var oversat til Department of ... Derfor hedder Institut for Elektroniske Systemer i dag Department of Electronic Systems, og afdelingerne er afløst af ialt 8 sektioner. I Sektion for Akustik (Section of Acoustics) er vi stort set samme medarbejderstab som i den tidligere Afdeling for Akustik, dog kan vi hilse velkommen tilbage til Per Rubak, som efter nogle år i søstermiljøer nu igen er at finde blandt akustikerne.

Per Rubak

Reorganiseringen er desuden fulgt af et vagtskifte blandt lederne, som ligger i forlængelse af rektor- og dekanudnævnelserne. Børge Lindberg er i dag institutleder, og undertegnede er sektionsleder for Akustik (ja, undskyld, det er det, vi hedder til daglig, og det er svært at vænne sig til sektionsbetegnelsen).

Udadtil er meget lidt ændret. Sekretariatet har samme bemanding, telefonnr. etc, og teknisk support er også uændret. Der er implementeret en ny webside for instituttet, og på et tidspunkt vil acoustics.aau.dk komme til at pege på de nye sider. En fuldstændig præsentation af arbejdsområde, ansatte, projekter og publikationer kan alternativt ses på Videnbase Nordjylland (vbn.dk).

Projekter

Et par nye projekter er startet op i efteråret. Det ene projekt vedr. støj fra vindmøller er et samarbejde med DELTA og partnere fra vindmølleindustrien, og ledes af Henrik Møller. Det andet projekt vedr. multimodale grænseflader er et europæisk samarbejde med 15 partnere, og ledes af undertegnede.

Uddannelse

For 2007 er der på uddannelsesfronten både godt og dårligt nyt.

Efter en række år med stabilt studenteroptag, har vi nu et 8. semester helt uden akustik-studerende. De årgange, vi rekrutterer fra, er i øjeblikket meget små, og regeringens beslutning om at kræve tuition fee for udlændinge rammer Acoustics hårdt. I en globaliseret verden med stor efterspørgsel på ingeniører er timingen for disse skridt snævert betragtet ikke heldige. I mellemtiden tilpasses både vores og andres uddannelser inden for EU de nye Bologna-regler, hvilket betyder, at det bliver lettere at krydse spor fra et universitet til et andet inden for Europa. Vi forventer, at vi allerede til efteråret vil se et resultat heraf.

Den nye uddannelse inden for Produkt og Design Psykologi (som handler om meget andet end lyd), kom flyvende fra start i efteråret. Godt en snes studerende fortsætter nu på 2. semester, og arbejdet har også givet mange vitaminer til de af vores medarbejdere, som med ildhu deltager i pionerarbejdet sammen med Institut for Psykologi. Det vil først om flere år vise sig, om vi har ramt rigtigt med profilen, men interessen synes i øjeblikket stabil.

På 10. semester har vi her i foråret i alt 12 studerende. De har valgt afgangsprojekter med følgende foreløbige titler:

Projekt: ***Loudspeaker Power Response***

Studerende: Lars Enggaard og Lars Juul Mikkelsen

Vejleder: Søren Krarup Olesen

Projekt: ***Tube Amplifiers vs. Solid State Amplifiers***

Studerende: Eric de Santis og Simon Henin

Vejleder: Per Rubak

Projekt: ***Determination of the Critical Band width at Low Frequencies***

Studerende: Carlos Jurado og David Robledano

Vejleder: Christian Sejer Pedersen

Projekt: ***"Nice noise" from Trucks***

Studerende: Casper Andersen

Vejleder: Miguel Angel Aranda De Toro

Projekt: ***Audibility of Magnitude and Phase Distortions in Audio Systems***

Studerende: Yesenia Lacouture Parodi og Anton Günther

Vejleder: Alex Karandreas

Projekt: ***Distance Perception***

Studerende: Fadl Mahmoud

Vejledere: Alex Karandreas og Flemming Chri stensen

Projekt: ***Headphone Sound Eposure and Hearing Thresholds***

Studerende: Beatriz Gutierrez Camarero og Irene Moledero Dominquez

Vejleder: Rodrigo Ordoñez

Abstracts

Præsenteret på Deutsches Gesellschaft für Psychologie, 17.-21. september 2006, Nürnberg, Tyskland:

Klangqualität und akustisches Design - Ein interdisziplinäres Forschungsfeld zwichen Wahrnehmungspsychologie und Ingenieurwissenschaften
Wolfgang Ellermeier, Karin Zimmer, Sound Quality Research Unit, Afdeling for Akustik, AAU

Das akustische 'Design' von Alltagsprodukten, die Bewertung der Wiedergabequalitaet von Audio-Systemen, die Gestaltung auditiver Benutzeroberflaechen und schliesslich die Realiserung kompletter 'virtual reality' Systeme sind Aufgaben, die nur unter Beruecksichtigung von Prinzipien der auditiven Wahrnehmung gelingen koennen. Insofern stellt dieser im englischen Sprachraum als ``sound quality engineering'' etikettierte Bereich ein relative neues Forschungs- und Arbeitsfeld für Psychologen dar, in welchem sowohl von universitärer als auch von industrieller Seite eine wachsende Nachfrage zu registrieren ist.

Die interdisziplinaere Aufgabenstellung verlangt offensichtlich gute Kenntnisse der Physik des Schalls, sowie seiner Erzeugung, Kontrolle und Messung. Weniger Einigkeit besteht darin, wie die durch die akustische Stimulation ausgeloesten Wahrnehmungsphaenomene zu erfassen oder gar quantitativ zu messen sind. Deshalb ueberwiegen in der angewandten Psychoakustik pragmatische ad-hoc-Methoden, welche vollkommen ignorieren, dass Messtheorie und Psychophysik ein wohlfundiertes Instrumentarium bereitstellen, subjektive Empfindungen zu messen.

Insbesondere haben sich Paradigmen aus der Begriffsanalyse (formal concept analysis, theory of knowledge spaces) als vielversprechend erwiesen [Wickelmaier & Ellermeier, Perception & Psychophysics (in press)], diejenigen Klangattribute, die in einem gegebenen Kontext ueberhaupt eine Rolle spielen, zu identifizieren und auf Konsistenz im Gebrauch zu ueberpruefen. Weiterhin konnte gezeigt werden, dass indirekte Skalierungsmethoden, die auf probabilistischen Modellen des Wahlverhaltens basieren, eine fundiertere, ueberpruefba-

re Messung der Auspraegung von Klangeigenschaften ermoeglichen, als die verbreiteten direkten Schaetzmethoden [Zimmer, Ellermeier & Schmid, Acustica/acta acustica, 90, 1019-1028 (2004)]. Dies wird an Forschungsbeispielen illustriert, insbes. (a) der Untersuchung der raeumlichen Klangattribute, die sich durch verschiedene Audio-Wiedergabe-Formate realisieren lassen, und (b) der Beurteilung der Qualitaet von Fahrzeug-Innengeraeuschen.

Es scheint, dass Fortschritt in diesem neuen Forschungsbereich kritisch davon abhaengt, ob sich die Psychologie als von Methode (Empfindungs- und Leistungsmessung) und Inhalt (auditive Wahrnehmung) einschlaegige Wissenschaft anbietet, und offensiv propagiert, dass an die subjektive Messung gleichermassen strikte Kriterien anzulegen seien wie an die objektive Messung der Stimulationsbedingungen.

Præsenteret på 12th International Meeting on Low Frequency Noise and Vibration and its Control, 18.-20. September 2006, Bristol, England:

Indoor measurements of sound at low frequencies
Steffen Pedersen, Henrik Møller, Kerstin Persson Waye, Søren Krarup Olesen, Afdeling for Akustik, AAU

Due to standing waves, the sound pressure level within a room may vary as much as 20-30 dB with low-frequency tonal noise, somewhat less with noise bands. For assessment of annoyance from low-frequency noise it is relevant to measure a level close to the highest level of the room, rather than a room average. As a means in this, current Swedish and Danish measurement methods include corner measurements. These positions are however still with some specified height and distance to the walls, and they may not effectively serve the purpose. Alternative measurement positions were investigated based on theoretical considerations and observations from numerical simulations. The performance of the methods in practice was studied by measurements in three rooms, while various low-frequency sounds were produced in adjacent rooms. The sound pressure level was measured in 1) the entire room by scanning, 2) corner positions specified by Swedish and Danish measurement methods, and 3) all three-dimensional corners. The level that is exceeded in 10% of the space in a room ($L_{90\%}$) was found to be a reasonable target for a measurement method rather than the absolute maximum. Good results can be expected with the Swedish method, as the Swedish corner position is obtained by scanning and yields levels close to the target; however there are serious concerns regarding the use of C-weighting in the scanning. With the Danish method, good results can only be expected, if complainants can accurately appoint measurement positions, since the corner position in this method generally fails to represent the high levels in the room. As an alternative method, it is proposed to use the power average of measurements in some or all three-dimensional corners. This method is simple and seems to offer reliable and repeatable results in all rooms and at all frequencies.

Twenty-two cases of low-frequency noise complaints - a detailed investigation

Christian Sejer Pedersen, Henrik Møller, Kerstin Persson Waye, Afdeling for Akustik, AAU

In Denmark and in other industrialized countries there are cases where people complain about annoying low-frequency or infrasonic noise in their homes. Besides noise annoyance people often report other adverse effects such as insomnia, headache, lack of concentration etc. In many cases the noise can only be heard by a single person in the household, and if measurements are performed the authorities cannot find any noise exceeding the existing limits for noise. This raises the fundamental question whether the complainants are annoyed by an external physical sound, or if other explanations must be sought. The main aim of this study is to answer this fundamental question by thoroughly investigating 22 such cases. Recordings and analyses were made of the sound in the complainants' homes. Each complainant was then invited to the laboratory where low-frequency thresholds and equal-loudness contours were measured. In a blind test it was examined if they are able to hear the sound recorded in their homes. Details from noise recordings, analysis and the experimental design are presented, however, since the experiments were finishing at the time of paper submission no results are presented at the present stage, but the final results will be presented at the conference.

Præsenteret på 121st AES Convention, 6.-8. oktober 2006, San Francisco, Californien, USA:

Audibility of time differences in adjacent head-related transfer functions (HRTFs)

Pablo Hoffmann, Henrik Møller, Afdeling for Akustik, AAU

Changes in the temporal and spectral characteristics of the sound reaching the two ears are known to be of great importance for the perception of spatial sound. The smallest change that can be reliably perceived provides a measure of how accurate directional hearing is. The present study investigates audibility of changes in the temporal characteristics of HRTFs. A listening test is conducted to measure the smallest change in the interaural time difference (ITD) that produces an audible difference of any nature. Results show a large inter-individual variation with a range of audibility thresholds from about 20 μs to more than 300 μs.

Præsenteret på 152nd Meeting of the Acoustical Society of America, 28. nov.-2. december 2006, Hawaii, USA:

Review of literature on hearing damage by personal stereo

Dorte Hammershøi, Rodrigo Ordoñez, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

In the 1980s and 1990s there was a general concern for the high levels that personal stereo systems were capable of producing. At that time no standardized method for the determination of exposure levels existed, which could have contributed to overly conservative conclusions. With the publication of ISO 11904-1:2002 and 11904-2:2004, previous studies can be viewed in a different light, and the results point, in our opinion, at levels and listening habits that are of hazard to the hearing. The present paper will review previous studies that may shed light over the levels and habits of contemporary personal stereo systems, which can produce even higher levels and are of even wider use.

Field study of sound exposure by personal stereo

Rodrigo Ordoñez, Karen Reuter, Dorte Hammershøi, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

A number of large scale studies suggest that the exposure level used with personal stereo systems should raise concern. High levels can be produced by most commercially available mp3 players, and they are generally used in high background noise levels (i.e., while in a bus or train). A field study on young people's habitual sound exposure to personal stereos has been carried out using a measurement method according to principles of ISO 11904-2:2004. Additionally the state of their hearing has also been assessed. This presentation deals with the methodological aspects relating to the quantification of habitual use, estimation of listening levels and exposure levels, and assessment of their state of hearing, by either threshold determination or OAE measurement, with a special view to the general validity of the results (uncertainty factors and their magnitude).

Time characteristics of distortion product otoacoustic emissions recovery function after moderate sound exposure

Miguel Angel Aranda de Toro, Rodrigo Ordoñez, Dorte Hammershøi, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

Exposure to sound of moderate level temporarily attenuates the amplitude of distortion product otoacoustic emissions (DPOAEs). These changes are similar to the changes observed in absolute hearing thresholds after similar sound exposures. To be able to assess changes over time across a broad frequency range, a detailed model of the recovery time characteristics is necessary. In the present study, the methodological aspects needed in order to monitor changes in DPOAEs from human subjects measured with high time resolution are presented. The issues treated are (1) time resolution of the measurements, (2) number of frequency points required, and (3) effects in fine structures, are they affected with the exposure? [Work supported by the Danish Research Council for Technology and Production.]

Præsenteret på Inter-Noise 2006, 3.-6. december 2006, Hawaii, USA:

Distortion product otoacoustic emission (DPOAE) recovery after moderate sound exposure as a function of time

Miguel Angel Aranda de Toro, Rodrigo Ordonez, Dorte Hammershøi, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

The amplitude of distortion product otoacoustic emissions (DPOAE) decreases temporarily after exposure to a sound of moderate level. These changes show similarities to the changes observed in absolute hearing thresholds after similar sound exposures. To be able to assess changes over time across a broad frequency range, a detailed model of the recovery's time characteristics is needed. In the present study, the methodological aspects needed in order to monitor changes in DPOAEs obtained from human subjects with high time resolution are presented together with preliminary results collected after short duration tonal exposures.

Low-frequency noise complaints - a detailed investigation of twenty-two cases

Christian Sejer Pedersen, Henrik Møller, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

Kerstin Persson Waye, Department of Occupational and Environmental Medicine, Göteborg University, Sverige

In Denmark and in other industrialized countries there are cases where people complain about annoying low-frequency or infrasonic noise in their homes. Besides noise annoyance people often report other adverse effects such as insomnia, headache, lack of concentration etc. In many cases the noise is only heard by a single person in the household. This raises the fundamental question whether the complainants are annoyed by an external physical sound, or if other explanations such as low-frequency tinnitus must be sought. The main aim of this study is to answer this fundamental question by thoroughly investigating 22 such cases. Recordings and analyses were made of the sound in the complainants' homes and each complainant was invited to the laboratory where low-frequency thresholds and equal-loudness contours were measured. In a blind test it was examined if they are able to hear the sound recorded in their homes. The data analysis is not finished at the time of paper submission, but the results will be presented at the conference.

Measurement of low-frequency noise in rooms

Steffen Pedersen, Henrik Møller, Sektion for Akustik, Institut for Elektroniske Systemer, AAU. Kerstin Persson Waye, Kerstin Persson Waye, Department of Occupational and Environmental Medicine, Göteborg University, Sverige. Søren Krarup Olesen, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

Measurement of low-frequency noise in rooms is problematic due to standing wave patterns. The spatial variation in the sound pressure level can typically be as much as 20-30 dB. For assessment of annoyance from low-frequency noise in dwellings, it is important to measure a level close to the highest level present in a room, rather than a room average level. In order to ensure representative noise measurements, different positions were investigated based on theoretical considerations and observations from numerical room simulations. In addition measurements were performed in three different rooms. The sound pressure level was measured 1) in three-dimensional corners and 2) according to current Swedish and Danish measurement methods. Furthermore, the entire sound pressure distributions were measured by scanning. The Swedish and Danish measurement methods include a corner measurement position to ensure representative high levels. However, this position has some distance to the walls, and may still be subject to modal influence. It was confirmed by the measurements that the positions from especially the Danish measurement method may not effectively serve their purpose. It is suggested that four three-dimensional corners are used for indoor measurement of low-frequency noise.

Distortion product otoacoustic emission fine structure of symphony orchestra musicians *Karen Reuter, Dorte Hammershøi, Sektion for Akustik, Institut for Elektroniske Systemer, AAU*

Otoacoustic emissions (OAE) are sounds produced by the healthy inner ear. They can be measured as low-level signals in the ear canal and are used to monitor the functioning of outer hair cells. Several studies indicate that OAE might be a more sensitive measure to detect early noise-induced haring losses than pure-tone audiometry. The distortion product otoacoustic emission (DPOAE) fine structure is obtained when the ear is stimulated by dual

tone stimuli using a high frequency resolution. It is characterized by quasi-periodic variations across frequency, as it can be observed in the hearing threshold microstructure also. In this study DPOAE fine structures and hearing thresholds are obtained for symphony orchestra musicians both for left and right ears and before and after the orchestra rehearsal. DPOAE fine structures are analyzed with an automatic classification algorithm, which describes the ripple pattern by parameters. A difference between left and right ears could be detected for the DPOAE level but not for the fine structure parameters. No difference between the measures taken before and after exposure could be observed.

Sound exposure by personal stereo, field study of young people in Denmark

Rodrigo Ordonez, Karen Reuter, Dorte Hammershøi, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

A number of large scale studies suggest that the exposure level used with personal stereo systems should raise concern. It has been demonstrated that 1) high levels can be produced, 2) high levels are used, especially in situations with high background noise, 3) exposure levels are comparables with that of industrial noise exposure. In the present study, measurements of the everyday exposure levels will be measured according to principles of ISO 11904-2:2004 for students at various school levels. The measurements will be accompanied with questionnaire detailing the individual habits of use, and with assessment of hearing levels and OAE.

Effects of frequency content from exposures with the same A-weighted equivalent level *Rodrigo Ordonez, Dorte Hammershøi, Sektion for Akustik, Institut for Elektroniske Systemer, AAU*

According to traditional measurement methods, signals with the same A-weighted equivalent level should pose the same hazard to the auditory system. As a measure of hazard, it was assumed that Temporary Thresholds Shifts (TTS) reflect the onset of alterations to the hearing system that, if continued, will eventually lead to a permanent damage. Under this premise, results form a TTS experiment using three different band-passed signals taken from one channel of a binaural recording of an industrial mill are discussed [1]. The main result from this experiment is that there is a considerable difference in the resulting TTS after exposures presented at the same A-weighted equivalent level and vary only in frequency content.

Hearing damage by personal stereo: A literature review

Dorte Hammershøi, Rodrigo Ordonez, Karen Reuter, Sektion for Akustik, Institut for Elektroniske Systemer, AAU

The technological development within personal stereo systems, such as MP3 players, e.g. iPods, has changed music listening habits from home entertainment to everyday and everywhere use. The technology has developed considerably, since the introduction of cassette players and CD walkmen, and high-level low-distortion music is produced by minimal devices. In this paper, the existing literature on effects of personal stereo systems is reviewed, incl. studies of exposure levels, and effects on hearing. Generally, it is found that the levels being used are of concern, which in one study [1] is demonstrated to relate to the specific use in situations with high levels of background noise. Another study [2], demonstrates that the effect of using personal stereo is comparable to that of being exposed to noise in industry. The results are discussed in view of the measurement methods for noise exposure used, and technical issues that may explain the high exposure levels.

Methodological approaches to investigate the effects of meaning, expectations and context in listening experiments

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Cognitive factors in sound evaluation have received an increasing amount of attention over the past years, and specific effects of meaning, expectations, and context have been under

empirical investigation. The present paper is intended to contribute to the theoretical definition of

these concepts as well as to demonstrate their impact on the auditory assessments in selected empirical studies. To that effect, first the effects of source identifiability on loudness and annoyance judgements of environmental sounds are presented. Further, the concept of user expectations and its implications in applied situations is illustrated with examples from automotive research and development, pointing to the fundamental distinction between sound character and sound quality as proposed by [1]. Finally, the term context is defined within the theoretical framework of reference frames, and effects of the immediate stimulus context on ratings of auditory pleasantness are presented.

An examination of the parametric properties of four noise sensitivity measures: research proposal

Irene van Kamp, RIVM/cMGO, Holland. Wolfgang Ellermeier, Sektion for Akustik, Institut for Elektroniske Systemer, AAU. Isabel Lopez-Barrio, Higher Council for Scientific Research, (CSIC), Madrid, Spanien. Stephen Stansfeld, Centre for Psychiatry at Barts and the London, Queen Mary's School of Medicine and Dentistry, London. Julie Hatfield, NSW Injury Risk Management, University of NSW. Barbara Griefahn, Institut für Arbeitsphysiologie an der Universität Dortmund, Tyskland. Winni F. Hofman, Sleep Research Lab, Psychon. Group, Dept. of Psychology, University of Amsterdam, Holland

Noise sensitivity (NS) is a personality trait with a strong influence on reactions to noise. Studies of reaction should include a standard measure of NS that is founded on a theoretically justified definition of NS, and examination of existing NS measures' parametric properties (internal consistency; stability; convergent and predictive validity). At each of 6 laboratory centres (Aalborg; London; Sydney; Dortmund; Madrid, Amsterdam), participants will complete four NS measures on each of two occasions. In one occasion, participants will complete a task while exposed to recorded aircraft noise, and while not exposed, to measure potential noise-induced performance impairment. Participants will also be exposed to noise in the absence of a task. Physiological measures will be taken during both noise conditions, and differences from baseline measures will be assessed. Participants will complete self-report measures assessing responses to noise (perception; reaction; mood) in both noise conditions, reaction to noise from various sources at home, and moderating variables (e.g. sensitivity to non-auditory stimuli, health status, mood, personality, environmental attitudes, socially desirable responding, demographics and lifestyle). A standard NS measure should demonstrate high reliability, and should predict responses to noise. Discussion is welcomed and will focus on validation strategies and optimizing the study design.

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