

Preface

Speech communication assumes a dominant role in how we communicate, and it is nowadays available to support interaction with machines in a wide range of scenarios, ranging from personal assistants for smartphones to home entertainment. While in many circumstances audible speech may suffice, there are a multitude of scenarios for which it is inadequate due to ambient noise, need for privacy, or as a result of existing speech impairments. Nevertheless, the audible speech signal, although it is the more significant outcome, is the end result of the human speech production process that includes multiple stages (e.g., message conception in the brain, pulmonary and muscular activity, and articulators' movement). As humans are able to interpret a set of non-audible features, such as lip movement, which become an integral part of the communication, researchers are starting to explore how the information from the different phases of the speech production process can be acquired and used in the development of enhanced speech input modalities for interaction of humans with machines. This area of research, commonly designated as silent speech interfaces (SSI), holds a potential solution for a more natural human–computer interaction (HCI) in the absence of audible speech and is theoretically able to address several issues inherent to automatic speech recognition (ASR) technology based on the acoustic signal, addressing a broader set of scenarios from speech recognition in noisy environments to communication with speech-impaired individuals. Commonly, these systems sense and collect data from key elements of the human speech production process—from glottal and articulators' activity, their neural pathways, or the brain itself—and create an alternative digital representation of speech.

While notable work exists, the literature on SSI still lacks an integrated view of key aspects, technologies, and findings that enable a systematic approach and a clear perception of what is at stake with SSI. In line with this current status, our goal was to address this gap collecting, in a single source, the grounds for further developments, hopefully motivating further interest of researchers for this multidisciplinary research field.

This book constitutes a broad and comprehensive overview of the existing technical approaches in the area of SSI. Each technique is described in the context of the human speech production process, allowing the reader to clearly understand the principles behind SSI in general and across different approaches. Additionally, the book explores the combined use of different data sources in order to tackle limitations of simpler SSI approaches and to address current challenges of this field. Another set of information deemed relevant concerns existing SSI applications, resources, and a simple tutorial on how to build an SSI.

All these contents aim to guide readers—even those not particularly acquainted with the different disciplines involved—from the application contexts in which SSI may play a key role to the more technical aspects of designing and developing such systems.

And our effort would not be completed without some thoughts on the future of SSI. After all, as important as understanding where we are, in this research field, is to set our minds to where we need to go from here. May readers find this book a source of knowledge and inspiration for the future of silent speech interfaces.

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