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2:55

1pEA3. Recent advances in computer-aided design of loudspeakers. Vance Dickason (Vance Dickason Consulting, 333 S. State St., Ste. 152, Lake Oswego, OR 97035)

Although successful CAE software that allows the accurate simulation and development of loudspeaker enclosures and crossover networks has been available for professional design work for several years, a number of loudspeaker industry practitioners still persist in using traditional methods of "cut and try." This presentation outlines a computer-aided loudspeaker development case study of a commercial three-way loudspeaker using a vented enclosure and a crossover network that incorporated fourth-order acoustic slopes. Measurement of the resulting prototype showed close agreement, within 0.5–1 dB, with the computer simulation. Time required for the development of the fairly complex crossover network determined for this loudspeaker was less than 1.5 h, substantially less than what is generally expected of "cut and try" methods. Key to the resulting accuracy using this type of computer software is the correct portrayal of interdriver time delay and driver phase. Driver phase for this project was derived from the driver magnitude using a highly sophisticated phase calculation methodology, as opposed to being directly measured with a two-port analyzer. Other criteria responsible for the success of the loudspeaker modeling portrayed in this case study are the ability to predetermine the group delay performance of the enclosure design, and the ability to examine crossover network transfer function during the design process.

3:15

1pEA4. Time Align® loudspeaker crossovers. Edward M. Long (E. M. Long Assoc., 4107 Oakmore Rd., Oakland, CA 94602)

A Time Align® loudspeaker system must produce an acoustical output at the listening position such that the fundamental and overtones of a complex, transient signal have the same relationships that they have at the electrical input to the system. To qualify for the use of the Time Align® trademark, the natural time offset between the acoustical outputs of the loudspeaker drivers must be corrected. This time offset is caused by the natural low-pass filter characteristics of the drivers and the electrical crossover filters. The time offsets between the acoustical output of each of the drivers must be corrected and the electrical crossover filters must be designed to produce an acoustical output from adjacent drivers that is 6 dB down from its passband level. When the coherent acoustical outputs of adjacent drivers are combined, the result is a uniform acoustical output. The polarity of the acoustical outputs is also affected by the crossovers; this is also a major consideration in the design of a Time Align® crossover. A Time Align® loudspeaker system must be able to produce acoustical square waves and have a short impulse response. Time Align® design techniques are shown by practical examples.

3:35

1pEA5. A new family of rotary loudspeaker transducers. Thomas J. Danley (Quantum Sound, Inc., 305 Era Dr., Northbrook, IL 60062)

A technical overview will be provided for a new electromagnetic transducer concept that employs rotary motion rather than rectilinear piston motion. The differences in the physical rules that govern the distribution of force and mass in the rotary and rectilinear systems will be explored. These relationships have permitted the construction of a new category of transducer which offers solutions to some of the seemingly insurmountable design constraints inherent in conventional coil/cone driver systems. One of the transducers examined is a high-output, full-range (40 Hz to 20 kHz) rotary loudspeaker which produces low-distortion, minimum-phase acoustic output with a radiation pattern resembling that of a line source.

3:55

1pEA6. Design considerations for an application-specific loudspeaker. James E. Mitchell (Frazier Div., Sound-Craft Systems, Inc., Rt. 3, Box 319, Morrilton, AR 72110)

The design of a proprietary loudspeaker for use in IMAX theaters posed some unusual problems while offering a unique opportunity: that of optimizing a loudspeaker design for a predetermined and relatively narrowly defined set of acoustic, geometric, and mechanical conditions. Requirements unique to the application, a specialty cinema format which employs six discrete audio signal channels and makes substantial demands on sound system bandwidth and acoustic output, are explained. Methods used to arrive at the final loudspeaker design are presented. Sound system coverage prediction software was utilized in a novel fashion, significantly reducing the time required to complete the development of the loudspeaker. Investigation of IMAX theater geometries indicated that a vertically asymmetric radiation pattern was highly desirable. Optimum loudspeaker directivity criteria were established, and horns were developed with these criteria in mind. Testing of prototypes indicated that the criteria had been substantially met. Predictive work was verified with *in situ* testing of prototype systems.

Contributed Papers

4:15

1pEA7. Neodymium iron boron and professional audio loudspeakers. Daniel M. Warren (Peavey Electronics Corp., 711 A St., Meridian, MS 39302)

Neodymium iron boron, a high reminence, high coercivity permanent magnet material, has been in use in the audio industry for several years in the form of small (approximately 1-cm-diam) disks in high-performance microphones. Dropping prices and continuing enhancements in material properties, reducing thermal demagnetization and increasing residual magnetic flux density, have made neodymium more attractive for use in professional audio loudspeakers, where magnent size can reach 4 in. in diameter and almost $\frac{1}{2}$ in. thick. While still considerably more expensive than the more commonly used ferrite ceramic magnets, neodymium magnet structures can be smaller and have a higher flux density than can be practically attined with ceramics. A specific example of loudspeaker motor structure design using neodymium—the Architectural Acoustics Neo Series Acoustical Components from Peavey Electronics—will be presented. Acoustical implications of high-force loudspeakers on enclosure design will also be discussed. [Work supported by Peavey Electronics Corporation.]