Progress on Real-time UHD HEVC Encoder

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Abstract
This demo paper presents a fully optimized HEVC encoder. Currently the overall encoder could provide 1920x1080@25fps with only 0.5dB PSNR decrease in a wide bitrate range compared with HM10. If low complexity configuration is enabled, our encoder can even support 3840x2160@25fps encoding.

Full Optimization for HEVC Encoder

A. Architecture Level
We re-designed the HEVC encoder architecture and key data structures. The new architecture provides significant convenience for encoding control, data flowing, and parallel-friendly optimization. The whole framework was implemented in pure C language.

B. Algorithm Level
We developed many low complexity algorithms (fast RDO for intra and inter coding, fast motion estimation, etc) which suffer little RD performance but dramatic complexity decrease. Furthermore, by carefully evaluating different candidate tools, we integrate those which bring better compression gains without incurring significant complexity.

C. Platform level
1) Task-level parallelism: We provide WPP, frame and GOP level parallel processing.
2) Data-level parallelism: SSE, AVX are fully utilized for the optimization of computation-intensive modules, including: DCT/IDCT, Quant/DeQuant, SAD, SSD, SATD, interpolation and Intra prediction.

Our HEVC Encoder Features

A. Specification
- Input: YUV 4:2:0, 8 bit
- Out: UDP/RTP, TS/MP4/FLV
- Profile: HEVC Main Profile, HM10.0
- Performance: 1080p@25fps, < 0.5dB compared to HM10.0
- Platform: HP 620 (Intel Xeon E3-2670 Dual Core@2.6G)

B. Main Tools
- CTU: 64x64; CU: 64x64-4x4; TU depth: 2
- Parallel processing tools: WPP/Frame/GOP
- Intra prediction: 33 directions + DC + Planar
- ME range +/- 64, MV precision: 1/4, ME alg. HE/ODA
- Number of Reference Pictures: 1
- Loop filters: Deblocking and SAO
- Advanced Tools: Sign Hide and RDOQ
- Rate Control: CBR and VBR

RD Comparison

Fig.1 HD(1920x1080p) RD Curve

Fig.2 4K(3840x2140p) RD Curve, where Marathon is from [1] and Mobile is from [2].

Demo System Diagram

Reference