Contents

Preface

This book is an outgrowth of a senior level elective course in audio engineering that I have taught to electrical engineering students at the Georgia Institute of Technology. The first part of the book covers basic acoustics. The emphasis is on that part of acoustics that pertains to the field of audio engineering. Most of the remainder of the book concerns the application of the tools of electroacoustics to the analysis and synthesis of microphones, loudspeakers, crossover networks, and acoustic horns. The book concludes with a chapter that covers the basic theory of audio amplifier design.

Electroacoustics is that part of acoustics that pertains to the modeling of acoustical systems with electrical circuits. Because most acoustical devices have a mechanical part, the modeling of mechanical systems with electrical circuits is a basic part of electroacoustics. Separate chapters in the book are devoted to analogous circuits of mechanical systems and to analogous circuits of acoustical systems. The traditional approach in these circuits has been to use transformers to model the coupling between the electrical, the mechanical, and the acoustical parts. A major departure in this book is the use of controlled sources to model the coupling. An advantage of this approach is that it avoids the need for mobility analogs in the acoustical circuits. In addition, I have found that students have much less difficulty with the approach. Perhaps this is because the controlled-source circuits are more intuitive than the transformer circuits. In addition, the circuits can be easily analyzed with circuit simulation software such as SPICE.

Electroacoustic models are developed for the more common microphone types and for the moving-coil loudspeaker driver. Separate chapters cover closed-box and vented-box loudspeaker systems. Although the emphasis is on basic system theory, practical methods of design are also presented. Because crossover networks are such an important part of loudspeaker systems, a chapter is devoted to crossover networks. Acoustic horns are a vital component in public address systems. A chapter is devoted to horn models. In all cases, SPICE simulation examples are presented where appropriate.

One might ask why a chapter on audio amplifiers is included in a book that is primarily concerned with electroacoustics. Without a power amplifier, a loudspeaker could not make sound. Therefore, one might say that the role of an amplifier in a system is just as important as the role of a loudspeaker. The chapter on amplifiers is not intended to be an in-depth chapter on electronic theory. Instead, it addresses the more important aspects of amplifier design with an emphasis on the basic operation of the circuits. Practical examples are presented that illustrate how some of the pitfalls of amplifier design can be avoided.

This revised printing corrects errors in the second edition. The chapter on audio amplifiers has been revised. Some of the appendices have been combined to form a new chapter. An errata and updates to the text can be found at http://users.ece.gatech.edu/~mleach/audiotext/.

W. Marshall Leach, Jr.
April 2001