A Spatial Scalable Video Coding with Selective Data Transmission using Wavelet Decomposition

by

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Abstract

In this research a scalable video coding framework is proposed, mainly focusing on spatial scalability, and a subjective data compression algorithm based on: (1) quality, (2) resolution (target output device), and (3) bandwidth. This framework enables the scalable delivery of video based on the output display resolution, and through a congested network or limited bandwidth with an acceptable visual quality.

In order to achieve this scalable framework we have used wavelets, for greater flexibility, and a multiresolution approach. The multiresolution motion estimation (MRME) provides the reusability of motion vectors across different resolution levels. In MRME the motion estimation, which is carried out in the wavelet domain, is initially performed in the lower resolution and the resultant motion vectors are used as a basic motion estimate in other higher resolutions. The translation of motion vectors across different resolution levels results in translation error or mismatches. These mismatches are identified using a novel approach, which uses two thresholds. The first threshold is used to determine the possible occurrence of mismatches in a given video frame subject to the motion in the previous frame. This helps to give a broader location of all the mismatches in general. In order to specifically focus on the worst mismatches among them another threshold is used. This gives a more accurate identification of the mismatches that definitely need to be handled while the others can be waived depending upon the available resources. By varying these two parameters, the quality and resolution of the video can be adjusted to suit the bandwidth requirements. The next step is about handling the identified mismatches. The refinements are handled in any of the following two ways: by using motion vector correction, which gives improved prediction, or by using the directly replacing the error block. We have also presented a brief comparative study of the two error correction methods, discussing their benefits and drawbacks.

The methods used here give a precise motion estimate thereby utilizing the temporal redundancy in an efficient manner and providing an effective scalability solution. This scalable framework is useful to provide a flexible multiresolution adaptation to various network and terminal capabilities, to provide quality degradation during severe network conditions, and to provide better error robustness.

Statement of Originality

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Signed

Date

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Presentation

Veerapandian, L., Sorell, M., and White, L., (2007), "Scalable video coding using multiresolution motion estimation", *Australian Communications Theory Workshop*, Adelaide, February.

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Acronym

2D	2 Dimensional
3D	3 Dimensional
4CIF	4 Common Intermediate Format
16CIF	16 Common Intermediate Format
ADSL	Asymmetric Digital Subscriber Line
ADSL 2+	Enhanced version of ADSL
B frame	Bi-directionally predictive coded frame
bmp	bitmap – an image format
bpp	bits/pixel
bps	bit/ s
CCIR	International Consultative Committee for Radio
CCITT	International Telegraph and Telephony Consultative Committee
CD-ROM	Compact Disc Read Only Memory
CIF	Common Intermediate Format
DCT	Discrete Cosine Transform
DFT	Discrete Fourier Transform
DSL	Digital Subscriber Line
DWT	Discrete Wavelet Transform
EBCOT	Embedded Block Coding with Optimized Truncation
EC	Error Correction
EZW	Embedded Zerotree Wavelet
fps	frames per second
FGS	Fine Granular Scalability
FGST	Fine Granular Scalability with Temporal scalability
G bits/s	Giga bits/second
GOP	Group of Pictures
GPRS	General Packet Radio Service
GSM	Global Systems for Mobile communications
HDTV	High Definition Television
HPC	Handheld Personal Computer

HVS	Human Visual System
I frame	Intra coded frame
IEC	International Electrotechnical Commission
ISDN	Integrated Services Digital Network
ITU-R	International Telecommunications Union – Radio Sector
ITU-T	International Telecommunications Union – Telecommunication Standardisation Sector
ISO	International Organisation for Standardisation
JPEG	Joint Photographic Experts Group
k bps	kilo bits per second (kilo = 1000)
KLT	Karhunen-Loeve Transform
LAN	Local Area Network
M bps	Mega bits/second
MATLAB	Matrix Laboratory
MC	Motion Compensation
MC-EZBC	Motion Compensated – Embedded Zero Block Coding
MCP	Motion Compensated Prediction
MCTF	Motion Compensated Temporal Filtering
ME	Motion Estimation
MPEG	Moving Pictures Experts Group
MRME	Multiresolution Motion Estimation
MSE	Mean Square Error
NTSC	National Television System Committee
P frame	Predictive coded frame
PAL	Phase Alteration Line
PC	Personal Computer
PDA	Personal Digital Assistant
PSNR	Peak Signal-to-Noise Ratio
PSTN	Public Switched Telephone Network
QCIF	Quarter Common Intermediate Format
QMF	Quadrature Mirror Filter

QSIF	Quarter Source Input Format
RGB	Red-Green-Blue color components
SAD	Sum of Absolute Difference
SECAM	Sequentiel Couleur Aavec Memoire
SDT	Selective Data Transmission
SIF	Source Output Format
SNR	Signal-to-Noise Ratio
SPIHT	Set Partitioning in Hierarchical Trees
SQCIF	Sub-Quarter Common Intermediate Format (also known as Sub-QCIF)
Sub-QCIF	see SQCIF
T1 line	A dedicated phone connection supporting a 1.522 Mbps data rate
TV	Television
UMTS	Universal Mobile Telecommunication System
VHS	Video Home System
WLAN	Wireless Local Area Network
YCbCr	Luminance and Chrominance color components
YUV	see YCbCr