Aurora operational guide

The Aurora grain reducer provides excellent grain and noise reduction qualities using simple non recursive filters. Figure 1 below shows the processing path.

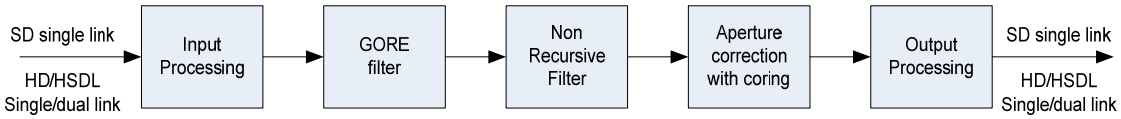

Figure 1 Aurora processing path

Following is a brief description of functionality and notes on where to set the controls for best results.

Input Processing

Provides RGB to YUV conversion for HD signals (This function is only supported in software version 43 (to be released shortly).

GORE filter

The GORE filter helps with very grainy material by reducing or filtering the very high frequency transients of the grain while leaving the image detail. Following is a brief description of its components.

The GORE filter consists of a low pas filter with 7 different roll-off frequencies and a level dependent mixer. The low pass filter reduces the energy in transitions allowing the recursive stage which follows, to work more efficiently. A GORE value of 0 allows the widest bandwidth to pass and under normal viewing, appears to have little effect. A GORE value of 7 reduces the bandwidth considerably and makes the picture look very soft when the amount control is turned to maximum. See Figure 2.

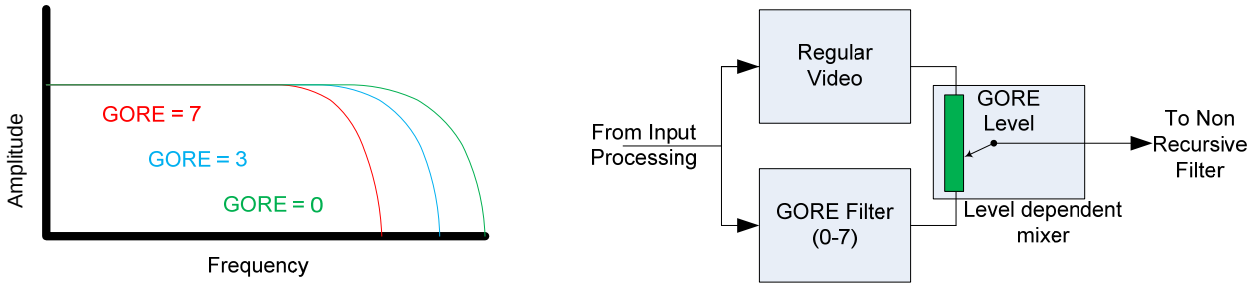

Figure 2

The user can select between the 8 different roll off frequencies and can control how the filtered image is mixed with the live image. With the “Amount” control set to “0%” no filtering is seen. Conversely when the control is set to 100% only the filtered image is seen. Typically a GORE value of 3 or 4 is used with an amount setting of between 10% and 30%, use higher settings for 16mm

The Non-Recursive Filter

The non recursive filter averages the value of each pixel over 5 frames. The user can then decide to replace the pixel with the averaged value or use just a small percentage of the original grainy image. It is nice to remove some grain from film but not all as the image tends to look plasticy and unlike film.

The following diagram Figure 3, shows the theory of operation for the non recursive filter.

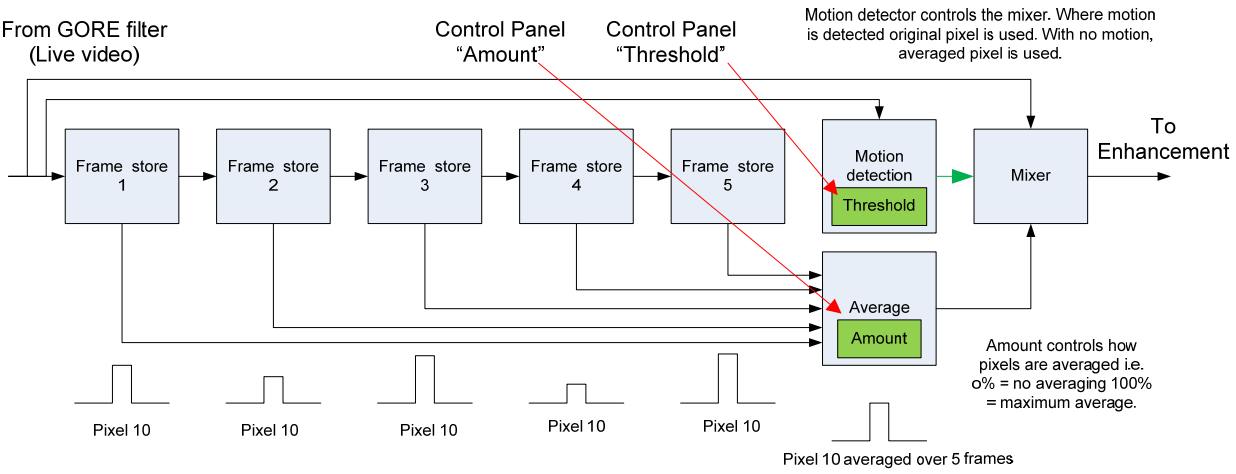

Figure 3 Non Recursive Filter

The filter works by averaging the value of a pixel over a number of frames. The above diagram shows how pixel 10 is averaged over 5 frames. The “Amount” control allows the user to select between original pixel value (O%) or the averaged pixel value (100%).

The “Threshold” controls control the motion detection. Objects that are moving are obviously in a different position between one frame and the next. The Recursive filter would try to average the pixels across any moving objects giving rise to many artifacts. Therefore it is necessary to detect when an object is moving and reduce or turn of the averaging where the object exists. This control is called the “Threshold” and can be set anywhere between (0%) no movement detection and (100%) maximum detection.

For good results with 35mm film set the “Amount” to 40%-50% and the “Threshold” to 40%.

The “Noise view” switch will display the difference between the grain reduced and the averaged value.

Noise Freeze

This was originally designed as a test function to test the validity of each of the frame stores memory. It can be used to greatly aid the setup process of the non recursive filter using the following technique. Most artifacts are noticed during fast motion and so if ”Freeze” is selected during the fast motion and then the image is stopped and rewound to the frame where the freeze was pressed, motion artifacts will be seen. If these are not noticeable turn both “Amount” and “Threshold to maximum. Turn down the “Threshold” until the artifacts disappear and then turn down the “Amount” until the grain is adequately reduced.

Edge Enhancement.

Removal of grain can often give the viewer the impression that the resolution has been reduced. Also higher amounts of GORE filter will soften the image. Applying “Edge Enhancement” will increase the apparent detail of the image to the point where it will look just as sharp or sharper than the original.

The following Figure 4 shows the method of operation for enhancement and coring.

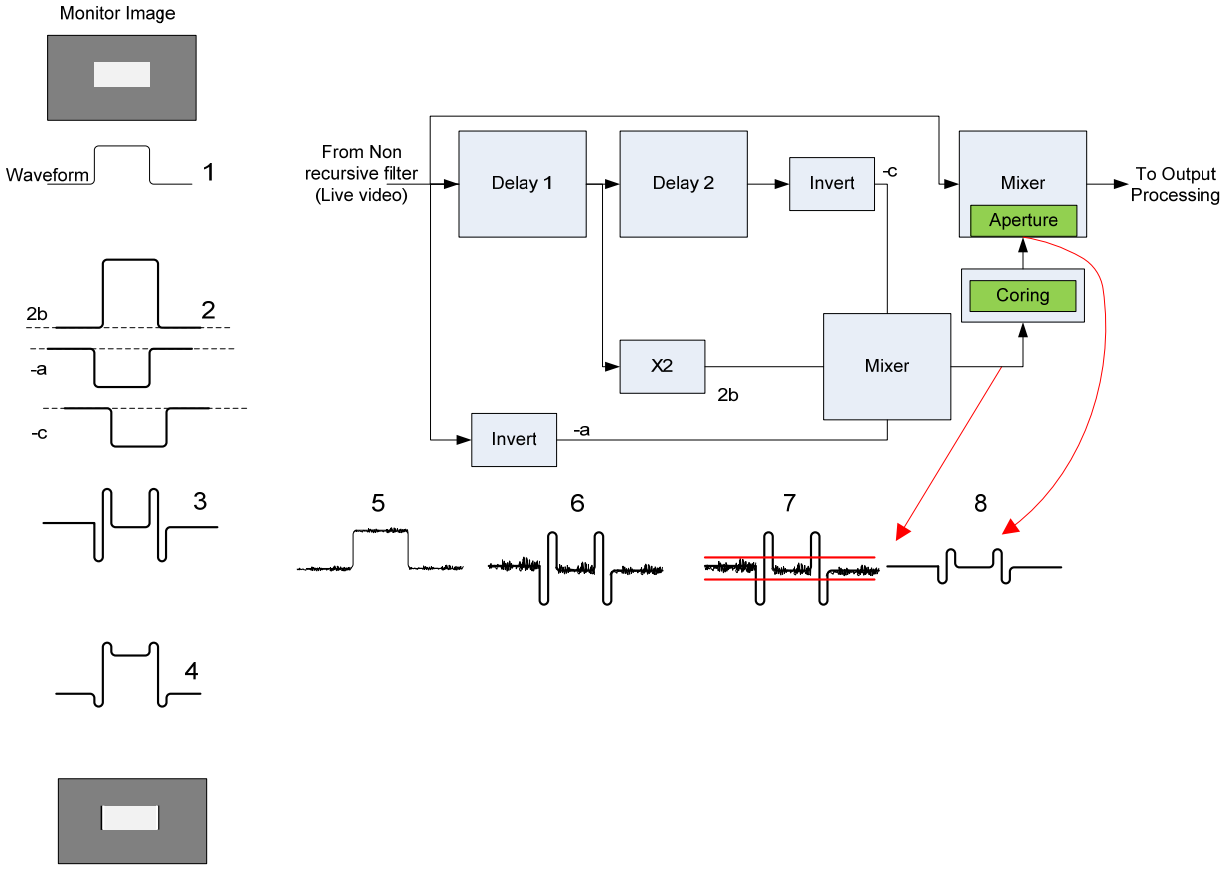

Figure 4. Aperture and Coring

The first image in the above figure shows an example of a light gray box on a darker gray background. Underneath is the waveform [1] that you would expect to be displayed on the wave form monitor. A rough formula for edge enhancement or aperture correction as it is also called, can be expressed as "-a +2b –c", where "a" is the source signal, "b" is the signal after some delay. The amount of delay determines the frequency of the enhancement (This delay fixed in the Aurora). "c" is the signal with twice the delay. As can be seen from the block diagram, "a" is inverted, "b" is amplified by 2, "c" is inverted and then all three signals are added in a mixer. On the left hand side of the diagram is each of the waveforms and their relationship in time and amplitude. Waveform [3] shows the edge enhancement signal. This is what is seen when the **"Edge view"** switch is selected. Waveform [4] shows the final output with edge enhancement added. The "Aperture" control allows the user to mix various levels of the edge enhancement signal into the original image.

Coring

Adding enhancement increases edge detail however any grain will also be enhanced. A control called coring is use to tune out the grain component. Refer to Figure 4. Waveform [5] shows the original source material with grain. Waveform [6] shows the edge enhancement signal and note that the grain or noise is also enhanced. Coring is used to remove the center component of the edge enhancement signal by only allowing transitions above the top red line and below the bottom red line in waveform [7]. Everything between the red lines is removed. The distance apart of the red lines or clip value is controlled by the "Coring" control.

The best way to set coring is to look at a stationary image with grain. Turn the "Edge Enhancement" to maximum (100%) and switch to "Edge View". With "Coring" set to (0%) the grain should be very noticeable. Turn up the "Coring" control until the grain disappears.

The are no typical values for "Aperture" as this is very dependent on the value set for the "Coring". Values to try are "Aperture" (35%) with coring set to 3%. Coring is normally set between 2% and 12%.

Further information is available in the Aurora Manual available at:
http://www.filmsys.com/downloads/Aurora.pdf