CJS Labs

Loudspeaker Design

This course will introduce the basic concepts of loudspeakers and then walk through an entire loudspeaker design. Equivalent circuits, impedance and Thiele-Small Parameters are shown. Inherent driver nonlinearities are explained. The effects of modal behaviour and cone breakup are demonstrated. Closed Box and Ported Box systems are analyzed and several design examples are meticulously worked through, both with hand calculations and using CAD. Passive Radiator, Band Pass, and Transmission Line systems are also introduced. Issues with multiple drivers and cabinet construction are discussed. Directivity and diffraction effects are illustrated. Crossover network design fundamentals are presented, with a specific design example for the previously shown ported enclosure design. A brief overview of room acoustic effects on loudspeakers is also presented.

Instructor

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Course Outline

Introduction
- Lorentz Force
- Woofer & Tweeter Construction
- Equivalent Circuit Modeling

Impedance
- Electrical & Motional Impedance
- Semi-Inductance & Skin Effect
- Thiele-Small Parameters

The Driver
- Infinite Baffle Response
- Voice Coil Geometries
- Inherent Nonlinearities: Bl, L_E, & K_{MS}
- Other Distortion Mechanisms
- Modal Behaviour
- Efficiency Bandwidth Product

Loudspeaker Systems
- Closed Box Systems
- Enclosure Filling
- Ported Box Systems
- Passive Radiator Systems
- Band Pass Systems
- Transmission Line Systems
- Multiple Driver Systems

Compression Drivers & Horns
- Principles of Operation
- Basic Design & Application

Enclosures & Cabinets
- Vibration & Modal Behaviour
- Diffraction
- 4π to 2π Loading Effect
- Directivity & Polar Response

Crossovers
- Phase & Group Delay
- Time Alignment
- 2^{nd}, 3^{rd}, and 4^{th} Order Passive Networks
- Zobel Networks & Driver Impedance Compensation
- "L" Pad Design
- Active & Digital Crossovers
- Equalization & Alignment Augmentation

Room Acoustics & Effects on System Response
- Sound Fields
- "Waterhouse" Boundary Effect
- Standing Waves & Room Modes
- *In-situ* Loudspeaker + Room Response

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