



# **Audiovisual Speech Processing**

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# Audiovisual Speech Processing

**Shawn L. Nissen**

## **Audiovisual Speech Processing:**

*Audiovisual Speech Processing* Gérard Bailly, Pascal Perrier, Eric Vatikiotis-Bateson, 2012-04-26 This book presents a complete overview of all aspects of audiovisual speech including perception production brain processing and technology

## **Audiovisual Speech Recognition: Correspondence between Brain and Behavior** Nicholas Altieri, 2014-07-09

Perceptual processes mediating recognition including the recognition of objects and spoken words is inherently multisensory. This is true in spite of the fact that sensory inputs are segregated in early stages of neuro sensory encoding. In face to face communication for example auditory information is processed in the cochlea encoded in auditory sensory nerve and processed in lower cortical areas. Eventually these sounds are processed in higher cortical pathways such as the auditory cortex where it is perceived as speech. Likewise visual information obtained from observing a talker's articulators is encoded in lower visual pathways. Subsequently this information undergoes processing in the visual cortex prior to the extraction of articulatory gestures in higher cortical areas associated with speech and language. As language perception unfolds information garnered from visual articulators interacts with language processing in multiple brain regions. This occurs via visual projections to auditory language and multisensory brain regions. The association of auditory and visual speech signals makes the speech signal a highly configural percept. An important direction for the field is thus to provide ways to measure the extent to which visual speech information influences auditory processing and likewise assess how the unisensory components of the signal combine to form a configural integrated percept. Numerous behavioral measures such as accuracy e.g. percent correct susceptibility to the McGurk Effect and reaction time RT have been employed to assess multisensory integration ability in speech perception. On the other hand neural based measures such as fMRI, EEG and MEG have been employed to examine the locus and/or time course of integration. The purpose of this Research Topic is to find converging behavioral and neural based assessments of audiovisual integration in speech perception. A further aim is to investigate speech recognition ability in normal hearing, hearing impaired and aging populations. As such the purpose is to obtain neural measures from EEG as well as fMRI that shed light on the neural bases of multisensory processes while connecting them to model based measures of reaction time and accuracy in the behavioral domain. In doing so we endeavor to gain a more thorough description of the neural bases and mechanisms underlying integration in higher order processes such as speech and language recognition.

*Audiovisual Speech Processing* Gérard Bailly, Pascal Perrier, Eric Vatikiotis-Bateson, 2012 When we speak we configure the vocal tract which shapes the visible motions of the face and the patterning of the audible speech acoustics. Similarly we use these visible and audible behaviors to perceive speech. This book showcases a broad range of research investigating how these two types of signals are used in spoken communication how they interact and how they can be used to enhance the realistic synthesis and recognition of audible and visible speech. The volume begins by addressing two important questions about human audiovisual performance how auditory and visual signals combine to access the mental

lexicon and where in the brain this and related processes take place It then turns to the production and perception of multimodal speech and how structures are coordinated within and across the two modalities Finally the book presents overviews and recent developments in machine based speech recognition and synthesis of AV speech Provided by publisher

*Audiovisual Speech Processing* Luis Morís Fernández,2016    *Advances in Audiovisual Speech Processing for Robust Voice Activity Detection and Automatic Speech Recognition* Fei Tao (Electrical engineer),2018 Speech processing systems are widely used in existing commercial applications including virtual assistants in smartphones and home assistant devices Speech based commands provide convenient hands free functionality for users Two key speech processing systems in practical applications are voice activity detection VAD which aims to detect when a user is speaking to a system and automatic speech recognition ASR which aims to recognize what the user is speaking A limitation in these speech tasks is the drop in performance observed in noisy environments or when the speech mode differs from neutral speech e g whisper speech Emerging audiovisual solutions provide principled frameworks to increase the robustness of the systems by incorporating features describing lip motion This study proposes novel audiovisual solutions for VAD and ASR tasks The dissertation introduces unsupervised and supervised audiovisual voice activity detection AV VAD The unsupervised approach combines visual features that are characteristic of the semi periodic nature of the articulatory production around the orofacial area The visual features are combined using principal component analysis PCA to obtain a single feature The threshold between speech and non speech activity is automatically estimated with the expectation maximization EM algorithm The decision boundary is improved by using the Bayesian information criterion BIC algorithm resolving temporal ambiguities caused by different sampling rates and anticipatory movements The supervised framework corresponds to the bimodal recurrent neural network BRNN which captures the taskrelated characteristics in the audio and visual inputs and models the temporal information within and across modalities The approach relied on three subnetworks implemented with long short term memory LSTM networks This framework is implemented with either hand crafted features or features representations directly derived from the data i e end toend system The study also extends this framework by increasing the temporal modeling by using advanced LSTMs A LSTMs For audiovisual automatic speech recognition AV ASR the study explores the use of visual features to compensate for the mismatch observed when the system is evaluated with whisper speech We propose supervised adaptation schemes which significantly reduce the mismatch between normal and whisper speech across speakers The study also introduces the Gating neural network GNN The GNN aims to attenuate the effect of unreliable features creating AV ASR systems that improve or at least maintain the performance of an ASR system implemented only with speech Finally the dissertation introduces the front end alignment neural network AliNN to address the temporal alignment problem between audio and visual features This front end system is important as the lip motion often precedes speech e g anticipatory movements The framework relies on RNN with attention model The resulting aligned

features are concatenated and fed to conventional back end ASR systems obtaining performance improvements The proposed approaches for AV VAD and AV ASR systems are evaluated on large audiovisual corpora achieving competitive performance under real world scenarios outperforming conventional audio based VAD and ASR systems or alternative audiovisual systems proposed by previous studies Taken collectively this dissertation has made algorithmic advancements for audiovisual systems representing novel contributions to the field of multimodal processing *An Investigation of Audiovisual Speech Processing in Mandarin and English Subjects* Shawn L. Nissen,1998

*Hearing and Seeing a Speaker* Elina Kaplan,2018

In face to face conversations listeners process and combine speech information obtained from hearing and seeing the speaker talk Audiovisual speech typically leads to more robust recognition of speech as it provides more information for recognition but also as it helps listeners adjust to speaker idiosyncrasies The goal of the current thesis was to examine how certain perceptual and cognitive factors modulate how listeners use visual speech to facilitate momentary speech perception and to adjust to a speaker s idiosyncrasies Results showed that older listeners sensitivity to cross modal synchrony is related to the size of the audiovisual interactions during early perceptual processing Furthermore when experiencing asynchrony it was demonstrated that younger listeners adapted their speech perception to the current situation such that early neural interactions emerged Higher level mechanisms also modulated audiovisual speech processing We provide evidence that when listeners fixate the speaker s eyes as they typically do the gathered visual speech information can successfully facilitate early auditory processing Allocating covert attention to the mouth area is not needed We also demonstrated that the availability of working memory resources determines how quickly and thoroughly listeners can disambiguate visual speech to recalibrate phonetic categories to accommodate a speaker s idiosyncrasy In summary the studies in this thesis thus provide valuable insight into factors affecting the mechanisms involved in the processing of audiovisual speech *Cognitively*

*Inspired Audiovisual Speech Filtering* Andrew Abel,Amir Hussain,2015-08-07 This book presents a summary of the cognitively inspired basis behind multimodal speech enhancement covering the relationship between audio and visual modalities in speech as well as recent research into audiovisual speech correlation A number of audiovisual speech filtering approaches that make use of this relationship are also discussed A novel multimodal speech enhancement system making use of both visual and audio information to filter speech is presented and this book explores the extension of this system with the use of fuzzy logic to demonstrate an initial implementation of an autonomous adaptive and context aware multimodal system This work also discusses the challenges presented with regard to testing such a system the limitations with many current audiovisual speech corpora and discusses a suitable approach towards development of a corpus designed to test this novel cognitively inspired speech filtering system *Audiovisual Speech Processing and Listening Effort in Untreated Age-related Hearing Loss: Evidence from Functional Magnetic Resonance Imaging* Christiane Thiel,Stephanie Rosemann,2019 *Robust Speech Recognition of Uncertain or Missing Data* Dorothea Kolossa,Reinhold Haeb-Umbach,2011-07-14 Automatic speech

recognition suffers from a lack of robustness with respect to noise reverberation and interfering speech. The growing field of speech recognition in the presence of missing or uncertain input data seeks to ameliorate those problems by using not only a preprocessed speech signal but also an estimate of its reliability to selectively focus on those segments and features that are most reliable for recognition. This book presents the state of the art in recognition in the presence of uncertainty offering examples that utilize uncertainty information for noise robustness, reverberation robustness, simultaneous recognition of multiple speech signals and audiovisual speech recognition. The book is appropriate for scientists and researchers in the field of speech recognition who will find an overview of the state of the art in robust speech recognition, professionals working in speech recognition who will find strategies for improving recognition results in various conditions of mismatch and lecturers of advanced courses on speech processing or speech recognition who will find a reference and a comprehensive introduction to the field. The book assumes an understanding of the fundamentals of speech recognition using Hidden Markov Models.

*Towards a Greater Understanding of the Neurophysiology of Natural Audiovisual Speech Processing* Michael J. Crosse, 2016    **Robust Speech Recognition of Uncertain or Missing Data** Dorothea Kolossa, Reinhold Haeb-Umbach, 2013-01-02

Automatic speech recognition suffers from a lack of robustness with respect to noise reverberation and interfering speech. The growing field of speech recognition in the presence of missing or uncertain input data seeks to ameliorate those problems by using not only a preprocessed speech signal but also an estimate of its reliability to selectively focus on those segments and features that are most reliable for recognition. This book presents the state of the art in recognition in the presence of uncertainty offering examples that utilize uncertainty information for noise robustness, reverberation robustness, simultaneous recognition of multiple speech signals and audiovisual speech recognition. The book is appropriate for scientists and researchers in the field of speech recognition who will find an overview of the state of the art in robust speech recognition, professionals working in speech recognition who will find strategies for improving recognition results in various conditions of mismatch and lecturers of advanced courses on speech processing or speech recognition who will find a reference and a comprehensive introduction to the field. The book assumes an understanding of the fundamentals of speech recognition using Hidden Markov Models.

**Audio-visual Speech Processing** Simon Lucey, 2002    *Toward a Unified Theory of Audiovisual Integration in Speech Perception* Nicholas Altieri, 2010-09-09

Auditory and visual speech recognition unfolds in real time and occurs effortlessly for normal hearing listeners. However, model theoretic descriptions of the systems level cognitive processes responsible for integrating auditory and visual speech information are currently lacking primarily because they rely too heavily on accuracy rather than reaction time predictions. Speech and language researchers have argued about whether audiovisual integration occurs in a parallel or in coactive fashion and also the extent to which audiovisual occurs in an efficient manner. The Double Factorial Paradigm introduced in Section 1 is an experimental paradigm that is equipped to address dynamical processing issues related to architecture parallel vs coactive processing as

well as efficiency capacity Experiment 1 employed a simple word discrimination task to assess both architecture and capacity in high accuracy settings Experiments 2 and 3 assessed these same issues using auditory and visual distractors in Divided Attention and Focused Attention tasks respectively Experiment 4 investigated audiovisual integration efficiency across different auditory signal to noise ratios The results can be summarized as follows Integration typically occurs in parallel with an efficient stopping rule integration occurs automatically in both focused and divided attention versions of the task and audiovisual integration is only efficient in the time domain when the clarity of the auditory signal is relatively poor although considerable individual differences were observed In Section 3 these results were captured within the milieu of parallel linear dynamic processing models with cross channel interactions Finally in Section 4 I discussed broader implications for this research including applications for clinical research and neural biological models of audiovisual convergence

**Audio-visual Speech Processing for Multimedia Localisation** Matthew Aaron Benatan,2016 **Multisensory Development** Andrew J. Bremner,David J. Lewkowicz,Charles Spence,2012-06-21 We perceive and understand our environment using many sensory systems vision touch hearing taste smell and proprioception These multiple sensory modalities give us complementary sources of information about the environment This book explores how we develop the ability to integrate our senses *The Impact of Audiovisual Speech on Working Memory During Semantic Processing* Max Hebert,2013 **Proceedings of the International Conference on Audio-Visual Speech Processing 2011** Giampiero Salvi,Kungliga tekniska högskolan. Institutionen för tal, musik och hörsel,2011 **IEEE ... Workshop on Multimedia Signal Processing** ,2004 **Handbook of Neural Networks for Speech Processing** Shigeru Katagiri,2000 Here are the comprehensive details on cutting edge technologies employing neural networks for speech recognition and speech processing in modern communications Going far beyond the simple speech recognition technologies on the market today this new book written by and for speech and signal processing engineers in industry R D and academia takes you to the forefront of the hottest emergent neural net based speech processing techniques

## Reviewing **Audiovisual Speech Processing**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is actually astonishing. Within the pages of "**Audiovisual Speech Processing**," an enthralling opus penned by a very acclaimed wordsmith, readers attempt an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve into the book's central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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