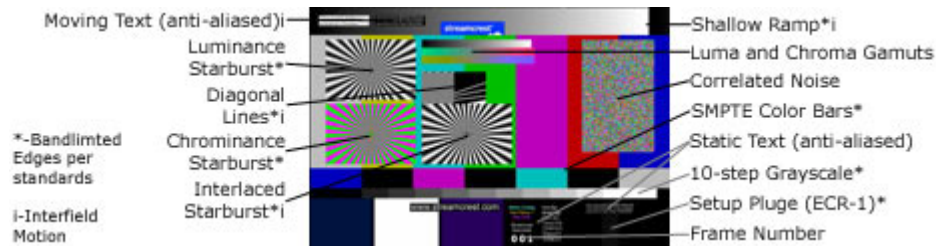# Streamcrest Motion1 Test Sequence and Utilities

Robert Bleidt - June 7,2002

A. Using the Motion1 Sequence

Streamcrest's Motion1 Test Sequence Generator generates the test pattern shown in the still below as a YUV image file in ITU-R/CCIR 601/656 format. It was designed for tests on streaming video codecs with interlace and motion artifacts in mind.

Moving Text (anti-aliased)i —
Luminance Starburst* —
Diagonal Lines*i —
Chrominance Starburst* —
Interlaced Starburst*i —
*-Bandlimted Edges per standards —
i-Interfield Motion —
— Shallow Ramp*i
— Luma and Chroma Gamuts
— Correlated Noise
— SMPTE Color Bars*
— Static Text (anti-aliased)
— 10-step Grayscale*
— Setup Pluge (ECR-1)*
— Frame Number

You make the file by running the "motion1.exe" program on a Windows 2000 machine at a command prompt as follows:

```
motion1 motion1.yuv
```

You can use this file directly (as it contains ITU-R 601 data in "UYVY" format) or convert it into an uncompressed RGB AVI file with the yuv2avi conversion utility.

Some thoughts on the features of the sequence are:

Shallow Ramp – This ramp should be absolutely smooth in gradation and motion. (Look at the YUV data if you don't believe me.) The transition between white and black is carefully bandlimited and should show as a smooth, sharp edge without any ringing.

Moving Text – Note that this text moves between fields, as a real sign would in front of a camera. Thus, progressive playback may cause the text to be blurred. The edges around the Streamcrest logo are usually the first spot to show coding artifacts.

Starbursts – These patterns are fairly difficult to encode, and the center will give a rough indication of any pre-filtering or aliasing. Only the Interlaced Starburst moves between fields. Unlike a zone plate, the center of the starburst is not bandlimited. The center is effectively an infinite spatial frequency, and will alias on any display. Compare the original sequence with an encoded one to train your eye to the "normal" aliasing in the source.

Noise Patches – The Correlated Noise patch contains a set of static patterns of random luma and chroma values that translate vertically at various rates. A good motion estimator should detect this and code these as motion vectors. About halfway through the sequence, two patches of completely uncorrelated random noise is introduced. This is very difficult to encode, and serves as a transient to the encoder's rate control mechanism. Look for

any changes in encoding quality in other areas of the sequence when these patches are introduced. All these patches may "bleed" onto adjacent regions after encoding.

Diagonal Lines – These are very useful to detect progressive playback or improper field sequence. You can change the field order in Virtual Dub (see section D below) to visualize incorrect playback. In most cases, these lines are better for detecting this than the Interlaced Starburst.

Frame Number – If you can record the output of a codec's player, or examine a reconstructed sequence, this can aid you in determining which frames are dropped.

Setup Pluge – This is the pluge from SMPTE ECR-1 Color Bars. On playback, the middle step and the left step should be indistinguishable.

White Bar - This is the white reference from SMPTE ECR-1 Color Bars. On playback, this should be the peak white level of the display.

More information on the technical parameters of the sequence features can be obtained through the address in F below.

B. Using the file directly.

The Motion1 test sequence format is designed to be compatible with the sequences published by the Video Quality Experts Group at "http://ftp.crc.ca/test/pub/crc/vqeg/" Their description of the format is:

```
          --------------------------------------------
            Video Quality Experts Group Test Sequences
          --------------------------------------------

This directory contains the Video Quality Experts Group (VQEG) test sequences.

NOTE: Each sequence file beneath this directory is 182MB. Download
      times of an hour per sequence is typical.

The sequence files are in the format specified by the VQEG Objective Video
Quality Model Test Plan except the alignment patterns have been removed.

The format is as follows:

  10 Frames(Not used) + 8seconds Video + 10 Frames(Not used)

The 10 frames of unused video allow enough frames for an MPEG2
codec to stabilize. Objective models will skip these frames.

There are two video formats 525@60Hz and 625@50Hz. The format may be
identified by the sequence file name. The 525@60Hz sequence file names end
with _525.yuv and the 625@50Hz file names end with _625.yuv. Both formats
contain 720 pixels (1440 bytes) per horizontal line. The 525@60 sequences have
486 active lines per frame and the 625@50 sequences have 576 active lines per
frame.

Each line is in pixel multiplexed 4:2:2 component video format as follows:

  Cb Y Cr Y ...
  720  Y bytes per line
```

```
  360 Cb bytes per line
  360 Cr bytes per line
```

Lines are concatenated into frames and frames are concatenated to form the sequence files.

All sequences are from interlaced video source except src13 which was converted from 24Hz film by the 3/2 pulldown method. The lines of the two fields are interlaced into the frames. The top field of the 525@60Hz material is temporally LATER than the bottom field (Bottom field first) and the top field of the 625@50Hz material is temporally EARLIER than the bottom field (Top field first).

The frame sizes are:

```
  525@60Hz Frame size = 1440 x 486 = 699840 bytes/frame
  625@50Hz Frame size = 1440 x 576 = 829440 bytes/frame
```

And the sequence sizes are:

```
  525@60Hz 8 sec + 20 frames file size = 699840 x 260 frames = 181958400 bytes
  625@50Hz 8 sec + 20 frames file size = 829440 x 220 frames = 182476800 bytes
```

For compatibility with common PC encoding raster sizes, and to enable a integer number of macroblocks, the 525 sequences have been cropped to 480 lines by removing the last six lines in each frame.

Caution: In the PC world, this data format is equivalent to the format of AVI fourCC type UYVY. You may be tempted to convert this sequence to an AVI file in this format by appending the necessary headers and index. In fact, the yuv2avi.exe program supplied will do this when the UYVY format is specified. This is a dangerous idea, because most applications will try to play or encode the resulting file with the msyuv.dll codec. Most versions of this codec only support rendering 16-bit RGB data instead of 24 bits. This will cause severe banding in the video due to the loss of two or three lsb's of each pixel. Thus, if you need AVI files, you should use uncompressed RGB as explained below:

C. Using uncompressed RGB AVI files.

If AVI files are more convenient, or to preview the sequences with Windows Media Player or Virtual Dub, you may use yuv2avi utility to make uncompressed RGB AVI files. For reference, the typical usage of yuv2avi is:

motion1 motion1.yuv
yuv2avi motion1.yuv motion1.avi 525c RGB255

More details are provided in section D below.

D. Suggestions for previewing the sequences

If you would like to preview the sequences on a PC, it suggested you do the following:

1. Run the makeSeqAVI.bat file to get RGB AVI files.

2. Copy the AVI files to a fast drive, RAID array, or ramdisk.
3. Use Virtual Dub (http://www.virtualdub.org) to view the file with the following settings:
    a. Options | Preview Field Mode | Field Order B (for 525 material)
    b. Options | Preview Field Mode | Field Order A (for 625 material)
    c. Options | Preferences | Output Color Depth | 24-bit(TrueColor)
    d. Options | Preferences | Process Priority | Highest
4. Alternatively, if you have a video production card in the PC, such as the Matrox Digisuite series, use its file player utilities.

E. YUV to AVI Converter Utility Man Page

Usage: yuv2avi inFile.yuv outFile.avi (525|525c|625) (UYVY|RGB255|RGB235) [YV12]

YUV to AVI video file converter v1.4
Copyright 2002 Streamcrest Associates ALL RIGHTS RESERVED
(www.streamcrest.com)

Help:

yuv2avi infile outfile raster format [informat]

infile - input filename - example: "525seq1.yuv"

outfile - output filename - example: "525seq1.avi"

raster - specifies the frame size of the input file:
  525 - 720 x 486
  525c - 720 x 480
  625 - 720 x 576

format -
  UYVY - direct copy of yuv data into output file (see caution below)
  RGB255 - transcode yuv pixesl to rgb, black = 0, white = 255d
  RGB235 - transcode yuv pixels to rgb, black = 16d, white = 235d

informat -
  not present - input data is in raw 601 yuv "UYVY" format
  YV12 - input data is in raw "YV12" format (4:2:0 input of many encoders)

This program converts raw video data files, commonly used for video coding test sequences, into AVI files suitable for use with common Windows-based encoders or utilities. For example, you can use this to read VQEG sequences

into Virtual Dub or Real Producer.

RGB255 is the usual format for most PC applications. Note that the Microsoft MSYUV codec will try to produce values close to RGB235. The bars and tone signal from Adobe Premiere is also similar to the RGB235 values.

One advantage of RGB235 is that the luminance values are directly reproduced without scaling multiplication that will introduce additional quantization noise due to rounding to 8 bit values.

The words UYVY and YV12 refer to FCC four-character codes that indicate the contents of AVI files. You can learn about them at http://www.webartz.com/fourcc/ and about the AVI file format at http://www.jmcgowan.com/avi.html

UYVY is the same format as the active picture data from a ITU-R 601/656 video stream. Specifying it will cause the program to just put an AVI format wrapper around the unmodified image data.

Although this has the advantage of not touching the image, it's is a dangerous idea, because most applications will try to play or encode the resulting file with the msyuv.dll codec. Most versions of this codec only support rendering 16-bit RGB data instead of 24 bits. This will cause severe banding in the video due to the loss of two or three lsb's of each pixel.

Thus, if you need AVI files, stick to RGB format unless you have a different yuv codec installed. Rumor indicates that the XP version of msyuv.dll offers a full 24 bits, but this has not been tested.

This program transcodes to RGB by multiplication using 32-bit integer arithmetic followed by truncation to 8-bit values. Chrominance components for pixels between 4:2:2 chroma samples are interpolated from the two adjacent pixel values. A linear transformation similar to equation 9.11 in "A Technical Introduction to Digital Video", Poynton, 1996, is used. No attempts have been made to use dynamic rounding/residue accumulation in the multiplication or to do anything more elaborate than two-pixel chroma interpolation.

The informat argument allows you to easily preview YV12 files that are used as input to or reconstructed output from an encoder. Just leave it off otherwise.

This program makes "old style" AVI files limited to 2GB. It issues a warning at 1GB, since some ancient programs have trouble at 1GB, and an error at 2GB. If you need support for longer files, send an email to the address below.

F. More Information

These programs are offered without warranty or indemnification of any kind, contain bugs and errors, and their use is AT YOUR OWN RISK. They may be freely distributed (including reasonable duplication/media fees) in their unmodified form.

You may obtain more information by contacting:

Streamcrest Associates
www.streamcrest.com
info@streamcrest.com