

Motion Estimation Algorithms For Video Compression The Springer International Series In Engineering And Computer Science

Video compression technology aims at compressing large amount of video data for efficient transmission and storage without significant loss of quality. Most video compression techniques rely on removing temporal data redundancy between frames using motion estimation and motion compensation techniques which are generally very computationally expensive. The objective of the research done in this thesis is to develop new efficient motion estimation techniques that reduce the computational complexity of motion estimation. The thesis presents a new prediction technique referred to as weighted sum block matching (WSBM) which dynamically reduces the computational complexity by limiting the search to a small subset of the search area. Simulation results have shown that adding WSBM to some well-known search algorithms reduces their computational complexity by 6-1.5 without affecting the visual quality of the reconstructed video frames. The thesis also presents two new algorithms based on the simplex optimization method. the simplex based block matching algorithm (SMPLX) and the flexible triangle search (FTS). Both techniques use a triangle that moves inside the search area and checks only positions that lie at its vertices. As a result the computational complexity of the search is reduced since it depends directly on the number of positions checked. The techniques can change the size and orientation of the search triangle during the search. The changes make the search highly flexible and efficient and reduce the number of search positions to be checked compared to those in other search algorithms. The SMPLX uses equations based on the simplex optimization method to compute the new triangle size and orientation. The FTS, on the other hand, was implemented to be more suitable for a digital search grid by using look-up tables and integer computations. The two algorithms were implemented as part of the H.263 and H.264 encoders. Both algorithms were compared to the state of the a.

Este trabalho teve por objetivo estudar algoritmos de estimação de movimento baseados na técnica de casamento de bloco a fim de avaliar a importância da sua escolha na construção de um codificador para uso em compressão de seqüência de imagens. Para isto foram estudados quatro algoritmos baseados na técnica de casamento de bloco, sendo verificada a interdependência existente entre os vários parâmetros que os compõem, tais como, tamanho da área de busca, critérios de medida de distorção entre blocos e tamanhos de blocos, em relação à qualidade da imagem reconstruída.

Real-Time Video Compression: Techniques and Algorithms introduces the XYZ video compression technique, which operates in three dimensions, eliminating the overhead of motion estimation. First, video compression standards, MPEG and H.261/H.263, are described. They both use asymmetric compression algorithms, based on motion estimation. Their encoders are much more complex than decoders. The XYZ technique uses a symmetric algorithm, based on the Three-Dimensional Discrete Cosine Transform (3D-DCT). 3D-DCT was originally suggested for compression about twenty years ago; however, at that time the computational complexity of the algorithm was too

high, it required large buffer memory, and was not as effective as motion estimation. We have resurrected the 3D-DCT-based video compression algorithm by developing several enhancements to the original algorithm. These enhancements make the algorithm feasible for real-time video compression in applications such as video-on-demand, interactive multimedia, and videoconferencing. The demonstrated results, presented in this book, suggest that the XYZ video compression technique is not only a fast algorithm, but also provides superior compression ratios and high quality of the video compared to existing standard techniques, such as MPEG and H.261/H.263. The elegance of the XYZ technique is in its simplicity, which leads to inexpensive VLSI implementation of any XYZ codec. Real-Time Video Compression: Techniques and Algorithms can be used as a text for graduate students and researchers working in the area of real-time video compression. In addition, the book serves as an essential reference for professionals in the field.

This book is part of a three-volume set that constitutes the refereed proceedings of the 11th International Conference on Knowledge-Based Intelligent Information and Engineering Systems, KES 2007. Coverage in this first volume includes artificial neural networks and connectionists systems, fuzzy and neuro-fuzzy systems, evolutionary computation, machine learning and classical AI, agent systems, and information engineering and applications in ubiquitous computing environments.

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In recent years, the paradigm of video coding has shifted from that of a frame-based approach to a content-based approach, particularly with the finalization of the ISO multimedia coding standard, MPEG-4. MPEG-4 is the emerging standard for the coding of multimedia content. It defines a syntax for a set of content-based functionalities, namely, content-based interactivity, compression and universal access. However, it does not specify how the video content is to be generated. To generate the video content, video has to be segmented into video objects and tracked as they transverse across the video frames. This book addresses the difficult problem of video segmentation, and the extraction and tracking of video object planes as defined in MPEG-4. It then focuses on the specific issue of face segmentation and coding as applied to videoconferencing in order to improve the quality of videoconferencing images especially in the facial region. Modal-based coding is a content-based coding technique used to code synthetic objects that have become an important part of video content. It results in extremely low bit rates because only the parameters needed to represent the modal are transmitted. Model-based coding is included to provide background information for the synthetic object coding in MPEG-4. Lastly, MPEG-4, the first coding standard for multimedia content is described in detail. The topics covered include the coding of audio objects, the coding of natural and synthetic video objects, and error resilience. Advanced Video Coding is one of the first books on content-based coding and MPEG-4 coding standard. It serves as an excellent information source and reference for both researchers and practicing engineers.

The need of video compression in the modern age of visual communication cannot be over-emphasized. This monograph will provide useful information to the postgraduate students and researchers who wish to work in the domain of VLSI design for video processing applications. In this book, one can find an in-depth discussion of several motion estimation algorithms and their VLSI implementation as conceived and developed by the authors. It records an account of research done involving fast three step search, successive elimination, one-bit transformation and its effective combination with diamond search and dynamic pixel truncation techniques. Two appendices provide a number of instances of proof of concept through Matlab and Verilog program segments. In this aspect, the book can be considered as first of its kind. The architectures have been developed with an eye to their applicability in everyday low-power handheld appliances including video camcorders and smartphones. H.264 Advanced Video Coding or MPEG-4 Part 10 is fundamental to a growing range of markets such as high definition broadcasting, internet video sharing, mobile video and digital surveillance. This book reflects the growing importance and implementation of H.264 video technology. Offering a detailed overview of the system, it explains the syntax, tools and features of H.264 and equips readers with practical advice on how to get the most out of the standard. Packed with clear examples and illustrations to explain H.264 technology in an accessible and practical way. Covers basic video coding concepts, video formats and visual quality. Explains how to measure and optimise the performance of H.264 and how to balance bitrate, computation and video quality. Analyses recent work on scalable and multi-view versions of H.264, case studies of H.264 codecs and new technological developments such as the popular High Profile extensions. An invaluable companion for developers, broadcasters, system integrators, academics and students who want to master this burgeoning state-of-the-art technology. "[This book] unravels the mysteries behind the latest H.264 standard and delves deeper into each of the operations in the codec. The reader can implement (simulate, design, evaluate, optimize) the codec with all profiles and levels. The book ends with extensions and directions (such as SVC and MVC) for further research." Professor K. R. Rao, The University of Texas at Arlington, co-inventor of the Discrete Cosine Transform

Video technology promises to be the key for the transmission of motion video. A number of video compression techniques and standards have been introduced in the past few years, particularly the MPEG-1 and MPEG-2 for interactive multimedia and for digital NTSC and HDTV applications, and H.261/H.263 for video telecommunications. These techniques use motion estimation techniques to reduce the amount of data that is stored and transmitted for each frame. This book is about these motion estimation algorithms, their complexity, implementations, advantages, and drawbacks. First, we present an overview of video compression techniques with an emphasis to techniques that use motion estimation, such as MPEG and H.261/H.263. Then, we give a survey of current

motion estimation search algorithms, including the exhaustive search and a number of fast search algorithms. An evaluation of current search algorithms, based on a number of experiments on several test video sequences, is presented as well. The theoretical framework for a new fast search algorithm, Densely-Centered Uniform-P Search (DCUPS), is developed and presented in the book. The complexity of the DCUPS algorithm is comparable to other popular motion estimation techniques, however the algorithm shows superior results in terms of compression ratios and video quality. We should stress out that these new results, presented in Chapters 4 and 5, have been developed by Joshua Greenberg, as part of his M.Sc. thesis entitled "Densely-Centered Uniform P-Search: A Fast Motion Estimation Algorithm" (FAU, 1996).

This book discusses data communication and computer networking, communication technologies and the applications of IoT (Internet of Things), big data, cloud computing and healthcare informatics. It explores, examines and critiques intelligent data communications and presents inventive methodologies in communication technologies and IoT. Aimed at researchers and academicians who need to understand the importance of data communication and advanced technologies in IoT, it offers different perspectives to help readers increase their knowledge and motivates them to conduct research in the area, highlighting various innovative ideas for future research.

This second edition provides easy access to important concepts, issues and technology trends in the field of multimedia technologies, systems, techniques, and applications. Over 1,100 heavily-illustrated pages — including 80 new entries — present concise overviews of all aspects of software, systems, web tools and hardware that enable video, audio and developing media to be shared and delivered electronically.

Multi-Frame Motion-Compensated Prediction for Video Transmission presents a comprehensive description of a new technique in video coding and transmission. The work presented in the book has had a very strong impact on video coding standards and will be of interest to practicing engineers and researchers as well as academics. The multi-frame technique and the Lagrangian coder control have been adopted by the ITU-T as an integral part of the well known H.263 standard and are were adopted in the ongoing H.26L project of the ITU-T Video Coding Experts Group. This work will interest researchers and students in the field of video coding and transmission. Moreover, engineers in the field will also be interested since an integral part of the well known H.263 standard is based on the presented material.

The book deals with the development of a methodology to estimate the motion field between two frames for video coding applications. This book proposes an exhaustive study of the motion estimation process in the framework of a general video coder. The conceptual explanations are discussed in a simple language and with the use of suitable figures. The book will serve as a guide for new researchers working in the field of motion estimation techniques.

The volume comprises of papers presented at the first CADEC-2019 conference held at Vellore Institute of Technology-Andhra Pradesh, Amaravati, India. The book contains computer simulated results in various areas of electronics and communication engineering such as, VLSI and embedded systems, wireless communication, signal

processing, power electronics and control theory applications. This volume will help researchers and engineers to develop and extend their ideas in upcoming research in electronics and communication.

Search algorithms aim to find solutions or objects with specified properties and constraints in a large solution search space or among a collection of objects. A solution can be a set of value assignments to variables that will satisfy the constraints or a sub-structure of a given discrete structure. In addition, there are search algorithms, mostly probabilistic, that are designed for the prospective quantum computer. This book demonstrates the wide applicability of search algorithms for the purpose of developing useful and practical solutions to problems that arise in a variety of problem domains. Although it is targeted to a wide group of readers: researchers, graduate students, and practitioners, it does not offer an exhaustive coverage of search algorithms and applications. The chapters are organized into three parts: Population-based and quantum search algorithms, Search algorithms for image and video processing, and Search algorithms for engineering applications.

UP-TO-DATE, TECHNICALLY ACCURATE COVERAGE OF ESSENTIAL TOPICS IN IMAGE AND VIDEO PROCESSING This is the first book to combine image and video processing with a practical MATLAB®-oriented approach in order to demonstrate the most important image and video techniques and algorithms. Utilizing minimal math, the contents are presented in a clear, objective manner, emphasizing and encouraging experimentation. The book has been organized into two parts. Part I: Image Processing begins with an overview of the field, then introduces the fundamental concepts, notation, and terminology associated with image representation and basic image processing operations. Next, it discusses MATLAB® and its Image Processing Toolbox with the start of a series of chapters with hands-on activities and step-by-step tutorials. These chapters cover image acquisition and digitization; arithmetic, logic, and geometric operations; point-based, histogram-based, and neighborhood-based image enhancement techniques; the Fourier Transform and relevant frequency-domain image filtering techniques; image restoration; mathematical morphology; edge detection techniques; image segmentation; image compression and coding; and feature extraction and representation. Part II: Video Processing presents the main concepts and terminology associated with analog video signals and systems, as well as digital video formats and standards. It then describes the technically involved problem of standards conversion, discusses motion estimation and compensation techniques, shows how video sequences can be filtered, and concludes with an example of a solution to object detection and tracking in video sequences using MATLAB®. Extra features of this book include: More than 30 MATLAB® tutorials, which consist of step-by-step guides to exploring image and video processing techniques using MATLAB® Chapters supported by figures, examples, illustrative problems, and exercises Useful websites and an extensive list of bibliographical references This accessible text is ideal for upper-level undergraduate and graduate students in digital image and video processing courses, as well as for engineers, researchers, software

developers, practitioners, and anyone who wishes to learn about these increasingly popular topics on their own.

With the increasing popularity of technologies such as Internet streaming video and video conferencing, video compression has become an essential component of broadcast and entertainment media. Motion Estimation (ME) and compensation techniques, which can eliminate temporal redundancy between adjacent frames effectively, have been widely applied to popular video compression coding standards such as MPEG-2, MPEG-4. Traditional fast block matching algorithms are easily trapped into the local minima resulting in degradation on video quality to some extent after decoding. Since Evolutionary Computing Techniques are suitable for achieving global optimal solution, these techniques are introduced to do Motion Estimation procedure in this thesis. Zero Motion prejudgement is also included which aims at finding static macroblocks (MB) which do not need to perform remaining search thus reduces the computational cost. Simulation results obtained show that the proposed Clonal Particle Swarm Optimization algorithm given a very good improvement in reducing the computations overhead and achieves very good Peak Signal to Noise Ratio (PSNR) values, which makes the techniques more efficient than the conventional searching algorithms. To reduce the Motion vector overhead in Bidirectional frame prediction, in this thesis novel Bidirectional Motion Estimation algorithm based on PSO is also proposed and results shows that the proposed method can significantly reduces the computational complexity involved in the Bidirectional frame prediction and also least prediction error in all video sequences.

Image and Video Compression Standards: Algorithms and Architectures presents an introduction to the algorithms and architectures that underpin the image and video compression standards, including JPEG (compression of still images), H.261 (video teleconferencing), MPEG-1 and MPEG-2 (video storage and broadcasting). In addition, the book covers the MPEG and Dolby AC-3 audio encoding standards, as well as emerging techniques for image and video compression, such as those based on wavelets and vector quantization. The book emphasizes the foundations of these standards, i.e. techniques such as predictive coding, transform-based coding, motion compensation, and entropy coding, as well as how they are applied in the standards. How each standard is implemented is not dealt with, but the book does provide all the material necessary to understand the workings of each of the compression standards, including information that can be used to evaluate the efficiency of various software and hardware implementations conforming to the standards. Particular emphasis is placed on those algorithms and architectures that have been found to be useful in practical software or hardware implementations. Audience: A valuable reference for the graduate student, researcher or engineer. May also be used as a text for a course on the subject.

Motion estimation is a key issue in the field of moving images analysis. In the

framework of video coding, it is combined with motion compensation in order to exploit the spatio temporal correlation of image sequences along the motion trajectory. It then achieves one of the most important compression factors of a video coder. By dividing each frame into rectangular blocks, motion vectors are obtained via the block matching algorithms (BMA). The full search algorithm (FS) is a brute force BMA. It searches all possible locations inside the search window in the reference frame to provide an optimal solution. However, its high computational complexity makes it often not suitable for real-time implementation. Many fast but sub-optimal algorithms are introduced to improve the performance of video coders. The present book analyses three prospects of improving the quality of existing video coding schemes. Namely, one at a time optimization, adaptive search stagey and feature domain based criteria. The objective of my research is reducing the complexity of video coding standards in real-time scalable and multi-view applications.

MPEG-4 is the multimedia standard for combining interactivity, natural and synthetic digital video, audio and computer-graphics. Typical applications are: internet, video conferencing, mobile videophones, multimedia cooperative work, teleteaching and games. With MPEG-4 the next step from block-based video (ISO/IEC MPEG-1, MPEG-2, CCITT H.261, ITU-T H.263) to arbitrarily-shaped visual objects is taken. This significant step demands a new methodology for system analysis and design to meet the considerably higher flexibility of MPEG-4. Motion estimation is a central part of MPEG-1/2/4 and H.261/H.263 video compression standards and has attracted much attention in research and industry, for the following reasons: it is computationally the most demanding algorithm of a video encoder (about 60-80% of the total computation time), it has a high impact on the visual quality of a video encoder, and it is not standardized, thus being open to competition. Algorithms, Complexity Analysis, and VLSI Architectures for MPEG-4 Motion Estimation covers in detail every single step in the design of a MPEG-1/2/4 or H.261/H.263 compliant video encoder: Fast motion estimation algorithms Complexity analysis tools Detailed complexity analysis of a software implementation of MPEG-4 video Complexity and visual quality analysis of fast motion estimation algorithms within MPEG-4 Design space on motion estimation VLSI architectures Detailed VLSI design examples of (1) a high throughput and (2) a low-power MPEG-4 motion estimator. Algorithms, Complexity Analysis and VLSI Architectures for MPEG-4 Motion Estimation is an important introduction to numerous algorithmic, architectural and system design aspects of the multimedia standard MPEG-4. As such, all researchers, students and practitioners working in image processing, video coding or system and VLSI design will find this book of interest.

This comprehensive and state-of-the art approach to video processing gives engineers and students a comprehensive introduction and includes full coverage of key applications: wireless video, video networks, video indexing and retrieval and use of video in speech processing. Containing all the essential methods in

video processing alongside the latest standards, it is a complete resource for the professional engineer, researcher and graduate student. Numerous conceptual and numerical examples All the latest standards are thoroughly covered: MPEG-1, MPEG-2, MPEG-4, H.264 and AVC Coverage of the latest techniques in video security "Like its sister volume "The Essential Guide to Image Processing," Professor Bovik's Essential Guide to Video Processing provides a timely and comprehensive survey, with contributions from leading researchers in the area. Highly recommended for everyone with an interest in this fascinating and fast-moving field." —Prof. Bernd Girod, Stanford University, USA * Edited by a leading person in the field who created the IEEE International Conference on Image Processing, with contributions from experts in their fields. * Numerous conceptual and numerical examples *All the latest standards are thoroughly covered: MPEG-1, MPEG-2, MPEG-4, H.264 and AVC. * Coverage of the latest techniques in video security

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