FEI Encoding Sample

Overview

FEI Encoding Sample works with **Intel® Media Server Studio 2018 R2 – SDK for Linux* Server**.

It demonstrates usage of **Media Server Studio – SDK** (hereinafter referred to as "**SDK**") API for creation of a simple console application that performs encoding of an uncompressed or compressed video streams according to a H.264 video compression standard. The sample uses SDK FEI API (Flexible Encoder Interface) and provides capability to stream internal encoder information during encoding process to specified output.

- ENCODE FEI H.264. This is extension of conventional encoding functionality described in *SDK API Reference Manual*. It covers all stages of encoding and produces encoded bitstream from original raw frames. It is performed by ENCODE class of functions.
- PREENC FEI H.264. PreENC – pre encoding. As follow from the name it is preliminary step to gather MB level statistics, that later may be used for optimal encode configuration. This step may be used on its own for different kind of video processing, but usually it is followed by ENCODE step.
- ENC FEI H.264. This interface perform following encoding stages: Intra Prediction, Motion Estimation and Mode Decision. This step may be used on its own, but usually it is followed by PAK step.
- PAK FEI H.264. This interface perform following encoding stages: Transform; Quantization; Entropy Coding; generating Reconstruct Frames, which can be used by ENC; generating of output bitstream.

What's New

Version 7.0.*

New Features:

- Added MFE support.

- [33664] To facilitate the development of SW ENC + PAK pipeline, the ref list for B pyramid case can be customized, to disable prediction of P frames from reference to B frames.
- [34158] Added functionality to dump reconstruction surfaces.

Overview of source code changes:

- Unlock ext buffers during recovery from DEVICE_FAILED error.
- Added multisession mode support with parfile.
- Removed calling of QueryIOSurf() for PreENC.
- Clean up buffers to avoid possible memory growth after pipeline recreation.

Features

FEI Encoding Sample supports the following video formats:

input (uncompressed/compressed)	YUV420, NV12, H.264 (AVC), MPEG2, VC1
output (compressed)	H.264 (AVC)

Note: For format YUV420, the **FEI Encoding Sample** assumes the order Y, U, V in the input file.

Software Requirements

See `<install-folder>/Media_Samples_Guide.pdf`.

How to Build the Application

See `<install-folder>/Media_Samples_Guide.pdf`.

Running the Software

The executable file `sample_fei` requires the following command-line switches to function properly:

`-i <InputFile>`	Input (uncompressed) video file, name and path.
`-o <OutputFile>`	Output (compressed) video file, name and path
`-w <width>`	Width of input video frame
`-h <height>`	Height of input video frame

The following command-line switches are optional (parameters marked with gray color are currently unsupported):

-i::h264|mpeg2|vc1 <InputFile>	Set input encoded video file name, path and decoder type.
-nv12	Signals that input is in NV12 color format, if not specified YUV420 is expected.
-tff|bff|mixed	Specify input stream pucstruct: interlaced (top|bottom field first); mixed (interlaced and progressive frames within stream, picstruct for current frame should be obtained from input stream); if not specified - progressive is assumed.
-single_field_processing	Use single-field coding mode: one call for each field, tff/bff option required.
-bref	Arrange B frames in B pyramid reference structure (by default the decision is made by library).
-nobref	Do not use B-pyramid (by default the decision is made by library).
-noPtoBref	In B pyramid case, disable prediction of P frames from reference B; This option is not for ENCODE pipeline.
-idr_interval <size>	IDR interval size in number of GOPs term, default 0 means every I is an IDR, 1 means every other I frame is an IDR and etc.
-f <framerate>	Video frame rate (frames per second).
-n <number>	Number of frames to process.
-timeout <seconds>	Set timeout to run processing in seconds.
-r (-GopRefDist) <distance>	Distance between I- or P- key frames (1 means no B-frames) (default is 0 (I frames only)).
-g <size>	Set GOP size (1(default) means I-frames only).
-l <numSlices>	Set number of slices.
-x (-NumRefFrame) <numRefs>	Number of reference frames (number of DPB frame slots).
-qp <value>	Set QP value for frames.
-num_active_P <numRefs>	

	Set number of maximum allowed references for P frames (up to 4(default)).
-num_active_BL0 <numRefs>	Set number of maximum allowed backward references for B frames (up to 4(default)).
-num_active_BL1 <numRefs>	Set number of maximum allowed forward references for B frames (up to 2(default) for interlaced, 1(default) for progressive).
-gop_opt <closed|strict>	Set GOP optimization flags (can be used together): closed – references to other GOPs are forbidden; strict – no GOP optimization from MSDK.
-trellis <value(bitfield)>	Set trellis bitfield: 0 = default, 1 = off, 2 = on for I frames, 4 = on for P frames, 8 = on for B frames (ENCODE only).
-preenc <ds_strength(optional)>	Introduce extended FEI interface PREENC to pipeline. If ds_strength parameter is missed or less than 2, PREENC is used on the full resolution, otherwise PREENC is used on downscaled (by VPP resize in ds_strength times) surfaces.
-encode	Introduce extended FEI interface ENC+PAK (FEI ENCODE) to pipeline (RC is forced to constant QP).
-encpak	Introduce extended FEI interface ENC only and PAK only (separate calls) to pipeline.
-enc	Introduce extended FEI interface ENC (only) to pipeline.
-pak	Introduce extended FEI interface PAK (only) to pipeline.
-reset_start	Set start frame No. of Dynamic Resolution change, please indicate the new resolution with -dstw –dsth.
-reset_end	Specifies the end of current Dynamic Resolution Change related options.
-profile <decimal>	Set AVC profile.
-level <decimal>	Set AVC level.
-EncodedOrder	Force ENCODE to use internal logic for reordering, reading from files (mvin, mbqp)

	will be also in encoded order (default is display; ENCODE only).
-DecodedOrder	Force decoder output to decoded order (useful to dump streamout data in DecodedOrder). WARNING: all FEI interfaces expects frames to come in DisplayOrder.
-mbctrl <file>	Use this input to set MB control for FEI (only ENC+PAK).
-mbsize	With this options size control fields will be used from MB control structure (only ENC+PAK).
-mvin <file>	Use this input to set MV predictor for FEI. PREENC and ENC (ENCODE) expect different structures.
-repack_preenc_mv	Use this in pair with -mvin to import preenc MVout directly.
-mvout <file>	Output MV predictors to this file.
-mbcode <file>	Output per MB information (structure mfxExtFeiPakMBCtrl) to this file.
-mbstat <file>	Output per MB distortions to this file.
-mbqp <file>	Use this input to set per MB QPs.
-repackctrl <file>	Use this file to fill mfxExtFeiRepackCtrl fileds: max encoded frame size, number of pass and delta qp (ENCODE only).
-streamout <file>	Use this file to dump decode streamout structures.
-recon <file>	Dump reconstructed surfaces to YUV file, this option is for pipelines with PAK (PAK, ENC+PAK, PREENC+ENC+PAK)
-sys	Use system memory for surfaces (ENCODE only).
-8x8stat	Set 8x8 block for statistic report, default is 16x16 (PREENC only).
-search_window <value>	Specifies one of the predefined search path and window size. In range [1, 8] (0 is default). If non-zero value specified: -ref_window_w / _h, -len_sp are ignored.

-ref_window_w <width>	Set width of search region (should be multiple of 4), maximum allowed search window w*h is 2048 for one direction and 1024 for bidirectional search
-ref_window_h <height>	Set height of search region (should be multiple of 4), maximum allowed is 32.
-len_sp <length>	Defines number of search units in search path. In range [1, 63].
-search_path <value>	Defines shape of search path. 0 -full, 1-diamond.
-sub_mb_part_mask <mask_hex>	Specifies which partitions should be excluded from search (default is 0x00 - enable all).
-sub_pel_mode <mode_hex>	Specifies sub pixel precision for motion estimation 0x00-0x01-0x03 integer-half-quarter (default is 0x03).
-intra_part_mask <mask_hex>	Specifies what blocks and sub-blocks partitions are enabled for intra prediction (default is 0x00).
-intra_SAD	Specifies intra distortion adjustment. 0x00 - none, 0x02 - Haar transform (default)\n"));
-inter_SAD	Specifies inter distortion adjustment. 0x00 - none, 0x02 - Haar transform (default)\n"));
-adaptive_search	Enables adaptive search.
-forward_transform	Enables forward transform. Additional statistics is calculated and reported, QP required (PREENC only).
-repartition_check	Enables additional sub pixel and bidirectional refinements (ENC, ENCODE).
-multi_pred_l0	Use MVs from neighbor MBs as predictors for L0 prediction list (ENC, ENCODE).
-multi_pred_l1	Use MVs from neighbor MBs as predictors for L1 prediction list (ENC, ENCODE).
-adjust_distortion	Adds a cost adjustment to distortion, default is RAW distortion (ENC, ENCODE).
-n_mvpredictors_P <num>	

	Specifies number of MV predictors to use for l0 list of P frames. Up to 4 is supported (default is 1) (ENC, ENCODE).
-n_mvpredictors_BL0 <num>	Specifies number of MV predictors to use for l0 list of B frames. Up to 4 is supported (default is 0) (ENC, ENCODE).
-n_mvpredictors_BL1 <num>	Specifies number of MV predictors to use for l1 list of B frames. Up to 4 is supported (default is 0) (ENC, ENCODE).
-preenc_mvpredictors_l0 <bit>	Enable/disable l0 predictor (default is to use if l0 reference exists) (PREENC only).
-preenc_mvpredictors_l1 <bit>	Enable/disable l1 predictor (default is to use if l1 reference exists) (PREENC only).
-colocated_mb_distortion	Provides the distortion between the current and the co-located MB. It has performance impact (ENC, ENCODE) do not use it, unless it is necessary.
-dblk_idc <value>	Set value of DisableDeblockingIdc (default is 0), in range [0, 2].
-dblk_alpha <value>	Set value of SliceAlphaC0OffsetDiv2 (default is 0), in range [-6, 6].
-dblk_beta <value>	Set value of SliceBetaOffsetDiv2 (default is 0), in range [-6, 6].
-chroma_qpi_offset <first_offset>	First offset used for chroma qp in range [-12, 12] (used in PPS, pass_headers should be set).
-s_chroma_qpi_offset <second_offset>	Second offset used for chroma qp in range [-12, 12] (used in PPS, pass_headers should be set).
-constrained_intra_pred_flag	Use constrained intra prediction (default is off, used in PPS, pass_headers should be set).
-transform_8x8_mode_flag	Enables 8x8 transform, by default only 4x4 is used (used in PPS, pass_headers should be set).
-dstw <width>	Set destination picture width, invokes VPP resizing.
-dsth <height>	Set destination picture height, invokes VPP resizing.

-perf	Switch on performance mode (disabled file operations, simplified predictors repacking), significantly speed up applications if predictors repacking present, quality impact is minor.
-rawref	Use raw frames for reference instead of reconstructed frames (ENCODE only).
-n_surf_input <num>	Specifies number of surfaces that would be allocated for input frames.
-n_surf_recon <num>	Specifies number of surfaces that would be allocated for reconstruct frames (ENC or/and PAK).
?	Print help.
-mfe_frames <N>	Specifies number of frames to be used for Multi-Frame Encode
-par_file	Enables sample_fei to red parameters from parfile, one line in parfile specifies one session of transcoding, parameters specification is the same as for standard command-line mode for each session. When working with Multi-Frame Encode automatically joins sessions. 1:N MBR mode is not suported at a moment.

Below are examples of command-lines that can be used to execute **FEI Encoding Sample**:

For ENCODE

```
sample_fei -n 10 -r 4 –x 4 -g 32 –qp 35 -encode -i
input_352x288i_300.yuv -o output.h264 -w 352 -h 288 –tff –bref -mbcode
mbcode_file.bin -mbstat mbstat_file.bin -mvout mvout_file.bin –
num_active_P 3 –num_active_BL0 2 –num_active_BL1 1
```

For PREENC

```
sample_fei -n 10 -r 1 –x 2 -g 32 -qp 25 -preenc -i 352x288_300.yuv -w
352 -h 288 -mbstat mbstat_file.bin -mvout mvout_file.bin -mbqp
MBQp_file.bin
```

For DECODE + VPP + PREENC (with 4x DownSampling) + ENCODE

```
sample_fei -i::h264 input_1920x1088i.h264 -o output.h264 -w 1920 -h
1088 -n 300 -f 30 -qp 27 -l 1 -NumRefFrame 4 -g 32 -GopRefDist 4 -bref
-preenc 4 -encode -dstw 720 -dsth 480 -tff
```

For DECODE + VPP + PREENC (with 4x DownSampling) + ENCODE with multisession and Multi-Frame Encode

```
sample_fei –par_file parfile.par
```

```
Parfile:
-i::h264 input1_1920x1088i.h264 -o output1.h264 -w 1920 -h 1088 -n 300
-f 30 -qp 27 -l 1 -NumRefFrame 4 -g 32 -GopRefDist 4 -bref -preenc 4 -
encode -dstw 720 -dsth 480 –tff –mfe_frames 3
-i::h264 input2_1920x1088i.h264 -o output2.h264 -w 1920 -h 1088 -n 300
-f 30 -qp 27 -l 1 -NumRefFrame 4 -g 32 -GopRefDist 4 -bref -preenc 4 -
encode -dstw 720 -dsth 480 –tff –mfe_frames 3
-i::h264 input3_1920x1088i.h264 -o output3.h264 -w 1920 -h 1088 -n 300
-f 30 -qp 27 -l 1 -NumRefFrame 4 -g 32 -GopRefDist 4 -bref -preenc 4 -
encode -dstw 720 -dsth 480 –tff –mfe_frames 3
```

Tip:

To achieve better performance, use input streams in NV12 color format. If the input stream is in YUV420 format, each frame is converted to NV12 which reduces overall performance.

If encoded sequence used as input it is mandatory to set same picstruct for output bitstream. Other ways the application will be closed due to picstructs mismatch.

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