

Status and Trends in Video Coding Technologies

- Video Compression -

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Video coding technologies have been studied for a long time as one of the key technologies to transmit, receive, store, and deliver multimedia information. Following this study, a lot of practical and computational work has been cultivating more advanced coding schemes, especially since the 1980s thanks to growing computation power to carry out dense computer simulations. Above all, the Moving Picture Experts Group (MPEG), which started its work in 1988, has performed an important role in video coding, both in terms of technology and the industry. The MPEG-2 standard for video coding, transmission, and storage has been used for emerging digital broadcasting and DVD video. The MPEG-4 standard is going to be used for Internet video delivery and mobile video services including portable video recording/viewing devices.

The principle idea of video compression schemes like MPEG standards consists of prediction, transformation followed by quantization, and entropy coding. Prediction is carried out to remove temporal and spatial redundancy from input video signals that are correlated. Transformation localizes the energy of the video signals to limited transform coefficients, which are to be quantized to represent the discrete energy level with constrained accuracy. Entropy coding then statistically compresses the set of quantization indices and side information codes. Many studies have been done to improve the accuracy of prediction, efficiency of transformation, and performance of entropy coding. MPEG-2, standardized in 1994, achieves 1/20~1/30 compression (around 5Mbps) for SDTV (720x480x30fps) and 1/30~1/40 compression (around 20Mbps) for HDTV (1920x1080x30fps) with sufficient picture quality. MPEG-4, standardized in 1999, achieves 1/70 compression (64kbps) for videophone (176x144x15fps), or (320kbps) for small screen size video (320x240x24fps) with good picture quality.

Is further compression needed? The goal is not obvious and static, since it depends on the environment such as network quality (QoS), storage capacity, computation power, and cost for whole. Currently the answer to the question is Yes. People need (and we pursue) higher quality, more error robustness, longer recording in their storage, faster transportation, and so on. We are working on higher compression with a reasonable system cost including production, delivery, and terminal. Moreover we are working on new types of video materials such as extremely high resolution video, e.g., digital cinema and multi-view video such as free viewpoint video representation, including new functionalities such as scalability of coded video. These approaches should be useful to maintain and present our valuable "visible information."

Keywords:

MPEG: Moving Picture Experts Group is the name of ISO/IEC JTC1/SC29/WG11. It started its work in 1988. Since then this group has produced many successful standards like MPEG-1 (video CD, karaoke, video for PC), MPEG-2 (digital broadcasting, DVD video recorder/player), and MPEG-4 (mobile videophone, Internet streaming, digital broadcasting for mobile).

DVD video: Digital Versatile Disc has a set of specifications including some for DVD video, which defines DVD video disc, DVD recorders/players.

SDTV: Standard Definition Television. Typical resolution for SDTV is 720 picture elements by 480 lines with 29.97 frames per second in Japan and the U.S., where the NTSC format is used for television. SDTV can be 720 picture elements by 576 lines with 25 frames per second typically in many of European countries where the PAL format is used for television.

HDTV: High Definition Television. Typical and maximum resolution is 1920 picture elements by 1080 lines with 30 frames per second. There can be others like 1440 by 1080, 1280 by 720, and so on.

QoS: Quality of Service is a term to represent the general quality of network transportation. It can include information rate, error rate, delay, jitter, and stability.

bps: Bits per second. This is used to represent the information rate or speed.

fps: Frames per second. This is used to represent the temporal resolution of video.