

Aggelos Katsaggelos
Fan Zhai *Editors*

Joint Source-Channel Video Transmission

Joint Source Channel Video Transmission Aggelos Katsaggelos

Liqiang Nie,Meng Liu,Xuemeng Song



Joint Source Channel Video Transmission Aggelos Katsaggelos:

Joint Source-Channel Video Transmission Fan Zhai, Aggelos Katsaggelos, 2022-06-01 This book deals with the problem of joint source channel video transmission i.e. the joint optimal allocation of resources at the application layer and the other network layers such as data rate adaptation channel coding power adaptation in wireless networks quality of service QoS support from the network and packet scheduling for efficient video transmission Real time video communication applications such as videoconferencing video telephony and on demand video streaming have gained increased popularity However a key problem in video transmission over the existing Internet and wireless networks is the incompatibility between the nature of the network conditions and the QoS requirements in terms for example of bandwidth delay and packet loss of real time video applications To deal with this incompatibility a natural approach is to adapt the end system to the network The joint source channel coding approach aims to efficiently perform content aware cross layer resource allocation thus increasing the communication efficiency of multiple network layers Our purpose in this book is to review the basic elements of the state of the art approaches toward joint source channel video transmission for wired and wireless systems In this book we present a general resource distortion optimization framework which is used throughout the book to guide our discussions on various techniques of joint source channel video transmission In this framework network resources from multiple layers are assigned to each video packet according to its level of importance It provides not only an optimization benchmark against which the performance of other sub optimal systems can be evaluated but also a useful tool for assessing the effectiveness of different error control components in practical system design This book is therefore written to be accessible to researchers expert industrial R D engineers and university students who are interested in the cutting edge technologies in joint source channel video transmission Contents Introduction Elements of a Video Communication System Joint Source Channel Coding Error Resilient Video Coding Channel Modeling and Channel Coding Internet Video Transmission Wireless Video Transmission Conclusions **Signal Recovery Techniques for Image and Video Compression and Transmission** Aggelos

Katsaggelos, Nick Galatsanos, 2013-03-09 *Signal Recovery Techniques for Image and Video Compression and Transmission* establishes a bridge between the fields of signal recovery and image and video compression Traditionally these fields have developed separately because the problems they examined were regarded as very different and the techniques used appear unrelated Recently though there is growing consent among the research community that the two fields are quite closely related Indeed in both fields the objective is to reconstruct the best possible signal from limited information The field of signal recovery which is relatively mature has long been associated with a wealth of powerful mathematical techniques such as Bayesian estimation and the theory of projections onto convex sets to name just two This book illustrates for the first time in a complete volume how these techniques can be brought to bear on the very important problems of image and video compression and transmission *Signal Recovery Techniques for Image and Video Compression and Transmission* which is

written by leading practitioners in both fields is one of the first references that addresses this approach and serves as an excellent information source for both researchers and practicing engineers *Multimodal Learning toward Micro-Video Understanding* Liqiang Nie, Meng Liu, Xuemeng Song, 2022-05-31 Micro videos a new form of user generated contents have been spreading widely across various social platforms such as Vine Kuaishou and Tik Tok Different from traditional long videos micro videos are usually recorded by smart mobile devices at any place within a few seconds Due to its brevity and low bandwidth cost micro videos are gaining increasing user enthusiasm The blossoming of micro videos opens the door to the possibility of many promising applications ranging from network content caching to online advertising Thus it is highly desirable to develop an effective scheme for the high order micro video understanding Micro video understanding is however non trivial due to the following challenges 1 how to represent micro videos that only convey one or few high level themes or concepts 2 how to utilize the hierarchical structure of the venue categories to guide the micro video analysis 3 how to alleviate the influence of low quality caused by complex surrounding environments and the camera shake 4 how to model the multimodal sequential data i e textual acoustic visual and social modalities to enhance the micro video understanding and 5 how to construct large scale benchmark datasets for the analysis These challenges have been largely unexplored to date In this book we focus on addressing the challenges presented above by proposing some state of the art multimodal learning theories To demonstrate the effectiveness of these models we apply them to three practical tasks of micro video understanding popularity prediction venue category estimation and micro video routing Particularly we first build three large scale real world micro video datasets for these practical tasks We then present a multimodal transductive learning framework for micro video popularity prediction Furthermore we introduce several multimodal cooperative learning approaches and a multimodal transfer learning scheme for micro video venue category estimation Meanwhile we develop a multimodal sequential learning approach for micro video recommendation Finally we conclude the book and figure out the future research directions in multimodal learning toward micro video understanding *Handbook of Image and Video Processing* Alan C. Bovik, 2010-07-21 55% new material in the latest edition of this must have for students and practitioners of image video processing This Handbook is intended to serve as the basic reference point on image and video processing in the field in the research laboratory and in the classroom Each chapter has been written by carefully selected distinguished experts specializing in that topic and carefully reviewed by the Editor Al Bovik ensuring that the greatest depth of understanding be communicated to the reader Coverage includes introductory intermediate and advanced topics and as such this book serves equally well as classroom textbook as reference resource Provides practicing engineers and students with a highly accessible resource for learning and using image video processing theory and algorithms Includes a new chapter on image processing education which should prove invaluable for those developing or modifying their curricula Covers the various image and video processing standards that exist and are emerging driving today s explosive industry Offers an

understanding of what images are how they are modeled and gives an introduction to how they are perceived Introduces the necessary practical background to allow engineering students to acquire and process their own digital image or video data Culminates with a diverse set of applications chapters covered in sufficient depth to serve as extensible models to the reader's own potential applications About the Editor Al Bovik is the Cullen Trust for Higher Education Endowed Professor at The University of Texas at Austin where he is the Director of the Laboratory for Image and Video Engineering LIVE He has published over 400 technical articles in the general area of image and video processing and holds two U S patents Dr Bovik was Distinguished Lecturer of the IEEE Signal Processing Society 2000 received the IEEE Signal Processing Society Meritorious Service Award 1998 the IEEE Third Millennium Medal 2000 and twice was a two time Honorable Mention winner of the international Pattern Recognition Society Award He is a Fellow of the IEEE was Editor in Chief of the IEEE Transactions on Image Processing 1996 2002 has served on and continues to serve on many other professional boards and panels and was the Founding General Chairman of the IEEE International Conference on Image Processing which was held in Austin Texas in 1994 No other resource for image and video processing contains the same breadth of up to date coverage Each chapter written by one or several of the top experts working in that area Includes all essential mathematics techniques and algorithms for every type of image and video processing used by electrical engineers computer scientists internet developers bioengineers and scientists in various image intensive disciplines

Wavelet Image Compression William Pearlman, 2022-05-31 This book explains the stages necessary to create a wavelet compression system for images and describes state of the art systems used in image compression standards and current research It starts with a high level discussion of the properties of the wavelet transform especially the decomposition into multi resolution subbands It continues with an exposition of the null zone uniform quantization used in most subband coding systems and the optimal allocation of bitrate to the different subbands Then the image compression systems of the FBI Fingerprint Compression Standard and the JPEG2000 Standard are described in detail Following that the set partitioning coders SPECK and SPIHT and EZW are explained in detail and compared via a fictitious wavelet transform in actions and number of bits coded in a single pass in the top bit plane The presentation teaches that besides producing efficient compression these coding systems except for the FBI Standard are capable of writing bit streams that have attributes of rate scalability resolution scalability and random access decoding Many diagrams and tables accompany the text to aid understanding The book is generous in pointing out references and resources to help the reader who wishes to expand his knowledge know the origins of the methods or find resources for running the various algorithms or building his own coding system Table of Contents Introduction Characteristics of the Wavelet Transform Generic Wavelet based Coding Systems The FBI Fingerprint Image Compression Standard Set Partition Embedded Block SPECK Coding Tree based Wavelet Transform Coding Systems Rate Control for Embedded Block Coders Conclusion

Virtual Reality and Virtual Environments in 10 Lectures Stanislav

Stanković,2022-06-01 The book is based on the material originally developed for the course on Virtual Reality which the author was teaching at Tampere University of Technology as well as course on Virtual Environments that the author had prepared for the University for Advancing Studies at Tempe Arizona This original purpose has influenced the structure of this book as well as the depth to which we explore the presented concepts Therefore our intention in this book is to give an introduction into the important issues regarding a series of related concepts of Virtual Reality Augmented Reality and Virtual Environments We do not attempt to go into any of these issues in depth but rather outline general principles and discuss them in a sense broad enough to provide sufficient foundations for a further study In other words we aim to provide a set of keywords to the reader in order give him a good starting point from which he could go on and explore any of these issues in detail Table of Contents Preface Acknowledgments Lecture 1 Introduction Lecture 2 History of VR and Current Applications Lecture 3 Human Senses Lecture 4 VR Systems Lecture 5 User Experience Human Computer Interaction and UI Lecture 6 Input Devices and Tracking Lecture 7 Displays Lecture 8 Networked VR Lecture 9 Augmented Reality Lecture 10 VE and Video Games Bibliography Author s Biography Index **Combating Bad Weather Part I** Sudipta Mukhopadhyay,Abhishek Kumar Tripathi,2022-06-01

Current vision systems are designed to perform in normal weather condition However no one can escape from severe weather conditions Bad weather reduces scene contrast and visibility which results in degradation in the performance of various computer vision algorithms such as object tracking segmentation and recognition Thus current vision systems must include some mechanisms that enable them to perform up to the mark in bad weather conditions such as rain and fog Rain causes the spatial and temporal intensity variations in images or video frames These intensity changes are due to the random distribution and high velocities of the raindrops Fog causes low contrast and whiteness in the image and leads to a shift in the color This book has studied rain and fog from the perspective of vision The book has two main goals 1 removal of rain from videos captured by a moving and static camera 2 removal of the fog from images and videos captured by a moving single uncalibrated camera system The book begins with a literature survey Pros and cons of the selected prior art algorithms are described and a general framework for the development of an efficient rain removal algorithm is explored Temporal and spatiotemporal properties of rain pixels are analyzed and using these properties two rain removal algorithms for the videos captured by a static camera are developed For the removal of rain temporal and spatiotemporal algorithms require fewer numbers of consecutive frames which reduces buffer size and delay These algorithms do not assume the shape size and velocity of raindrops which make it robust to different rain conditions i e heavy rain light rain and moderate rain In a practical situation there is no ground truth available for rain video Thus no reference quality metric is very useful in measuring the efficacy of the rain removal algorithms Temporal variance and spatiotemporal variance are presented in this book as no reference quality metrics An efficient rain removal algorithm using meteorological properties of rain is developed The relation among the orientation of the raindrops wind velocity and terminal velocity is established This relation is used in

the estimation of shape based features of the raindrop Meteorological property based features helped to discriminate the rain and non rain pixels Most of the prior art algorithms are designed for the videos captured by a static camera The use of global motion compensation with all rain removal algorithms designed for videos captured by static camera results in better accuracy for videos captured by moving camera Qualitative and quantitative results confirm that probabilistic temporal spatiotemporal and meteorological algorithms outperformed other prior art algorithms in terms of the perceptual quality buffer size execution delay and system cost The work presented in this book can find wide application in entertainment industries transportation tracking and consumer electronics Table of Contents Acknowledgments Introduction Analysis of Rain Dataset and Performance Metrics Important Rain Detection Algorithms Probabilistic Approach for Detection and Removal of Rain Impact of Camera Motion on Detection of Rain Meteorological Approach for Detection and Removal of Rain from Videos Conclusion and Scope of Future Work Bibliography Authors Biographies

Contextual Analysis of Videos Myo Thida,How-lung Eng,Dorothy Monekosso,Paolo Remagnino,2022-06-01 Video context analysis is an active and vibrant research area which provides means for extracting analyzing and understanding behavior of a single target and multiple targets Over the last few decades computer vision researchers have been working to improve the accuracy and robustness of algorithms to analyse the context of a video automatically In general the research work in this area can be categorized into three major topics 1 counting number of people in the scene 2 tracking individuals in a crowd and 3 understanding behavior of a single target or multiple targets in the scene This book focusses on tracking individual targets and detecting abnormal behavior of a crowd in a complex scene Firstly this book surveys the state of the art methods for tracking multiple targets in a complex scene and describes the authors approach for tracking multiple targets The proposed approach is to formulate the problem of multi target tracking as an optimization problem of finding dynamic optima pedestrians where these optima interact frequently A novel particle swarm optimization PSO algorithm that uses a set of multiple swarms is presented Through particles and swarms diversification motion prediction is introduced into the standard PSO constraining swarm members to the most likely region in the search space The social interaction among swarm and the output from pedestrians detector are also incorporated into the velocity updating equation This allows the proposed approach to track multiple targets in a crowded scene with severe occlusion and heavy interactions among targets The second part of this book discusses the problem of detecting and localising abnormal activities in crowded scenes We present a spatio temporal Laplacian Eigenmap method for extracting different crowd activities from videos This method learns the spatial and temporal variations of local motions in an embedded space and employs representatives of different activities to construct the model which characterises the regular behavior of a crowd This model of regular crowd behavior allows for the detection of abnormal crowd activities both in local and global context and the localization of regions which show abnormal behavior

The Structure and Properties of Color Spaces and the Representation of Color Images Eric Dubois,2022-05-31

This lecture describes the author's approach to the representation of color spaces and their use for color image processing. The lecture starts with a precise formulation of the space of physical stimuli light. The model includes both continuous spectra and monochromatic spectra in the form of Dirac deltas. The spectral densities are considered to be functions of a continuous wavelength variable. This leads into the formulation of color space as a three-dimensional vector space with all the associated structure. The approach is to start with the axioms of color matching for normal human viewers, often called Grassmann's laws, and developing the resulting vector space formulation. However, once the essential defining element of this vector space is identified, it can be extended to other color spaces, perhaps for different creatures and devices, and dimensions other than three. The CIE spaces are presented as main examples of color spaces. Many properties of the color space are examined. Once the vector space formulation is established, various useful decompositions of the space can be established. The first such decomposition is based on luminance, a measure of the relative brightness of a color. This leads to a direct sum decomposition of color space where a two-dimensional subspace identifies the chromatic attribute and a third coordinate provides the luminance. A different decomposition involving a projective space of chromaticity classes is then presented. Finally, it is shown how the three types of color deficiencies present in some groups of humans lead to a direct sum decomposition of three one-dimensional subspaces that are associated with the three types of cone photoreceptors in the human retina. Next, a few specific linear and nonlinear color representations are presented. The color spaces of two digital cameras are also described. Then the issue of transformations between different color spaces is addressed. Finally, these ideas are applied to signal and system theory for color images. This is done using a vector signal approach where a general linear system is represented by a three-by-three system matrix. The formulation is applied to both continuous and discrete space images, and specific problems in color filter array sampling and displays are presented for illustration. The book is mainly targeted to researchers and graduate students in fields of signal processing related to any aspect of color imaging.

Combating Bad Weather Part II Sudipta Mukhopadhyay, Abhishek Kumar Tripathi, 2022-05-31 Every year lives and properties are lost in road accidents. About one-fourth of these accidents are due to low vision in foggy weather. At present, there is no algorithm that is specifically designed for the removal of fog from videos. Application of a single image fog removal algorithm over each video frame is a time-consuming and costly affair. It is demonstrated that with the intelligent use of temporal redundancy, fog removal algorithms designed for a single image can be extended to the real-time video application. Results confirm that the presented framework used for the extension of the fog removal algorithms for images to videos can reduce the complexity to a great extent with no loss of perceptual quality. This paves the way for the real-life application of the video fog removal algorithm. In order to remove fog, an efficient fog removal algorithm using anisotropic diffusion is developed. The presented fog removal algorithm uses new dark channel assumption and anisotropic diffusion for the initialization and refinement of the airlight map, respectively. Use of anisotropic diffusion helps to estimate the better airlight

map estimation The said fog removal algorithm requires a single image captured by uncalibrated camera system The anisotropic diffusion based fog removal algorithm can be applied in both RGB and HSI color space This book shows that the use of HSI color space reduces the complexity further The said fog removal algorithm requires pre and post processing steps for the better restoration of the foggy image These pre and post processing steps have either data driven or constant parameters that avoid the user intervention Presented fog removal algorithm is independent of the intensity of the fog thus even in the case of the heavy fog presented algorithm performs well Qualitative and quantitative results confirm that the presented fog removal algorithm outperformed previous algorithms in terms of perceptual quality color fidelity and execution time The work presented in this book can find wide application in entertainment industries transportation tracking and consumer electronics

Dictionary Learning in Visual Computing Qiang Zhang, Baoxin Li, 2022-05-31 The last few years have witnessed fast development on dictionary learning approaches for a set of visual computing tasks largely due to their utilization in developing new techniques based on sparse representation Compared with conventional techniques employing manually defined dictionaries such as Fourier Transform and Wavelet Transform dictionary learning aims at obtaining a dictionary adaptively from the data so as to support optimal sparse representation of the data In contrast to conventional clustering algorithms like K means where a data point is associated with only one cluster center in a dictionary based representation a data point can be associated with a small set of dictionary atoms Thus dictionary learning provides a more flexible representation of data and may have the potential to capture more relevant features from the original feature space of the data One of the early algorithms for dictionary learning is K SVD In recent years many variations extensions of K SVD and other new algorithms have been proposed with some aiming at adding discriminative capability to the dictionary and some attempting to model the relationship of multiple dictionaries One prominent application of dictionary learning is in the general field of visual computing where long standing challenges have seen promising new solutions based on sparse representation with learned dictionaries With a timely review of recent advances of dictionary learning in visual computing covering the most recent literature with an emphasis on papers after 2008 this book provides a systematic presentation of the general methodologies specific algorithms and examples of applications for those who wish to have a quick start on this subject

Remote Sensing Image Processing Gustavo Camps-Valls, Devis Tuia, Luis Gómez-Chova, Sandra Jiménez, Jesus Malo, 2022-06-01 Earth observation is the field of science concerned with the problem of monitoring and modeling the processes on the Earth surface and their interaction with the atmosphere The Earth is continuously monitored with advanced optical and radar sensors The images are analyzed and processed to deliver useful products to individual users agencies and public administrations To deal with these problems remote sensing image processing is nowadays a mature research area and the techniques developed in the field allow many real life applications with great societal value For instance urban monitoring fire detection or flood prediction can have a great impact on economical and environmental issues To attain such

objectives the remote sensing community has turned into a multidisciplinary field of science that embraces physics signal theory computer science electronics and communications From a machine learning and signal image processing point of view all the applications are tackled under specific formalisms such as classification and clustering regression and function approximation data coding restoration and enhancement source unmixing data fusion or feature selection and extraction This book covers some of the fields in a comprehensive way Table of Contents Remote Sensing from Earth Observation Satellites The Statistics of Remote Sensing Images Remote Sensing Feature Selection and Extraction Classification Spectral Mixture Analysis Estimation of Physical Parameters **Image Fusion in Remote Sensing** Arian Azarang,Nasser

Kehtarnavaz,2022-05-31 Image fusion in remote sensing or pansharpening involves fusing spatial panchromatic and spectral multispectral images that are captured by different sensors on satellites This book addresses image fusion approaches for remote sensing applications Both conventional and deep learning approaches are covered First the conventional approaches to image fusion in remote sensing are discussed These approaches include component substitution multi resolution and model based algorithms Then the recently developed deep learning approaches involving single objective and multi objective loss functions are discussed Experimental results are provided comparing conventional and deep learning approaches in terms of both low resolution and full resolution objective metrics that are commonly used in remote sensing The book is concluded by stating anticipated future trends in pansharpening or image fusion in remote sensing **Image**

Understanding using Sparse Representations Jayaraman J. Thiagarajan,Karthikeyan Natesan Ramamurthy,Pavan Turaga,Andreas Spanias,2022-06-01 Image understanding has been playing an increasingly crucial role in several inverse problems and computer vision Sparse models form an important component in image understanding since they emulate the activity of neural receptors in the primary visual cortex of the human brain Sparse methods have been utilized in several learning problems because of their ability to provide parsimonious interpretable and efficient models Exploiting the sparsity of natural signals has led to advances in several application areas including image compression denoising inpainting compressed sensing blind source separation super resolution and classification The primary goal of this book is to present the theory and algorithmic considerations in using sparse models for image understanding and computer vision applications To this end algorithms for obtaining sparse representations and their performance guarantees are discussed in the initial chapters Furthermore approaches for designing overcomplete data adapted dictionaries to model natural images are described The development of theory behind dictionary learning involves exploring its connection to unsupervised clustering and analyzing its generalization characteristics using principles from statistical learning theory An exciting application area that has benefited extensively from the theory of sparse representations is compressed sensing of image and video data Theory and algorithms pertinent to measurement design recovery and model based compressed sensing are presented The paradigm of sparse models when suitably integrated with powerful machine learning frameworks can lead to advances in

computer vision applications such as object recognition clustering segmentation and activity recognition Frameworks that enhance the performance of sparse models in such applications by imposing constraints based on the prior discriminatory information and the underlying geometrical structure and kernelizing the sparse coding and dictionary learning methods are presented In addition to presenting theoretical fundamentals in sparse learning this book provides a platform for interested readers to explore the vastly growing application domains of sparse representations

Super Resolution of Images and Video Aggelos K. Katsaggelos, Rafael Molina, Javier Mateos, 2022-05-31 This book focuses on the super resolution of images and video The authors use of the term super resolution SR is used to describe the process of obtaining a high resolution HR image or a sequence of HR images from a set of low resolution LR observations This process has also been referred to in the literature as resolution enhancement RE SR has been applied primarily to spatial and temporal RE but also to hyperspectral image enhancement This book concentrates on motion based spatial RE although the authors also describe motion free and hyperspectral image SR problems Also examined is the very recent research area of SR for compression which consists of the intentional downsampling during pre processing of a video sequence to be compressed and the application of SR techniques during post processing on the compressed sequence It is clear that there is a strong interplay between the tools and techniques developed for SR and a number of other inverse problems encountered in signal processing e g image restoration motion estimation SR techniques are being applied to a variety of fields such as obtaining improved still images from video sequences video printing high definition television high performance color Liquid Crystal Display LCD screens improvement of the quality of color images taken by one CCD video surveillance remote sensing and medical imaging The authors believe that the SR RE area has matured enough to develop a body of knowledge that can now start to provide useful and practical solutions to challenging real problems and that SR techniques can be an integral part of an image and video codec and can drive the development of new coder decoders codecs and standards

Proceedings, 2005 *Joint Source-channel Video Transmission* Fan Zhai, Aggelos Katsaggelos, 2007 Examines the problem of joint source channel video transmission the joint optimal allocation of resources at the application layer and the other network layers such as data rate adaptation channel coding power adaptation in wireless networks quality of service QoS support from the network and packet scheduling for efficient video transmission

Conference Proceedings, 2004 *4G Wireless Video Communications* Haohong Wang, Lisimachos Kondi, Ajay Luthra, Song Ci, 2009-06-15 A comprehensive presentation of the video communication techniques and systems this book examines 4G wireless systems which are set to revolutionise ubiquitous multimedia communication 4G Wireless Video Communications covers the fundamental theory and looks at systems descriptions with a focus on digital video It addresses the key topics associated with multimedia communication on 4G networks including advanced video coding standards error resilience and error concealment techniques as well as advanced content analysis and adaptation techniques for video communications cross layer design and optimization frameworks and methods It also

provides a high level overview of the digital video compression standard MPEG 4 AVC H 264 that is expected to play a key role in 4G networks Material is presented logically allowing readers to turn directly to specific points of interest The first half of the book covers fundamental theory and systems while the second half moves onto advanced techniques and applications This book is a timely reflection of the latest advances in video communications for 4G wireless systems One of the first books to study the latest video communications developments for emerging 4G wireless systems Considers challenges and techniques in video delivery over 4G wireless systems Examines system architecture key techniques and related standards of advanced wireless multimedia applications Written from both the perspective of industry and academia Joint
Source-Channel Video Transmission : Image, Video & Multimedia Processing Fan Zhai,2007

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