Volume Preface

Models have always been a special feature of hearing research. The particular models described in this book are special because they seek to bridge the gap between physiology and psychophysics and ask how the psychology of hearing can be understood in terms of what we already know about the anatomy and physiology of the auditory system. However, although we now have a great deal of detailed information about the outer, middle, and inner ear as well as an abundance of new facts concerning individual components of the auditory brainstem and cortex, models of individual anatomically defined components cannot, in themselves, explain hearing. Instead, it is necessary to model the system as a whole if we are to understand how man and animals extract useful information from the auditory environment. A general theory of hearing that integrates all relevant physiological and psychophysical knowledge is not yet available but it is the goal to which all of the authors of this volume are contributing.

The volume starts with the auditory periphery by Meddis and Lopez-Poveda (Chapter 2) which is fundamental to the whole modeling exercise. The next level in the auditory system is the cochlear nucleus. In Chapter 3, Voigt and Zheng attempt to simulate accurately the responses of individual cell types and show how the connectivity among the different cell types determines the auditory processing that occurs in each subdivision.

Output from the cochlear nucleus has two main targets, the superior olivary complex and the inferior colliculus. The superior olivary complex is considered first in Chapter 4 by Jennings and Colburn because its output also passes through the inferior colliculus, which is discussed in Chapter 6 by Davis, Hancock, and Delgutte, who draws explicit links between the modeling work and psychophysics. Much less is known about the thalamus and cortex, and Chapter 5 by Eggermont sets out what has been achieved so far in understanding these brain regions and what the possibilities are for the future.

Four more chapters conclude this volume by looking at the potential of modeling to contribute to the solution of practical problems. Chapter 7 by Heinz addresses the issue of how hearing impairment can be understood in modeling terms. In Chapter 8, Brown considers hearing in connection with automatic speech recognition and reviews the problem from a biological perspective, including recent progress that has been made. In Chapter 9, Wilson, Lopez-Poveda, and Schatzer look more closely at cochlear implants and consider whether models can help to improve the coding strategies that are used. Finally, in Chapter 10, van Schaik, Hamilton, and Jin address these issues and show how models can be incorporated into very large scale integrated devices known more popularly as “silicon chips.”

As is the case with volumes in the Springer Handbook of Auditory Research, previous volumes have chapters relevant to the material in newer volumes. This is clearly the case in this volume. Most notably, the advances in the field can be easily seen when comparing the wealth of new and updated information since the publication of Vol. 6, *Auditory Computation*. As pointed out in this Preface, and throughout this volume, the models discussed rest upon a thorough understanding of the anatomy and physiology of the auditory periphery and the central nervous system. Auditory anatomy was the topic of first volume in the series (*The Mammalian Auditory Pathway: Neuroanatomy*) and physiology in the second (*The Mammalian Auditory Pathway: Physiology*). These topics were brought up to date and integrated in the more recent Vol. 15 (*Integrative Functions in the Mammalian Auditory Pathway*). There are also chapters in several other volumes that are germane to the topic in this one, including chapters in *Cochlear Implants* (Vol. 20), *The Cochlea* (Vol. 8), and *Vertebrate Hair Cells* (Vol. 27).

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