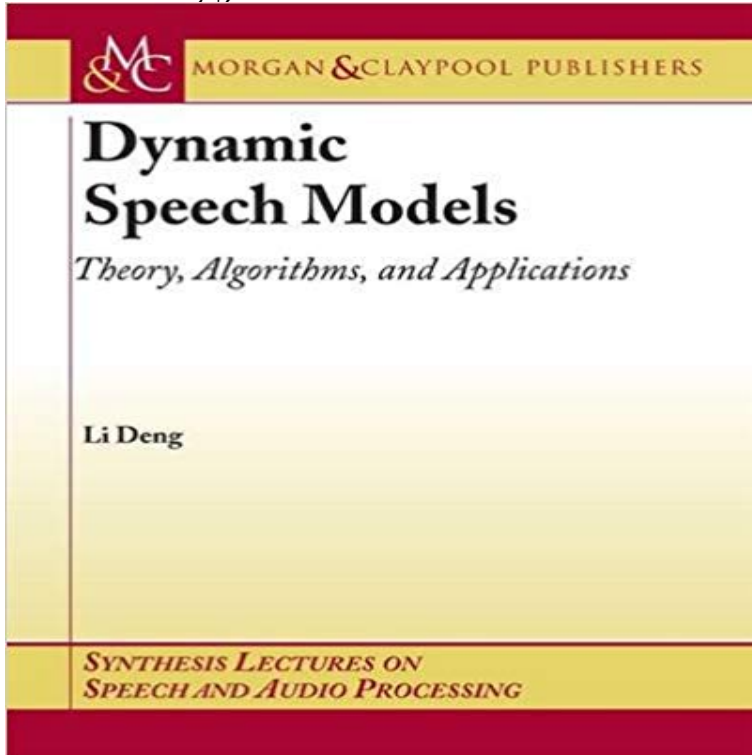


# Dynamic Speech Models (Synthesis Lectures on Speech and Audio Processing)



What are the compelling reasons for carrying out dynamic speech modeling? We provide the answer in two related aspects. First, scientific inquiry into the human speech code has been relentlessly pursued for several decades. As an essential carrier of human intelligence and knowledge, speech is the most natural form of human communication. Embedded in the speech code are linguistic (as well as para-linguistic) messages, which are conveyed through four levels of the speech chain. Underlying the robust encoding and transmission of the linguistic messages are the speech dynamics at all the four levels. Mathematical modeling of speech dynamics provides an effective tool in the scientific methods of studying the speech chain. Such scientific studies help understand why humans speak as they do and how humans exploit redundancy and variability by way of multitiered dynamic processes to enhance the efficiency and effectiveness of human speech communication. Second, advancement of human language technology, especially that in automatic recognition of natural-style human speech is also expected to benefit from comprehensive computational modeling of speech dynamics. The limitations of current speech recognition technology are serious and are well known. A commonly acknowledged and frequently discussed weakness of the statistical model underlying current speech recognition technology is the lack of adequate dynamic modeling schemes to provide correlation structure across the temporal speech observation sequence. Unfortunately, due to a variety of reasons, the majority of current research activities in this area favor only incremental modifications and improvements to the existing HMM-based state-of-the-art. For example, while the dynamic and correlation modeling is known to be an important topic, most of

the systems nevertheless employ only an ultra-weak form of speech dynamics; e.g., differential or delta parameters. Strong-form dynamic speech modeling, which is the focus of this monograph, may serve as an ultimate solution to this problem. After the introduction chapter, the main body of this monograph consists of four chapters. They cover various aspects of theory, algorithms, and applications of dynamic speech models, and provide a comprehensive survey of the research work in this area spanning over past 20~years. This monograph is intended as advanced materials of speech and signal processing for graduate-level teaching, for professionals and engineering practitioners, as well as for seasoned researchers and engineers specialized in speech processing.

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