MPEG

MPEG Moving Picture Coding Experts Group
pronounced M-peg

Family of international standards used for
coding audio-visual information in a digital compressed format

Includes MPEG-1 MPEG-2 MPEG-4
Technically, the standards are ISO/IEC-11172, ISO/IEC-13818 and ISO/IEC-14496

MPEG is originally the name given to the group of experts that developed the standards
Now is technically ISO/IEC JTC1/SC29/WG11
Is part of JTC1 - Joint ISO/IEC Technical Committee on Information Technology

Organization

First meeting May 1988 - 25 members
Today, typically ~350 experts from some 200 companies and organizations from about 20 countries take part in MPEG meetings
Meets three times a year - more if needed

Note: MPEG does not specify how to perform compression.
Describes a set of minimum requirements which the MPEG decoder must live up to
In particular, it defines a fictitious MPEG decoder, that incorporates the minimum requirements which determine whether something is MPEG or not

MPEG
Considers explicitly functionalities of other standards, e.g., it uses JPEG
Defines video, audio coding and system data streams with synchronization
Provides information on:
- Aspect Ratio
  - 1:1 corresponds to computer graphics
  - 4:3 corresponds to 702x575 pixels (TV format)
  - 16:9 corresponds to 625/525 lines (HDTV format).
- Refresh Frequency - 8 frequencies are encoded allowing for different nationalities

Core technology includes many different patents, but the MPEG committee only sets the technical standards without dealing with patents and intellectual property issues

MPEG-1 Audio and Video (July 1989) 1992 (Initiated date) adopted date
MPEG-2 Audio and Video (July 1991) 1994
MPEG-4 Audio and Video (July 1995) 1998

MPEG-1 was designed specifically for delivering video from a single speed CD-ROM drive.
Official name:
"Coding of Moving Pictures and Associated Audio for Digital Storage Media
at up to about 1.5 Megabits per second."
Compression for storage
1.5Mbps
Frame-based Compression

MPEG-2
Digital TV - HDTV
6.0 Mbps
Frame-based Compression
MPEG-2 is the video standard for DVD players.

MPEG-4
Multimedia Applications
Low bit rate
Object based compression

MPEG - 1

Level 1	System	describes synchronization and multiplexing of video and audio.
Level 2	Video	describes compression of non-interlaced video signals.
Level 3	Audio	describes compression of audio signals using high performance perceptual coding schemes.
Level 4	Compliance Testing	describes procedures for determining the characteristics of coded bit-streams and the decoding process and for testing compliance with the requirements stated in the other parts.

MPEG-3
Initially intended to cover HDTV
MPEG-2 was finessed to cover the requirements of HDTV
MPEG-3 was dropped.

MPEG-4
Initially specified for very low bit rates but now it supports up to 4Mbps

Level 1	Systems
Level 2	Visual
Level 3	Audio
Level 4	Conformance testing
Level 5	Software
Level 6	Delivery Multimedia Integration Framework (DMIF)

Designed for use in broadcast, interactive and conversational environments

MPEG-7
Formally 'Multimedia Content Description Interface'.

MPEG-7 will not replace MPEG-1, MPEG-2 or MPEG-4
application examples
- Digital libraries
- Multimedia directory services

How is it done??
First – generalities:
A video consists of a time-ordered sequence of frames, i.e., images.

Obvious solution to video compression would be predictive coding based on previous frames

Compression proceeds by subtracting images: subtract in time order and code the residual error

Compression with motion compensation
Consecutive frames in a video are similar - temporal redundancy exists.
Exploit temporal redundancy so that not every frame of the video needs to be coded independently as a new image

Steps of Video compression based on Motion Compensation (MC):
1. Motion Estimation (motion vector search).
2. MC-based Prediction.
3. Derivation of the prediction error, i.e., the difference.

Each image is divided into macroblocks of size N by N.
By default, N = 16 for luminance images, N =8 for chrominance images

The current image frame is referred to as Target Frame.
A match is sought between the macroblock in the Target Frame and the most similar macroblock in previous and/or future frame(s) (referred to as Reference frame(s)).
The displacement of the reference macroblock to the target macroblock is called a motion vector MV

MV search is usually limited to a small immediate neighborhood
- both horizontal and vertical displacements in the range (-p,p)