Malooba Lip Sync

Malooba Lip Sync is a simple way to ensure that video remains in sync after the source material is transcoded and processed for broadcast. It does this by creating 'fingerprints' of the audio signal, with millisecond resolution, that are timecoded from the video. Inexpensive Black Magic DeckLink Mini-Monitor cards are used to sample the timecode and audio channels from an SDI or HDMI stream.

The Malooba Lip Sync suite is comprised of two applications:

Malooba Lip Sync itself, is the monitoring application which compares two streams of fingerprints and determines the misalignment of each audio channel to the nearest millisecond.

Malooba Fingerprint is the fingerprint generator. Two instances of this application monitor the source and broadcast video streams. The corresponding fingerprint streams are transmitted over UDP to the Malooba Lip Sync application for analysis.

Both video streams must be timecoded so the broadcast video must be sampled before timecode is stripped.

A typical installation is shown in the diagram below.

[TODO: Diagram]

Installation

Run the installer executable and select whether to install one or both applications when prompted. The machine(s) chosen to run the Malooba Fingerprint application must have one DeckLink Mini-Monitor card per application instance.

Configuration and use

Both applications have three modes, Settings, Off and Run selected by the buttons at the top right. In the Settings mode a settings panel will open. Off mode leaves the application idle. Run mode starts processing. The selected mode is highlighted in green. The Run button will be greyed if the settings are incorrect or incomplete.

Configuration settings are stored in the users roaming profile area in a directory with the same name as the application and the filename "Settings.txt". This is fine unless you want to run multiple instances of either application on one machine. In this case you may supply a single command line argument which will replace the word "Settings" in the filename.

Malooba Lip Sync Settings

Malooba Lip Sync listens on two UDP ports for fingerprints from the two Malooba Fingerprint instances. The reference input should be derived from the source video and the broadcast input from the final broadcast video. In each case the Host setting should probably be left set to 0.0.0.0 unless the machine has multiple network interfaces and you need to select one of them. The Port settings can be set to any two unused network ports.

Malooba Fingerprint Settings

There are three pages of settings. On the input page select a DeckLink device. If there are none then check your hardware installation and confirm that you can access the DeckLink Mini-Monitor from the Black Magic supplied software.

On the Video page select a video mode and timecode mode.

On the Output page enter the IP address of the Malooba Lip Sync installation and enter the appropriate UDP port number to output on. Note that this application is a UDP client and 0.0.0.0 is not valid Host IP address.

Execution

Select Run mode on the two Malooba Fingerprint instances. Check that timecode is detected and displayed and that the expected audio channel indicators are illuminated. If the timecode is not running then check the timecode mode setting. If the expected audio indicator are not lit then check that there is audio present on the channels. The indicators are lit when there is a signal present, i.e. the channel is not silent.

Now start Malooba Lip Sync. If all is well the timecode display should become active and the audio channel presence indicators should light up green (A for the reference input and B for the Broadcast input.) Those channels with both A and B lit should also display the audio synchronisation offset in milliseconds.

If nothing happens check that the UDP settings are correct (TODO: Perhaps there should be A and B indicators under the timecode to indicate that valid fingerprints are being received.)

Next, check that the Malooba Fingerprint instances are displaying similar timecodes. Malooba Lip Sync will tolerate up to 10000 frames of delay in either fingerprint input but it must be able to align the timecodes in each input stream.

Operation

Malooba Lip Sync works by aligning the timecodes of the incoming fingerprint streams. It then selects 51 frames of reference fingerprints (the Haystack) and a centrally disposed 13 frames of broadcast fingerprints (the Needle.) It then searches for the Needle in the Haystack. If it can find a single clear match it will note the millisecond offset at which it occurs. If there are more than one match or if the match is indistinct it will be ignored. The stream of results from this search are then filtered to produce a stable output offset for each audio channel. If the offset is too large then it will not be detected and the output will display a hyphen to indicate that no result is available. The requirement to read Haystack fingerprints that are later than the analysis point as well as the subsequent filtering means that there will be a small latency in the result. This is unavoidable but is only of the order of a second.

Video Fingerprinting

The code contains an unused video fingerprint generator that creates a 15-bit fingerprint for each video frame. The fingerprint is resilient to changes of resolution, aspect, brightness, contrast and gamma that might occur in the transcode process. It is a simple matter to add the video fingerprint data to each frame fingerprint transmitted if this is desired. It is unused because it was not required for the specific application provided. The code is located in the function VideoFingerprint in Callback.cs in the MaloobaFingerprint project.