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Personal sound system design for mobile phone, monitor, and television set
Cylindrical shape approach

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5:40

4pEAa7. Virtual Prototyping of Electrodynamic Loudspeakers by Utilizing a Finite Element Method. Reinhard Lerch (Univ. Erlangen-Nuremberg, Dept. of Sensor Technology, Paul-Gordan-Str. 3/5, 91052 Erlangen, Germany, reinhard.lerch@lse.eei.uni-erlangen.de), Manfred Kaltenbacher (Univ. Erlangen-Nuremberg, Dept. of Sensor Technology, Paul-Gordan-Str. 3/5, 91052 Erlangen, Germany, manfred.kaltenbacher@lse.eei.uni-erlangen.de), Martin Meiler (Simetris GmbH, Am Weichselgarten 7, 91058 Erlangen, Germany, martin.meiler@simetris.de)

To speed up the development of electrodynamic loudspeakers, computer tools have to be applied. With appropriate computer simulations, the costly and lengthy fabrication of prototypes, as required within conventional experimental design, can be reduced tremendously. Present computer modeling tools are mainly based on equivalent circuit representations. The main drawback of these models, however, stems from the fact that the circuit element parameters have to be measured on a prototype, first. Therefore, the need for appropriate numerical simulation tools based on finite element method (FEM) arises, since as input parameters they suffice with geometrical and material data. However, present finite element tools suffer from their incompleteness in respect to full field couplings and nonlinear features. In this paper, a new finite element scheme is introduced and its utilization within the computer-aided design of electrodynamic loudspeakers is demonstrated. This scheme allows the precise and efficient calculation of the electromagnetic, mechanical and acoustic fields, including their couplings. Furthermore, nonlinear effects in the mechanical behavior of the spider as well as magnetic nonlinearities due to the nonhomogeneity of the magnetic field are taken into account.

6:00

4pEAa8. Tactile Touch Plate with Variable Boundary Conditions. Ros Kiri Ing (Laboratoire Ondes et Acoustique, ESPCI, Université Paris 7, CNRS, 10 rue Vauquelin, 75005 Paris, France, ros-kiri.ing@espci.fr), Didier Cassereau (Laboratoire Ondes et Acoustique, 10, rue Vauquelin, 75231 Paris, France, didier.cassereau@espci.fr), Mathias Fink (Laboratoire Ondes et Acoustique, ESPCI, Université Paris 7, CNRS, 10 rue Vauquelin, 75005 Paris, France, mathias.fink@espci.fr), Jean-Pierre Nikolovski (Laboratoire Ondes et Acoustique, ESPCI, Université Paris 7, CNRS, 10 rue Vauquelin, 75005 Paris, France, jean-pierre.nikolovski@cea.fr)

The touch screen device is becoming more and more widespread because it is a very user friendly human/machine interface. In acoustic domains, several approaches are used to realize such a device. Triangulation or Rayleigh waves absorption are such classical methods. However, these approaches are limited because they need a large number of sensors and are only applicable to plates of constant thickness and homogeneous materials. To remedy these limitations, a new approach is proposed using only two sensors. In this approach, one sensor is used to excite the plate, either continuously or impulsively. The second sensor is used to detect the acoustic waves generated in the plate. When an object comes into contact with the plate, some acoustic wave characteristics change. These changes affect different frequencies and depend on the position of the contact point. Comparing these changes with pre-recorded values, it is possible to achieve a tactile touch plate that only responds to specific touch locations. Several experiments with different types of plates were conducted and the results will be presented.

6:20

4pEAa9. Personal sound system design for mobile phone, monitor, and television set: cylindrical shape approach. Ji-Ho Chang (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, Dep. of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, chang.jiho@gmail.com), Jin-Young Park (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, Dep. of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, jypark1979@kaist.ac.kr), Yang-Hann Kim (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, 4114, Department of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, yanghannkim@kaist.ac.kr)

Personal sound system that focuses sound on the user and reduces in the other zone has great interest in these days because it has significant needs to be applied in personal devices such as mobile phone, monitor, and television set. We have shown the feasibility of the personal sound system using a line array of loudspeaker units [C.-H. Lee et. al., J. Acoust. Soc. Am., 122, 3053 (2007)] based on acoustic contrast control [J.-W. Choi, Y.-H. Kim, J. Acoust. Soc. Am. 111, 1695(2002)], with the successful result of about 20dB difference between the front and the side region for 800-5kHz range. Continuing this research, we try to apply acoustic contrast control in cylindrical shape instead of two-dimensional planar shape that was used before in order to reduce the level of side lobes more. That is, acoustically bright zone and dark zone are determined as cylindrical shape surrounding the array of loudspeakers. Computer simulation and experimental result will be addressed and evaluated by comparing to the previous result. (This work was supported by the Korea Science and Engineering Foundation(KOSEF) through the National Research Lab. Program funded by the Ministry of Science and Technology(M10500000112-05J0000-11210).)

6:40

4pEAa10. Efficient Directivity Pattern Control for Spherical Loudspeaker Arrays. Franz Zotter (Institute of Electronic Music and Acoustics, Inffeldgasse 10 / 3, 8010 Graz, Austria, zotter@iem.at), Hannes Pomberger (Institute of Electronic Music and Acoustics, Inffeldgasse 10 / 3, 8010 Graz, Austria, pom@sbox.tugraz.at), Andrew Schmeder (Center for New Music and Audio Technologies, 1750 Arch Street, Berkeley, CA 94720, USA, andy@cnmat.berkeley.edu)

With an appropriate control system, directivity pattern synthesis can be accomplished with spherical loudspeaker arrays, e.g. in the shape of Platonic solids or spheres. The application of such devices for the reproduction of natural or artificial directivity patterns poses a relatively young field of research in computer music and acoustic measurements. Using directivity measurements with microphones, the directivity patterns of the individual speakers on the array can be determined. Usually, the directivity of the whole array may be regarded as a linear combination of these patterns. In order to gain control, the measurement data of the linear system need to be inverted. Given L loudspeakers and M microphones, this inversion yields the desired control system, an expensive LxM multiple-input-multiple-output (MIMO) filter. We introduce discrete spherical harmonics transform and decoder matrices to reduce the number of channels required for this control system, thus reducing the computational effort. However, this step often leads to a sparse MIMO-system, in which many off-diagonal transfer functions vanish. If applicable, the computation of the non-zero transfer functions only can be done at even much lower cost. A case study for an icosahedral loudspeaker array is given, showing the properties of the sparse MIMO-system.

7:00

4pEAa11. Effects of enclosure design on the directivity synthesis by spherical loudspeaker arrays. Alexander Mattioli Pasqual (Universidade Estadual de Campinas, Rua Mendeleiev, 200, Cidade Universitária "Zeferino Vaz", 13083-970 Campinas, Brazil, pasqual@fem.unicamp.br), José Roberto Arruda (Universidade Estadual de Campinas, Rua Mendeleiev, 200, Cidade Universitária "Zeferino Vaz", 13083-970 Campinas, Brazil, arruda@fem.unicamp.br), Philippe Herzog (Laboratoire de Mécanique et d'Acoustique - CNRS, 31 chemin Joseph Aiguier, 13402 Marseille, France, herzog@lma.cnrs-mrs.fr)

Spherical loudspeaker arrays have been used to generate non-uniform directivity patterns. It is known that the poor radiation efficiency of spherical sources and the loudspeaker electroacoustic behavior impose constraints on the directivity synthesis at low frequencies, which are aggravated as the source volume is made smaller. In this work, the effects of the enclosure design on the loudspeaker signal powers are analyzed. Two different approaches have been reported in literature, although quantitative comparisons