

HC – MPEG2 encoder

Release HC022.1

General information

- ***What is HC***
HC is a simple to use MPEG2 video encoder and is meant for creating MPEG2 video streams with a strong focus on DVD-compliance.
All MPEG2 HD resolutions are supported, maximum resolution: 1920x1152.
- ***Installation***
Just unzip the archive where you have a few GB free space, the space is needed for the storage of intermediate files.
- ***Hardware requirements***
The encoder will run on any Intel and AMD processor using Windows XP/2000.Vista.
It will probably run under Linux (using Wine).
HC uses the next CPU extensions if available: MMX/SSE, SSE2, SSE3, SSSE3, at least MMX/ISSE must be present, if SSE2, SSE3 or SSSE3 is present HC will also use it, run time will be 5 - 10% faster with SSE2 and 5 – 30% with SSE3 or SSSE3. The encoder will automatically detect the CPU extensions.
Memory requirements: HC will run with only 256 MB installed, more is, as always, better.
For HD encodes 2 GB is recommended.
HC022 is a multi-threaded application, it's also possible to run multiple instances of Hcenc.
- ***Input***
Input can be a DGIndex/DGDecode d2v project or input using Avisynth.
HC expects as input YUV-planes (YV12 color space 4:2:0).
During the encoding process there are no color plane conversions, the encoder keeps the color planes in YV12 color space.
- ***Versions***
Two versions are available, a GUI version (HCgui) which is easy to use and the actual encoder (HCenc) which is controlled by a serie of commands in an ini file, it can also take parameters.
The GUI version will only generate the ini file, it uses HCenc to do the actual encoding.
- ***Output***
Output is a regular m2v file which can be used directly in your favorite authoring program.

Features

- ***Multipass***

HC is a 2 pass encoder which produces a VBR MPEG2 stream.

Bitrate control is controlled by an average bitrate value and a maximum bitrate value.

- ***Bitrate control***

Bitrate is controlled by two commands: *BITRATE and *MAXBITRATE.

Buffer underflows will never occur, while encoding the frames, the VBV (Video Buffer Verifier) is constantly checked for buffer underruns, if buffer underruns occur the bit stream will be adapted so the stream will always be DVD-compliant.

- ***Encoding quality***

Encoding quality is controlled by the encoding profile: FAST, NORMAL, BEST.

For the *PROFILE command, see the command section.

- ***GOP structure***

User controllable, maximum GOP length is 36, maximum consecutive B-pictures is 3.

You can for instance give the command *GOP 15 2 or *GOP 12 1, see the command section.

If the *GOP command is omitted, HC will run in AUTOGOP mode, this probably is the best way to run the encoder. In AUTOGOP mode HC scans frames to be encoded and measures the activity of the frames. Based on the activity of the frames HC tries to create an optimal GOP structure.

A sequence header is written for each GOP.

- ***Scene change detection***

HC has a scene change detection algorithm built in, on each scene detection an I-frame is inserted and the GOP will be closed so you can cut the video at each scene change.

If necessary the frames in the two previous GOP's will be redistributed to maintain a nice general GOP structure.

- ***Quantization matrices***

You can use any matrix you like, some well known matrices are already built in which can be activated by the *MATRIX command. If you want to use your own matrix (intra and non-intra) just give the command *CUSTOMMATRIX and specify the two matrices, see the command section.

If the *MATRIX command is omitted HC will use the standard "adapted" MPEG matrices, see the matrix section for the matrix specification.

- ***Progressive/interlaced encoding***

HC022 has an auto-detect mode which will choose the optimal encoding method for each frame (progressive vs interlaced), of course it can be forced to do progressive or interlaced only.

- ***Encoding speed***

Encoding speed is highly dependent of:

- Complexity and resolution of the video material
- Speed of your system: CPU, cache size and bus/memory speed
- Availability of CPU extensions

Encoding (interlaced) DV video might take longer to encode.

A fast system will encode a 3 hour movie (DVD backup) in approx. 1 hour with *PROFILE BEST.

Command section

HCenc is controlled by a series of commands in the ini file.
It can also use parameters, see the next section.

Commands may be given in any order, they all start with *, commands may be uppercase or lowercase and must start at the first column.

You can simply deactivate a command by putting a space before the command.

NOTE ABOUT INTERLACED ENCODING

There are 3 commands to control the interlaced encoding: *PROGRESSIVE, *INTERLACED and *DVSOURCE. If none of these commands are used it runs in auto detect mode with TFF.

The next commands are available:

***ADAPTIVEMATRIX**

<i>parameter</i>	-	<i>type</i>	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*ADAPTIVEMATRIX		

This command activates the code in matrix.dll. Using this command you can change matrices at every GOP. **This is meant for very experienced users only !!**
See the adaptive matrices section in this manual how to create the dll.

***ASPECT**

<i>parameter</i>	1:1, 4:3, 16:9, 2.21:1	<i>type</i>	character string
<i>Status</i>	not required		
<i>Default</i>	16:9		
<i>Example</i>	*ASPECT 4:3 (3:4 is also allowed)		

This command sets the desired aspect ratio.

***AUTOGOP**

<i>parameter</i>	goplength (12 – 18)	<i>type</i>	integer
<i>Status</i>	not required		
<i>Default</i>	15 (12 for 23.976 fps)		
<i>Example</i>	*AUTOGOP 12		

This command sets the maximum GOP length to be used by the autogop algorithm.
Running in AUTOGOP mode means the encoder tries to distribute the I, P and B frames in an optimal manner based on the activity of the frames.

Encoding using AUTOGOP will be DVD-compliant if the next values are used:

- For NTSC source to be pulldowned, use values 12 – 14.
- For PAL source a value of 15 should be used.
- For 29.97 NTSC source the maximum of 18 can be used.

***AVSMEMORY**

<i>parameter</i>	memory	<i>type</i>	integer
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*AVSMEMORY 32		

This command sets the maximum memory (MB) to be used by Avisynth, maximum value: 1024.
This command is equivalent to the SetMemoryMax() Avisynth command.

***AVSRELOAD**

<i>parameter</i>	-	<i>type</i>	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	*AVSRELOAD		

This command reloads the Avisynth script before the second pass.

***B3**

parameter	-	type	-
Status	not required		
Default	-		
Example	*B3		

This command allows 3 consecutive B-frames, NOT DVD-COMPLIANT.

***BFF**

parameter	-	type	-
Status	not required		
Default	NA for progressive, TFF for interlaced, BFF for DV source		
Example	*BFF		

This command specifies bottom field first, only used for interlaced encoding.

***BIAS**

parameter	bias (range 0 – 100)	type	integer
Status	not required		
Default	0		
Example	*BIAS 30		

This command tweaks the compression curve, 0 means full VBR (Variable BitRate), 100 tends to CBR (Constant BitRate).

***BITRATE**

parameter	bitrate	type	integer
Status	required		
Default	-		
Example	*BITRATE 3250		

This command specifies the average bitrate per second in kbits/s. (1 kbit = 1000 bit)

***CHAPTER**

parameter	nr. of chapters	type	integer
Status	not required		
Default	-		
Example	*CHAPTER 5 101 1253 2763 5471 8354		

This command sets chapter points at the frames given, this means an I-frame is inserted and the GOP is closed.
There's no limit on the number of chapters, you can even set a chapter on every frame.

***CLOSEDGOPS**

parameter	-	type	-
Status	not required		
Default	-		
Example	*CLOSEDGOPS		

This command closes all gops.
CLOSEDGOPS is disabled by default.

***CPU**

parameters	AUTO, MMX, SSE2, SSE3, SSSE3	type	character string
Status	not required		
Default	AUTO		
Example	*CPU MMX		

This command can be used to force the cpu to use specific extensions.

***CQ**

parameter	quantization	type	real
Status	not required		
Default	-		
Example	*CQ 5.8		

This command orders the encoder to do a 1-pass with a constant quantization factor.

The value for quantization is the non-linear scale value.

No database is created, the output file is created in the first pass.

NOTE: this is not the same as CBR encoding, HC doesn't do CBR encoding.

***CQ_BFACTOR**

parameter	factor for B-frame quantization	type	real
Status	not required		
Default	1.0		
Example	*CQ_BFACTOR 1.4		

Multiplication factor for the quantization of B-frames using constant quantization.

Range: 0.5 – 4.0.

Example: if *CQ or *CQ_MAXBITRATE is set to 5, using *CQ_BFACTOR 1.4 means B-frames will use $Q = 7$.

***CQ_MAXBITRATE**

parameter	quantization	type	real
Status	not required		
Default	-		
Example	*CQ_MAXBITRATE 5.8		

This command orders the encoder to do a 1-pass with a constant quantization factor.

If the actual bitrate overshoots the maximum bitrate set by the *MAXBITRATE command the quantizer is temporally raised. Output will be DVD-compliant.

The value for quantization is the non-linear scale value.

No database is created, the output file is created in the first pass.

NOTE: this is not the same as CBR encoding, HC doesn't do CBR encoding.

***CQ_PFACTOR**

parameter	factor for P-frame quantization	type	real
Status	not required		
Default	1.0		
Example	*CQ_PFACTOR 1.2		

Multiplication factor for the quantization of P-frames using constant quantization.

Range: 0.5 – 4.0.

Example: if *CQ or *CQ_MAXBITRATE is set to 5, using *CQ_PFACTOR 1.2 means P-frames will use $Q = 6$.

***CUSTOMMATRIX**

parameter	-	type	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	<pre>*CUSTOMMATRIX 8 16 19 22 26 27 29 34 16 16 22 24 27 29 34 37 19 22 26 27 29 34 34 38 22 22 26 27 29 34 37 40 22 26 27 29 32 35 40 48 26 27 29 32 35 40 48 58 26 27 29 34 38 46 56 69 27 29 35 38 46 56 69 83 16 17 18 19 20 21 22 23 17 18 19 20 21 22 23 24 18 19 20 21 22 23 24 25 19 20 21 22 23 24 26 27 20 21 22 23 25 26 27 28 21 22 23 24 26 27 28 30 22 23 24 26 27 28 30 31 23 24 25 27 28 30 31 33</pre>		

This command defines custom intra and non-intramatrices to be used and supersedes the default matrix and the *MATRIX command.

The matrices must be supplied as given in the example, 8 values per line.

***DBPATH**

parameter	path	type	character string
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	<pre>*DBPATH E:\tmp</pre>		

This command sets the path for the intermediate database file and optional lossless file.

***DC_PREC**

parameter	dc_precision	type	integer
<i>Status</i>	not required		
<i>Default</i>	9		
<i>Example</i>	<pre>*DC_PREC 8</pre>		

This command defines the DC_precision to be used, range 8 - 11.

NOTE: dc_precision 11 is NOT DVD-compliant.

***DVSOURCE**

parameter	-	type	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	<pre>*DVSOURCE</pre>		

This command sets the correct parameters for (interlaced) DV sources, the source is assumed to be pure interlaced, also the BFF flag is set.

If this command is used also the alternate scanmethod is set.

***FRAMELOG**

parameter	-	type	-
<i>Status</i>	not required		
<i>Default</i>	-		
<i>Example</i>	<pre>*FRAMELOG</pre>		

Use this command to write a file with encoding information per frame.

This file (framelog.txt) is written in the output file directory.

***FRAMES**

parameters	startframe endframe	type	(2X) integer
Status	not required		
Default	-		
Example	*FRAMES 0 499		

This command specifies the frames to be encoded, if this command is not present all frames will be encoded. The example will encode the first 500 frames.

***GOP**

parameters	goplength B-frames	type	(2X) integer
Status	not required		
Default	-		
Example	*GOP 12 2		

This command defines the GOP structure.

Max. GOP length is 36, max. B-frames is 3. 3 B-frames is NOT DVD-compliant, you also have to give the *B3 command to force the use of 3 B-frames.

If this command is omitted, HC wil run in AUTOGOP mode.

***INFILE**

parameter	input file name	type	character string
Status	required		
Default	-		
Example	*INFILE D:\movies\ test.av		

This command defines the input filename. This file should be a d2v project or an Avisynth file, so the extension is d2v or avs.

***INTERLACED**

parameter	-	type	-
Status	not required		
Default	-		
Example	*INTERLACED		

Use this command if your source is interlaced.

If this command is used also the alternate scanmethod is set.

***LASTIFRAME**

parameter	-	type	-
Status	not required		
Default	-		
Example	*LASTIFRAME		

The last frame will be encoded as an I-frame.

***LOGFILE**

parameter	log file name	type	character string
Status	not required		
Default	-		
Example	*LOGFILE D:\movies\test.log		

This command defines the log filename, if omitted no logfile will be written.

If the logfile already exists the logs will be appended.

***LOSSLESS**

parameter	-	type	-
Status	not required		
Default	-		
Example	*LOSSLESS		

Use this command to create a lossless intermediate file, works only with a 2 pass encode and Avisynth input. The source file will only be read once, this might speed up slow avs scripts.

Warning: these kind of files can be HUGE.

***LUMGAIN**

parameter	sensitivity (0 - 4)	type	integer
Status	not required		
Default	0		
Example	*LUMGAIN 2		

This command adapts the quantization matrices on dark scenes so the bitrate will be raised.

- 0 no change
- 1 mild change
- 2 moderate change
- 3 heavy change
- 4 hit dark scenes real hard

***MASK_SHIFT**

parameter	top bottom shift	type	3*integer
Status	not required		
Default	0 0 0		
Example	*MASK_SHIFT 16 144 64		

This command masks top and bottom lines, the 3th parameter specifies the shift in lines, positive values will shift the video upwards, negative values will shift it down.

The example will mask 16 top lines and 144 bottom lines, the video is shifted upwards 64 lines.

The shift is done first, after that the top and bottom masking. All values must be even.

***MATRIX**

parameter	matrix	type	character string
Status	not required		
Default	MPEG matrix		
Example	*MATRIX HClow		

This command defines the intra and non-intra matrix to use.

See the matrix section for available built-in matrices and the default matrix specification.

***MAXBITRATE**

parameter	bitrate	type	integer
Status	required		
Default	-		
Example	*MAXBITRATE 9000		

This command specifies the maximum bitrate per second in kbits/s. (1 kbit = 1000 bit)

***NOSEQ_ENDCODE**

parameter	-	type	-
Status	not required		
Default	-		
Example	*NOSEQ_ENDCODE		

This command disables output of the sequence endcode (00 00 01 B7) at the end of the stream.

***NOSCD**

parameter	-	type	-
Status	not required		
Default	-		
Example	*NOSCD		

This command disables the scene change detection.

Scene change detection is enabled by default, at each scene change an I-frame is inserted and the GOP is closed.

***NOSMP**

parameter	-	type	-
Status	not required		
Default	-		
Example	*NOSMP		

HC will detect the nr. of processors on your system and will use multi-thread encoding if the nr. of processors > 1.

This command disables multi-thread encoding.

***NOVBV**

parameter	-	type	-
Status	not required		
Default	-		
Example	*NOVBV		

This command disables the VBV (Video Buffer Verifier) checking.

VBV checking is enabled by default. This command should not be used for DVD creation.

***OUTFILE**

parameter	output file name	type	character string
Status	required		
Default	-		
Example	*OUTFILE D:\movies\test.m2v		

This command defines the output filename, required.

***PREVIEW**

parameter	-	type	-
Status	not required		
Default	-		
Example	*PREVIEW		

This command turns on the preview window in the encoder.

***PRIORITY**

parameter	IDLE, LOW, NORMAL, HIGH	type	character string
Status	not required		
Default	IDLE		
Example	*PRIORITY LOW		

This command sets the process priority.

***PROGRESSIVE**

parameter	-	type	-
Status	not required		
Default	-		
Example	*PROGRESSIVE		

Use this command if you're sure your source is progressive.

If this command is used also the zigzag scanmethod is set.

***PROFILE**

parameter	FAST, NORMAL, BEST	type	character string
Status	not required		
Default	NORMAL		
Example	*PROFILE BEST		

This command defines the encoding quality. As usual the best encoding will take the most time.

***PULLDOWN**

parameter	-	type	-
Status	not required		
Default	-		
Example	*PULLDOWN		

This command sets pulldown flags for 23.976 → 29.97 pulldown.

Interlaced will be turned off, if your source is interlaced, please de-interlace it first.

If the source isn't 23.976 fps this setting will be ignored.

***SCDFILE**

parameter	-	type	-
Status	not required		
Default	-		
Example	*SILENT		

This command writes the frames with a scene change in file <output>.scd.

***SHUTDOWN**

parameter	-	type	integer
Status	not required		
Default	-		
Example	*SHUTDOWN		

This command will shutdown the system in 300 seconds after finishing encoding.

***SILENT**

parameter	-	type	-
Status	not required		
Default	-		
Example	*SILENT		

This command disables the encoder GUI, background encode. It might have a marginal speed increase.

***SMP**

parameter	-	type	-
Status	not required		
Default	-		
Example	*SMP		

HC will detect the nr. of processors on your system and will use multi-thread encoding if the nr. of processors > 1.

This command forces multi-thread encoding, even on single processor PC's.

***TFF**

parameter	-	type	-
Status	not required		
Default	NA for progressive, TFF for interlaced, BFF for DV source		
Example	*TFF		

This command specifies top field first, only used for interlaced encoding.

***TIMECODE**

parameters	hour minute second frame	type	(4X) integer
Status	not required		
Default	0 0 0 0		
Example	*TIMECODE 1 2 3 4		

This command sets the timecode.

***WAIT**

parameter	second	type	integer
Status	not required		
Default	5		
Example	*WAIT 0		

This command sets the waiting time before HC exits after an encoding session, range 0 – 99.

If you have a lot of short encodes it's best set to *WAIT 0.

***ZONE**

parameter	nr. of zones	type	integer
Status	not required		
Default	-		
Example	*ZONE 3		
	1200 1.3		
	1500 1.		
	2700 0.5		

This command raises or lowers the bitrate for parts of the video.

The example will raise the bitrate starting at frame 1200, reset to normal at frame 1500 and lowers the bitrate starting at frame 2700.

The number of zones is limited to 6400.

Using parameters

The next commands with parameters can be passed:

command	parameter	info
-i	<i>input file</i>	full path
-o	<i>output file</i>	full path
-b	<i>bitrate</i>	kbit/s
-maxbitrate	<i>max. bitrate</i>	kbit/s
-frames	<i>startframe endframe</i>	frame range
-frames	<i>all</i>	encode all frames
-gop	<i>goplength B-frames</i>	GOP length and nr. of B-frames
-log	<i>log file</i>	full path
-chapter	<i>chapter file</i>	full path
-ini	<i>ini file</i>	full path
-profile	<i>fast, normal, best</i>	encoding quality
-aspectratio	<i>1:1, 4:3, 16:9, 2:21</i>	3:4, 9:16, 2.21:1 or 1:2.21 can also be used
-scene		enable scene change detection
-noscene		disable scene change detection
-interlaced		interlaced encoding, TFF flag set, alternate scan
-nointerlaced		progressive encoding, zigzag scan
-dvsources		interlaced encoding, BFF flag set, alternate scan
-matrix	<i>mpeg, hc, hclow, qlb, notch, jawor1cd, bach1, hvsgood, hvsbetter, hvsbest, avamat6, avamat7, fox1, fox2, fox3, mpegstd</i>	use a built-in matrix
-tff		set Top Field First, only for interlaced encoding
-bff		set Bottom Field First, only for interlaced encoding
-dc_prec	<i>8, 9, 10, 11</i>	dc precision, 11 is NOT DVD-compliant
-bias	<i>bias value</i>	0 – 100
-cq	<i>CQ value</i>	constant quantizer, one pass
-cq_maxbitrate	<i>CQ value</i>	constant quantizer respecting max bitrate and VBV, one pass
-cq_bfactor	<i>CQ B-factor</i>	CQ factor for b-frames
-cq_pfactor	<i>CQ P-factor</i>	CQ factor for p-frames
-pulldown		activate pulldown (only 23.796 --> 29.97)
-closedgops		close all GOPs
-priority	<i>idle, low, normal, high</i>	set priority
-smp		use multi threading
-nosmp		disable multi threading
-silent		background encoding, no HCenc gui
-wait	<i>seconds</i>	nr. of seconds before gui closes
-shutdown		shut down when encoding is finished
-noini		don't process the default HC.ini file
-2pass		always do a 2 pass encode, skip all CQ commands
-lossless		use a lossless file for 2 pass Avisynth encodes

If -noini isn't used, HCenc will always look if there's a HC.ini file in the same directory as the exe file and will also read values from it. Parameters passed have a higher priority than the values supplied in the ini file.

For batch processing you can do something like this:

```
HCenc_022 -i d:\movies\test1.avs -o d:\movies\test1.m2v -b 4000 -maxbitrate 9000 -ini d:\movies\hc.ini
HCenc_022 -i d:\movies\test2.d2v -o d:\movies\test2.m2v -b 3500 -maxbitrate 8000 -ini d:\movies\hc.ini
```

Input file, output file, bitrate and maxbitrate are set as parameter, rest of the commands are read from HC.ini.

Reading all from (different) ini files:

```
HCenc_022 -ini d:\movies\hc1.ini
HCenc_022 -ini d:\movies\hc2.ini
```

Matrices

The next built-in matrix will be used as default, the MPEG adapted matrix.

The intra matrix is the standard MPEG matrix and will not be written in the MPEG2 stream.

***MATRIX MPEG**

8 16 19 22 26 27 29 34	16 17 18 19 20 21 22 23
16 16 22 24 27 29 34 37	17 18 19 20 21 22 23 24
19 22 26 27 29 34 34 38	18 19 20 21 22 23 24 25
22 22 26 27 29 34 37 40	19 20 21 22 23 24 26 27
22 26 27 29 32 35 40 48	20 21 22 23 25 26 27 28
26 27 29 32 35 40 48 58	21 22 23 24 26 27 28 30
26 27 29 34 38 46 56 69	22 23 24 26 27 28 30 31
27 29 35 38 46 56 69 83	23 24 25 27 28 30 31 33

The next built-in matrix can be used with the *MATRIX command, the MPEG standard matrix.

The intra and inter matrix will not be written in the MPEG2 stream.

***MATRIX MPEGSTD**

8 16 19 22 26 27 29 34	16 16 16 16 16 16 16 16
16 16 22 24 27 29 34 37	16 16 16 16 16 16 16 16
19 22 26 27 29 34 34 38	16 16 16 16 16 16 16 16
22 22 26 27 29 34 37 40	16 16 16 16 16 16 16 16
22 26 27 29 32 35 40 48	16 16 16 16 16 16 16 16
26 27 29 32 35 40 48 58	16 16 16 16 16 16 16 16
26 27 29 34 38 46 56 69	16 16 16 16 16 16 16 16
27 29 35 38 46 56 69 83	16 16 16 16 16 16 16 16

The next built-in matrices can be used with the *MATRIX command:

(some of these matrices are copyrighted by their respective owners)

***MATRIX QLB**

8 16 19 22 26 27 29 34	16 17 18 19 20 21 22 23
16 16 22 24 27 29 34 37	17 18 19 20 21 22 23 25
19 22 26 27 29 34 37 39	18 19 20 21 22 23 24 26
22 22 26 27 29 34 38 42	19 20 21 22 23 24 26 28
22 26 27 29 32 36 40 50	20 21 22 23 25 26 28 29
26 27 29 32 36 40 50 61	21 22 23 24 26 28 29 31
26 27 29 35 40 50 59 75	22 23 24 26 28 29 31 34
27 29 35 40 50 59 75 89	23 24 25 28 29 31 34 38

***MATRIX NOTCH**

8 9 12 22 26 27 29 34	16 18 20 22 24 26 28 30
9 10 14 26 27 29 34 37	18 20 22 24 26 28 30 32
12 14 18 27 29 34 37 38	20 22 24 26 28 30 32 34
22 26 27 31 36 37 38 40	22 24 26 30 32 32 34 36
26 27 29 36 39 38 40 48	24 26 28 32 34 34 36 38
27 29 34 37 38 40 48 58	26 28 30 32 34 36 38 40
29 34 37 38 40 48 58 69	28 30 32 34 36 38 42 42
34 37 38 40 48 58 69 79	30 32 34 36 38 40 42 44

***MATRIX BACH1**

8 16 19 22 26 27 29 34	16 18 20 22 24 26 28 30
16 16 22 24 27 29 34 37	18 20 22 24 26 28 30 32
19 22 26 27 29 34 34 38	20 22 24 26 28 30 32 34
22 22 26 27 29 34 37 40	22 24 26 30 32 32 34 36
22 26 27 29 32 35 40 48	24 26 28 32 34 34 36 38
26 27 29 32 35 40 48 58	26 28 30 32 34 36 38 40
26 27 29 34 38 46 56 69	28 30 32 34 36 38 42 42
27 29 35 38 46 56 69 83	30 32 34 36 38 40 42 44

***MATRIX HC**

8 9 13 20 23 27 29 34
9 11 16 23 26 29 34 39
12 16 21 25 28 33 39 45
15 20 25 28 33 38 44 52
19 24 28 33 38 43 51 60
23 27 32 38 42 49 58 68
27 31 37 42 48 57 67 77
30 36 41 47 55 65 76 87

16 16 18 20 22 24 27 30
16 17 19 22 24 27 30 34
18 19 22 24 27 30 34 39
20 22 24 27 30 34 39 45
22 24 27 30 34 39 45 52
24 27 30 34 39 45 52 60
27 30 34 39 45 52 60 69
30 34 39 45 52 60 69 79

***MATRIX HCLOW**

8 16 17 18 20 22 26 32
16 16 17 20 22 26 30 36
17 17 18 22 26 30 36 40
18 20 22 26 30 36 40 48
20 22 26 30 36 40 48 56
22 26 30 36 40 48 56 72
26 30 36 40 48 56 72 96
32 36 40 48 56 72 96 108

16 16 17 18 19 20 22 24
16 16 17 19 20 22 24 26
17 17 17 20 22 24 26 30
18 19 20 22 24 26 30 36
19 20 22 24 26 30 36 40
20 22 24 26 30 36 40 48
22 24 26 30 36 40 48 56
24 26 30 36 40 48 56 64

***MATRIX JAWOR1CD**

8 16 20 23 27 30 32 34
16 16 23 24 29 31 34 38
20 23 27 28 30 35 38 40
23 24 28 29 35 39 40 44
27 29 30 35 39 42 45 50
30 31 35 39 42 46 54 59
32 34 38 40 45 54 62 72
34 38 40 44 50 59 72 84

17 19 21 23 25 27 29 31
19 21 23 25 27 28 29 33
21 23 25 27 29 30 32 37
23 25 27 30 31 34 40 45
25 27 29 31 38 46 54 60
27 28 30 34 46 58 72 74
29 29 32 40 54 72 90 100
31 33 37 45 60 74 100 124

***MATRIX HVSGOOD**

8 16 16 16 17 18 21 24
16 16 16 16 17 19 22 25
16 16 17 18 20 22 25 29
16 16 18 21 24 27 31 36
17 17 20 24 30 35 41 47
18 19 22 27 35 44 54 65
21 22 25 31 41 54 70 88
24 25 29 26 47 65 88 115

20 20 20 20 21 23 26 30
20 20 20 20 22 24 27 32
20 20 21 22 24 27 31 36
20 20 22 26 30 34 38 44
21 22 24 30 37 44 51 59
23 24 27 34 44 56 68 81
26 27 31 38 51 68 88 109
30 32 36 44 59 81 109 144

***MATRIX HVSBETTER**

8 16 16 16 17 18 21 24
16 16 16 16 17 19 22 25
16 16 17 18 20 22 25 29
16 16 18 21 24 27 31 36
17 17 20 24 30 35 41 47
18 19 22 27 35 44 54 65
21 22 25 31 41 54 70 88
24 25 29 36 47 65 88 115

19 19 19 19 20 22 25 29
19 19 19 19 20 23 26 30
19 19 20 21 23 26 29 34
19 19 21 25 28 32 37 42
20 20 23 28 35 42 48 56
22 23 26 32 42 53 64 77
25 25 29 37 48 64 83 104
29 30 34 42 56 77 104 137

***MATRIX HVSBEST**

8 16 16 16 17 18 21 24
16 16 16 16 17 19 22 25
16 16 17 18 20 22 25 29
16 16 18 21 24 27 31 36
17 17 20 24 30 35 41 47
18 19 22 27 35 44 54 65
21 22 25 31 41 54 70 88
24 25 29 36 47 65 88 115

18 18 18 18 19 21 23 27
18 18 18 18 19 21 24 29
18 18 19 20 22 24 28 32
18 18 20 24 27 30 35 40
19 19 22 27 33 39 46 53
21 21 24 30 39 50 61 73
23 24 28 35 46 61 79 98
27 29 32 40 53 73 98 129

8	16	19	22	26	27	29	34
16	16	22	24	27	29	35	35
19	22	26	27	29	34	35	38
22	22	26	27	29	34	35	40
22	26	27	29	32	35	40	48
26	27	29	32	35	40	48	50
26	27	29	35	40	48	50	60
27	29	35	40	48	50	60	62

8	16	19	22	26	28	32	38
16	16	22	24	28	32	38	44
19	22	26	28	32	38	44	48
22	22	26	32	38	44	48	54
22	26	32	38	44	48	54	64
26	32	38	44	48	54	64	74
32	38	44	48	54	64	74	84
38	44	48	54	64	74	84	94

8	8	9	11	13	13	14	17
8	8	11	12	13	14	17	18
9	11	13	13	14	17	17	19
11	11	13	13	13	17	18	20
11	13	13	13	16	17	20	24
13	13	13	16	17	20	24	29
13	12	13	17	19	23	28	34
12	13	17	19	23	28	34	41

8	8	9	11	13	13	14	17
8	8	11	12	13	14	17	18
9	11	13	13	14	17	17	16
11	11	13	13	13	17	18	20
11	13	13	13	16	17	20	24
13	13	13	16	17	20	24	29
13	12	13	17	19	23	28	34
12	13	17	19	23	28	34	41

8	8	9	11	13	13	14	17
8	8	11	12	13	14	17	18
9	11	13	13	14	17	17	16
11	11	13	13	13	17	18	20
11	13	13	13	16	17	20	24
13	13	13	16	17	20	24	29
13	12	13	17	19	23	28	34
12	13	17	19	23	28	34	41

16 16 16 16 16 16 16 16

Adaptive matrices

With HC021 you can change the matrices per GOP.
You have to write your own code to do so and create a DLL which should be named matrix.dll, this DLL should be in the same directory as the HCenc executable.

The next (Fortran 90) example shows how to create the routine and how it should be called.

```
subroutine EXTMATRIX(motion,luminance,intra,inter)
! input      - motion      integer*4      value 0 - 32 (0=low, 32=high)
! input      - luminance   integer*4      averaged GOP luminance per pixel (0 - 255)
! input/output - intra     integer*2 array intra matrix (64 values, row order)
! input/output - inter     integer*2 array inter matrix (64 values, row order)

!DEC$ ATTRIBUTES DLLEXPORT:: EXTMATRIX      ! export routine

      integer*4 motion,luminance
      integer*2 intra(64),inter(64)

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!
! Example code for adaptive matrix DLL creation.
!
! DLL: matrix.dll, should be in the same directory
! as the HCenc executable.
!
! This Fortran example adapts the intra and inter
! matrices dependent of source motion and luminance.
! If the *ADAPTIVEMATRIX command is present,
! this routine is called at every GOP during the
! first pass so the matrices can change at every GOP.
!
! Of course you can create any matrix you want, to be
! sure matrix values are valid, HCenc will limit all
! values between 8 and 255 and set intra(1) to 8,
! just like the last 3 lines of code in this example.
!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

! motion stuff
      if (motion <= 5) then
         a=1.-(5.-motion)/50.                ! interpolate factor a to minimum = 0.9 for low motion
      else
         a=1.+(motion-5.)/270.                ! interpolate factor a to maximum = 1.1 for high motion
      endif

! luminance stuff
      b=1.
      if (luminance < 48) b=0.90              ! lower values for medium dark scenes
      if (luminance < 32) b=0.70              ! lower values for dark scenes

! adapt matrix
      intra=NINT(a*b*intra)                  ! set to nearest integer for whole intra matrix
      inter=NINT(a*b*inter)                  ! set to nearest integer for whole inter matrix

! scale values into "safe values"
      intra=MAX(intra,8); intra=MIN(intra,255) ! scale intra values, 8 <= intra <= 255
      inter=MAX(inter,8); inter=MIN(inter,255) ! scale inter values, 8 <= inter <= 255
      intra(1)=8                             ! first intra value should always be 8

end
```

Note 1: Entering the routine the matrices intra and inter will have the values as given in the inputfile.

Note 2: This example code is just what it says, it's only an example how to create the routine, there's no guarantee this code will improve your encode.

Note 3: Using Fortran it's not necessary to declare local variables, variables are declared implicit: all variables are real*4 except variables which start with i - n, these are integer*4.