AMIRA & ALEXA SXT / SXT W / LF / MINI
Texture Control

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Contents

History

Version	Date	Change Note	Author
1.0	25-01-2019	Initial version	Tamara Seybold, Carola Mayr

1   Introduction

All ARRI cameras can apply user-defined looks to customize the color rendering of video images for different applications and individual preferences. This enables Cinematographers to show images on set that convey their creative intent. When a look file is activated, it automatically travels as metadata in recorded ProRes clips and in the SDI output. It is also possible to have a Look backed into material recorded on to card or as video over SDI (destructive mode). ARRIRAW (.ari) clips are always recorded non-destructively, with the look files embedded in the metadata. ARRI Look Files offer great and early creative interaction between DP and colorist, and between production and post-production.
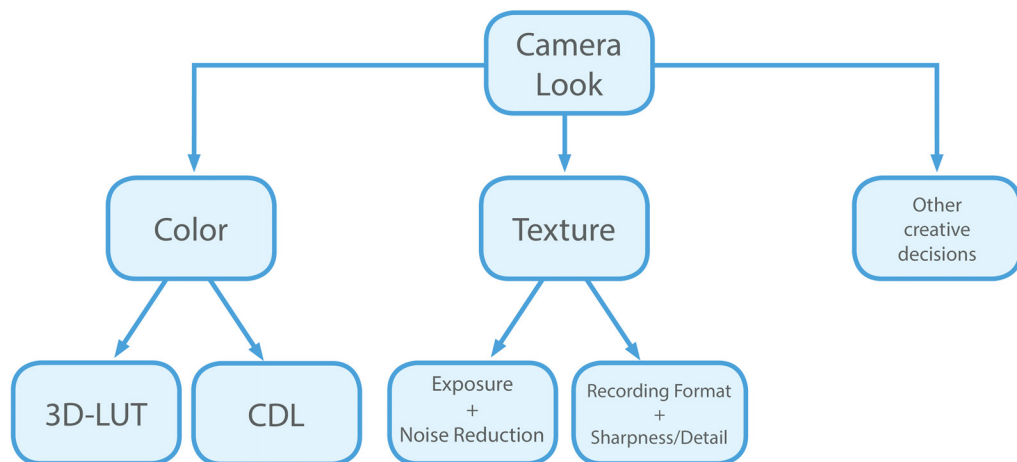
A camera look is more than color

Fig. 1: The look of a camera image can be adjusted in color using e.g. a 3D-LUT and/or CDL parameters. The texture can be adjusted using different amounts of grain (defined by exposure and noise reduction) and different sharpness and detail visibility of the images (defined by the format and sharpness/detail settings). Other creative decisions are the motion blur defined by the shutter angle, or depth of field defined by sensor size and optics.

Besides the color, an image captured with an ARRI digital camera has a texture that is an inherent part of the look of a camera. Texture describes the spatial characteristics, how for example an edge in the image appears smooth or crisp, or how the structure of a wooden surface is rendered. The processing steps in ARRI cameras are optimized to offer exceptional image quality with the organic look and feel of film. Customers around the world appreciate the texture rendering of ARRI digital cameras. While the default settings are perfect for most applications, some customers may wish to alter the texture according to their creative intent for one or more takes. Many do so by deciding for an exposure, e.g. low exposure to add more grain, or by deciding on specific recording format. The texture is not invariable: it is defined by the exposure – a low exposure could add a grainy texture to the image – and the recording format – from rendering very fine details when recording full sensor size with the ALEXA LF to using the Super 16 mode on the AMIRA. In addition to exposure and format, the camera processing offers influence on the texture: the default parameters provide sharp and natural images for HD, 2K, UHD and 4K Cine deliverables. To enable adjustments for different formats and creative intentions, we identified a range of settings that offer more creative control over the texture beyond format and exposure.

ARRI cameras[1] provide two additional parameters that regulate the sharpness and detail visibility of the images. These parameters can be set in post-production for ARRIRAW images of all cameras. All modern ARRI digital cameras contain a noise reduction parameter to adjust the amount of grain. These three parameters can be

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[1] The settings are available in-camera for most modern ARRI cameras, e.g. the ALEXA mini, see Table 1 and 2. For all ARRI cameras the settings are adjustable using the ARRIRAW Converter when ARRIRAW files are recorded.

used for fine adjustments and texture control within the same format and exposure to render the texture according to the creative intent. All settings apply to the rendering of Log C, hence are backed in if you record Log C or video.

This white paper provides information about the texture control in the ARRI camera menu, the ARRIRAW Converter (ARC) and the ARRIRAW SDK. In addition to the color look parameters (see link to ALF-2 white paper), we identified the parameters in the camera processing that alter texture. The first part discusses sharpness and detail, the second part the noise reduction feature. Each of these two parts first provides information about how to use the settings for each camera, for which recording formats the settings are available and where to find them.

High resolution images of all image examples used in this paper can be found under the link in section "Downloads and Links".

2　　Sharpness and Detail

There are two image parameters called sharpness and detail that influence the image sharpness.

These two filter parameters give the user the possibility to customize the look of the final image according to their specific needs. At the first glance, both parameters just increase and reduce the overall sharpness of the image, however they perform this in two completely different ways.

- **Sharpness parameter:**
  Amplifies or attenuates the contrast of edges, without introducing or removing fine details in the image. Small values of this parameter are reflected in smoother images and high values are reflected in crisper images. Its strength depends on the rescaling ratio and on the implementation. Though sharpness is always effective in software implementations (ARC/ARRIRAW SDK), in hardware it is effective only for upscaling and medium-low downscaling ratios, i.e. with a rescaling ratio lower than 5:2.

- **Detail parameter:**
  Works on fine details in the image. This parameter is reducing or maintaining the fine details depending on the ratio of the rescaling. A negative value of this parameter removes fine details and could, for instance, be used to remove some unwanted types of fine skin details. On the other hand, a positive value enhances fine details in the image, but, in case of high rescaling ratios, could increase the possibility to have Moirè effects in the image.

The sharpness and detail parameters are implemented in AMIRA and ALEXA MINI cameras and can be used for viewing purposes on set or backed in, while recording ProRes files. Furthermore as metadata of ARRIRAW (.ari) recordings the parameters offer the full flexibility to be changed in post-production.

2.1　　Practical Information about Sharpness and Detail

Because there are two parameters for adjusting image sharpness, the new ARRI filters allow finer sharpness adjustments than possible with conventional filters.

Values between *-5* and *+5* can be set for both parameters. The value *-5* corresponds to the lowest level of sharpness and detail and *+5* to the highest. ARRI recommends the standard value *0* for both parameters, which represent the values that ARRI camera systems traditionally record with, and that produce beautiful images for various contents and tastes. Other settings can be chosen to specifically reduce or enhance the sharpness and detail visibility according to the creative intent of the cinematographer.
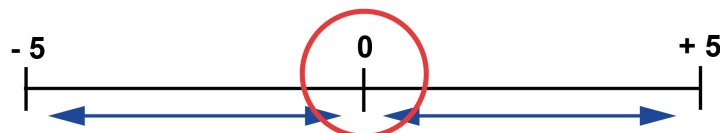

Fig. 2: *Parameter range of sharpness and detail*

The minimum and maximum values of the sharpness and detail filters are designed in such a way that they will always result in a pleasant image. They do not allow unrealistic sharpness and detail values, which would destroy the image structure.

The following figure shows the image results with different sharpness and detail settings.
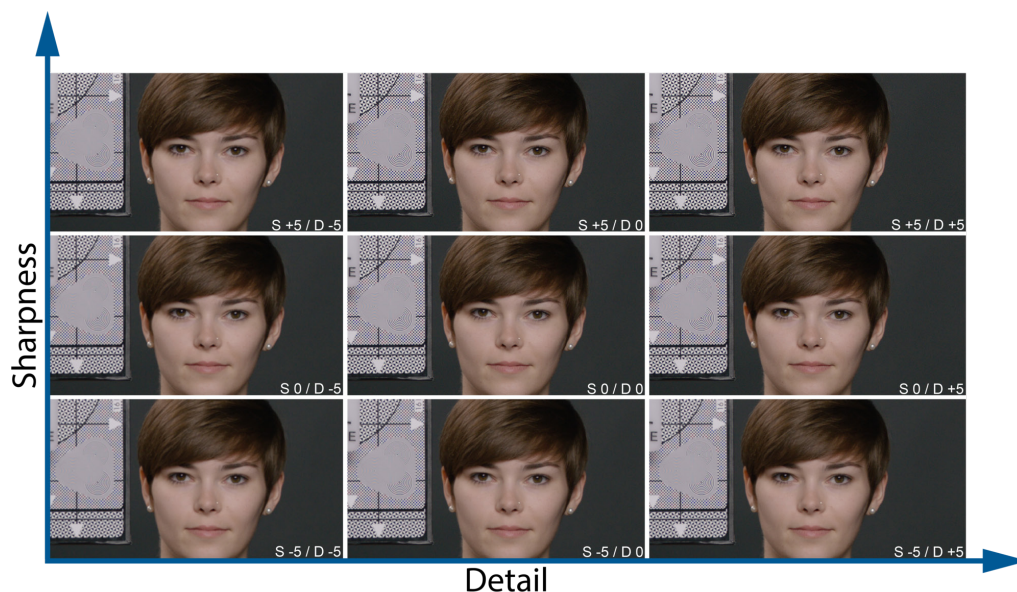
Fig. 3: Different sharpness and detail settings: (S = Sharpness parameter, D = Detail parameter); Lower left corner: lowest sharpness and detail values, upper right corner: highest sharpness and detail values.

By increasing the sharpness and detail values, the image noise will also be increased in sharpness and therefore become more apparent. The noise reduction filter can be used to mitigate the increase in noise.

2.2   Sharpness and Detail in the Camera

Sharpness and detail is available for the AMIRA and ALEXA Mini cameras in specific resolutions while recording ProRes.

In MXF/ARRIRAW and ARRIRAW (.ari) the parameters cannot be set in the camera.

Sharpness and detail values	Available for resolutions	
	ALEXA Mini	AMIRA
Sharpness: Between *-5* and *+5* **Detail:** Between *-5* and *0*	▪ S16 HD ▪ 3.2K ▪ 4K UHD ▪ 4:3 2.8K	▪ S16 HD ▪ 3.2K ▪ 4K UHD
Sharpness: Between *-5* and *+5* **Detail:** Between *-5* and *+5*	▪ HD ▪ HD Ana. ▪ 2K ▪ 2.39:1 2K Ana.	▪ HD ▪ 2K

Table 1: Available value range for sharpness and detail specific resolution
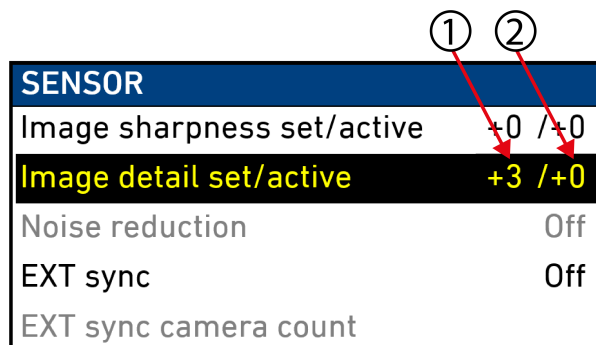
Setting up Sharpness and Detail in the Cameras

To set a sharpness and a detail value in the cameras:

1. Choose MENU > SYSTEM > SENSOR

2. Set your values for sharpness and detail

   →The set values are automatically used for all recording resolutions. There is one exception: Values over 0 for detail cannot be used for resolutions that include an up-scaler in the image path.

There are two values shown in the camera menu (see Fig.4) following the set/active pattern parameters. Only the first value of each parameter can be set. It shows the set value which is set by the user. The second value displays the actual used value, because resolutions with up-scaler do not allow detail values above zero. If you have selected a resolution with up-scaler, the second value does not exceed above *0* and the value *0* will be used for the recording.

Fig. 4: Sharpness and detail settings in the camera: (1) Set value; (2) Active value

2.3   Sharpness and Detail in Post-Production

After the recording, the parameters for sharpness and detail of MXF/ARRIRAW and ARRIRAW (.ari) footage of all cameras can be adjusted in the ARRIRAW Converter and/or third party tools which have implemented the ARRIRAW SDK.

3   ARRI Noise Reduction ANR-1

ARRI Noise Reduction ANR-1 is implemented in most modern ARRI camera models and can be used for monitoring purposes on set, recording to ProRes files (backed in) or as metadata of ARRIRAW (.ari) recordings with full flexibility to change the parameter in post-production.

ARRI Noise Reduction ANR-1 can be helpful in low light situations to reduce noise in the images. While it is commonly available in post-production tools, two reasons drove us towards creating a new, in-camera ARRI noise reduction: we enable fast, in-camera noise reduction and we provide a noise reduction method that retains the grain texture and natural looks that ARRI customers like.

Using ARRI Noise Reduction ANR-1 enables you to use noise reduction on set in the camera. This can be helpful for low light shots, where an in-camera noise reduction is a very fast solution. Furthermore, ARRI Noise Reduction ANR-1 gives you the possibility to combine the amount of grain with your sharpness and detail settings for the chosen exposure directly on set. You can store your decision either in the metadata, when recording MXF/ARRIRAW or ARRIRAW (.ari), or bake it into your ProRes files.

In contrast to general post-production tools, the ARRI Noise Reduction ANR-1 is optimized for the sensor noise characteristics and therefore can achieve a very natural noise reduction without any image blurring. This noise reduction, optimized for the ARRI sensors is available for ARRIRAW (.ari) recordings by using the new ARRIRAW Converter or a post-processing software that incorporates the ARRIRAW SDK.

The film-grain like, texture of ARRI cameras is highly appreciated by cinematographers around the world and therefore ARRI Noise Reduction ANR-1 is moderate and does not affect the grainy structure of the noise. The ARRI Noise Reduction ANR-1 just reduces it, nothing more.

3.1   Practical Information about the ARRI Noise Reduction ANR-1

The ARRI Noise Reduction ANR-1 is a temporal noise reduction filter, which analyses the frames around the target frame to reduce noise. Temporal noise reduction is a good way to reduce noise in static areas while at the same time maintaining the organic look of each frame.

The noise reduction strength can be set in a range from *0* (no noise reduction) to *3.5* (strong noise reduction).

We recommend the standard setting of *2.5* for noise reduction. Values above *2.5* should be set with caution, because higher values might cause temporal artefacts. Temporal artefacts are prone to appear near edges of moving objects in an otherwise static scene and at edges in sequences with very fast camera movements. In software and ALEXA LF, ARRI Noise Reduction ANR-1 includes Enhanced Motion Detection (EMD), which helps to avoid artefacts in areas with high motion.
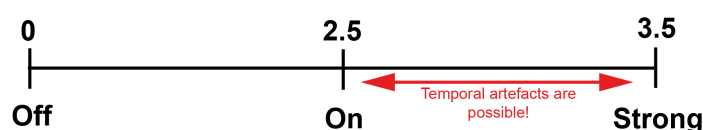

Fig. 5: Parameter range of the ARRI Noise Reduction ANR-1 filter

The following figures show the different results for EI 1600 and 3200 for the noise reduction settings of *2.5* and *3.5*. To enhance the visibility of the filter effects, only the red marked cropped area is used in the detailed figure examples.
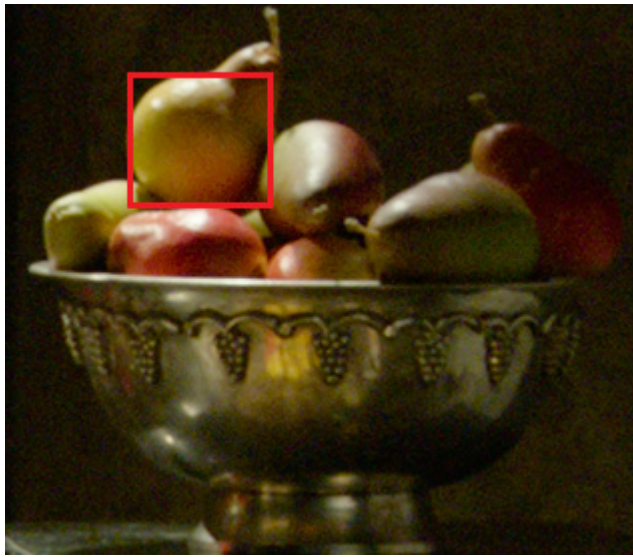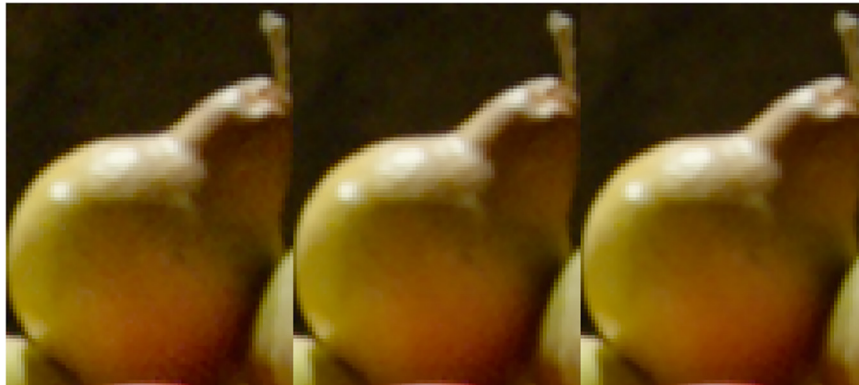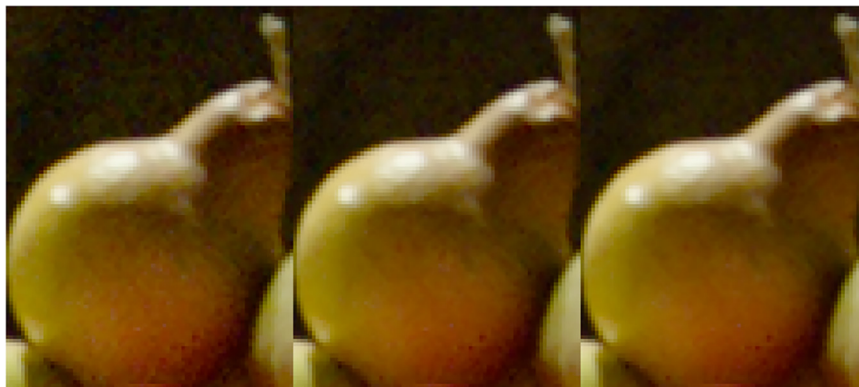

Fig. 6: Image example for noise reduction results

Example EI 1600

*Fig. 7: **Left:** ARRI Noise Reduction ANR-1 Off; **Middle:** ARRI Noise Reduction ANR-1 2.5; **Right:** ARRI Noise Reduction ANR-1 3.5*

Example EI 3200

*Fig. 8: **Left:** ARRI Noise Reduction ANR-1 Off; **Middle:** ARRI Noise Reduction ANR-1 2.5; **Right:** ARRI Noise Reduction ANR-1 3.5*

3.2   ARRI Noise Reduction ANR-1 in the Camera

Depending on the camera model, either two or three parameter values are available:

- *Off*: „Noise reduction" is deactivated.
- *On/Normal*: Standard value *2.5* is activated.
- *Strong*: Maximum value *3.5* is activated.

Only the latest ALEXA Mini and AMIRA software packages contain the parameter value *Strong*.

New in the ALEXA LF is Enhanced Motion Detection (EMD) in camera. EMD is possible because the ALEXA LF has more processing power than all previous ALEXA cameras. EMD additionally checks the pixel behavior around each pixel and thereby avoids temporal artefacts in high motion areas. This feature is newly introduced with the ALEXA LF to make noise reduction more robust for footage with high motion. In the ARRIRAW Converter and the ARRIRAW SDK, it is always activated.

The following camera models contain the ARRI Noise Reduction ANR-1:

Camera model	Noise reduction settings	Available for Formats	EMD
ALEXA SXT, SXT W	*Off/On*	All	-
ALEXA LF	*Off/On*	All	✓
AMIRA	*Off/Normal/Strong*	**ARRIRAW (.ari)** -	-
		ProRes ■ S16HD ■ 3.2K ■ 4K UHD	
ALEXA Mini	*Off/Normal/Strong*	**ARRIRAW (.ari)** -	-
		ProRes ■ S16HD ■ 3.2K ■ 4K UHD ■ 4:3 2.8K	

Table 2: Camera models which contain the ARRI Noise Reduction ANR-1

While recording ProRes files, the set noise parameter in the camera will be backed into the footage and therefore ProRes files cannot be opened and altered in the ARRIRAW Converter (ARC).

Recording ARRIRAW (.ari) with the ALEXA SXT, SXT W and LF cameras, the ARRI Noise Reduction ANR-1 is applied for preview (viewfinder and MON OUTs) but not backed into the footage. The set ARRI Noise Reduction ANR-1 strength will be stored in metadata.

The ALEXA Mini and AMIRA cameras do not allow to set a ARRI Noise Reduction ANR-1 strength when recording ARRIRAW (.ari). The ARRI Noise Reduction ANR-1 of course can be adjusted also for ARRIRAW (.ari) in the ARC.

3.3   ARRI Noise Reduction ANR-1 in Post-Production

After recording, MXF/ARRIRAW and ARRIRAW (.ari) footage of all cameras can be adjusted in the ARRIRAW Converter and/or third party tools which have implemented the ARRIRAW SDK. It contains the ARRI Noise Reduction ANR-1 including EMD. Only MXF/ARRIRAW and ARRIRAW (.ari) files can be opened and altered in ARRIRAW Converter.

As already mentioned for the ARRI Noise Reduction ANR-1 strength, all values between *0* and *3.5* can be set in the ARC. Higher values above *2.5* can produce temporal artefacts. However, the software version always uses Enhanced Motion Detection (EMD) and hence is more robust for footage with high motion.

The set ARRI Noise Reduction ANR-1 parameter is stored in the metadata of the ALEXA SXT, SXT W and LF cameras and this metadata value is used as the default value in the ARRIRAW Converter. For the ALEXA Mini it is turned off by default.

4   Workflow

The workflow from recording to post-production contains different steps depending on the camera model and recording format.

ARRI cameras can create image sequences in the compressed ProRes and uncompressed MXF/ARRIRAW and ARRIRAW (.ari) recording formats.

Set parameters in ProRes will directly be backed into the recorded file and cannot be adjusted in the ARRIRAW Converter or post-production tools which have implemented the ARRIRAW SDK.

ARRIRAW (.ari) is the raw format of ARRI cameras. The set camera parameters are saved in metadata and are not baked into the image data itself.

This chapter contains the different workflows for sharpness, detail and noise reduction in ALEXA SXT, SXT W, LF, Mini and AMIRA cameras.

4.1   ALEXA SXT, SXT W and LF

ALEXA SXT, SXT W and LF cameras only implement the digital noise reduction filter for all resolutions and recording formats. The filters for sharpness and detail can only be manipulated in post-production for ARRIRAW (.ari) files.

The noise reduction filter can bet set to *On* or to *Off* in the camera. *On* represents the standard ARRI Noise Reduction ANR-1 strength of *2.5*.

To activate noise reduction filter in the ALEXA SXT, SXT W and LF cameras:

1.   Choose MENU > SYSTEM > IMAGING

2.   Set "Noise reduction" to *On*

     → The noise reduction filter is automatically used for all recording resolutions.

To set a higher noise reduction strength than *2.5*, you can use the ARRIRAW Converter (ARC) after recording. In the ARC, the noise reduction strength can be set between *0* and *3.5*.

The Figure "Fig. 9: ALEXA SXT, SXT W, LF workflow" shows the processing procedure for compressed ProRes and uncompressed ARRIRAW (.ari).
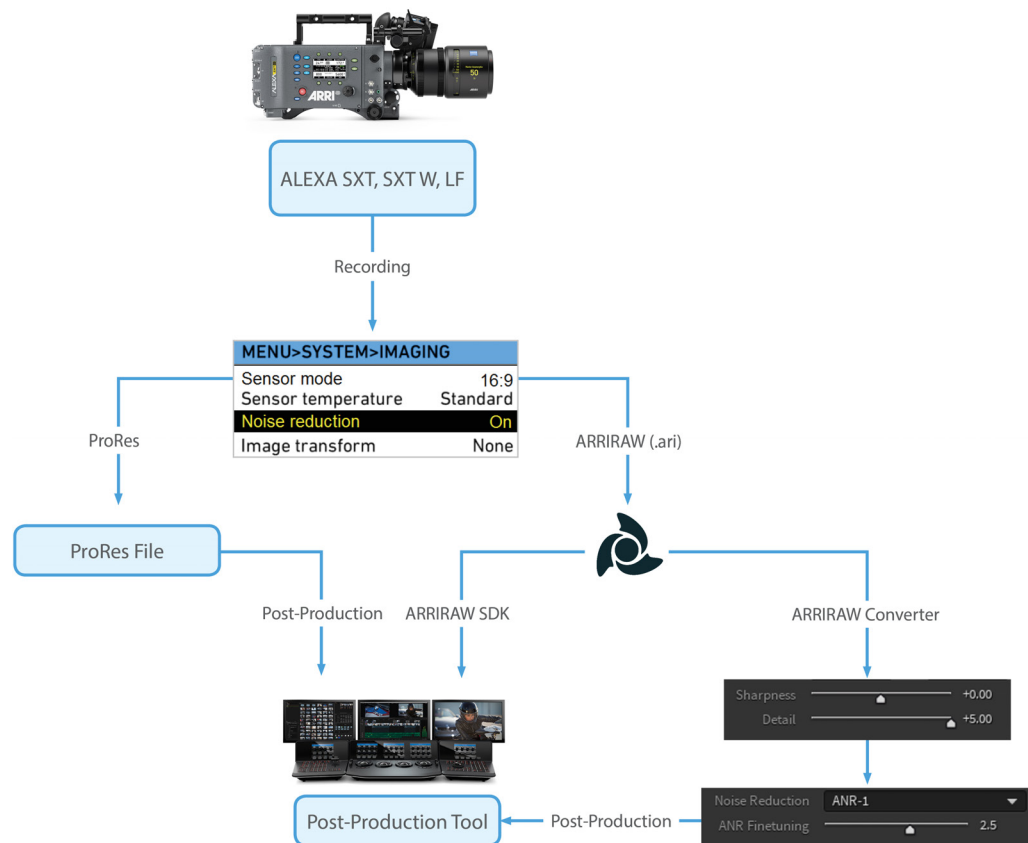
Fig. 9: ALEXA SXT, SXT W, LF workflow

When the noise reduction filter is activated in the camera, all created ProRes files will be denoised with the standard ARRI Noise Reduction ANR-1 strength of *2.5*.

The noise reduction settings in the camera will be saved in metadata of the ARRIRAW (.ari) files. To adjust sharpness, detail and noise reduction parameters after the recording, use the recording format ARRIRAW (.ari) and open them in the ARRIRAW Converter or in post-production tools which have implemented the ARRIRAW SDK.

4.2   AMIRA and ALEXA Mini

AMIRA and ALEXA Mini cameras implement the filter for sharpness, detail and noise reduction for selected recording formats.

The supported recording formats for sharpness and detail are listed in section "Sharpness and Detail in the Camera".

The supported recording formats for noise reduction are listed in section "Noise Reduction in the Camera".

Values between *-5* and *+5* can be set for sharpness and detail in the camera, the ARRIRAW Converter or post-production tools which have implemented the ARRIRAW SDK.

To set a sharpness and a detail value in the AMIRA and ALEXA Mini cameras:

1. Choose MENU > SYSTEM > SENSOR

2. Set your values for sharpness and detail

    →The set values are automatically used for all recording resolutions. There is one exception: Values over 0 for detail cannot be used for resolutions that include an up-scaler in the image path.

The ARRI Noise Reduction ANR-1 contains two strength levels for AMIRA and ALEXA MINI cameras. It can be set to *Off*, *Normal* and *Strong*. *Normal* represents the standard value *2.5* and *Strong* represents the value *3.5*.

To activate "Noise Reduction" in AMIRA and ALEXA Mini cameras:

1. Choose MENU > SYSTEM > SENSOR

2. Set "Noise Reduction" to *Normal* or *Strong*.

   → The set option is automatically used for all recording resolutions.

The ARRIRAW Converter or post-production tools which have implemented the ARRIRAW SDK allow to set finer values between *0* and *3.5*.

The following figure shows the processing procedure in compressed ProRes and uncompressed MXF/ARRIRAW recording formats for AMIRA and ALEXA Mini cameras:
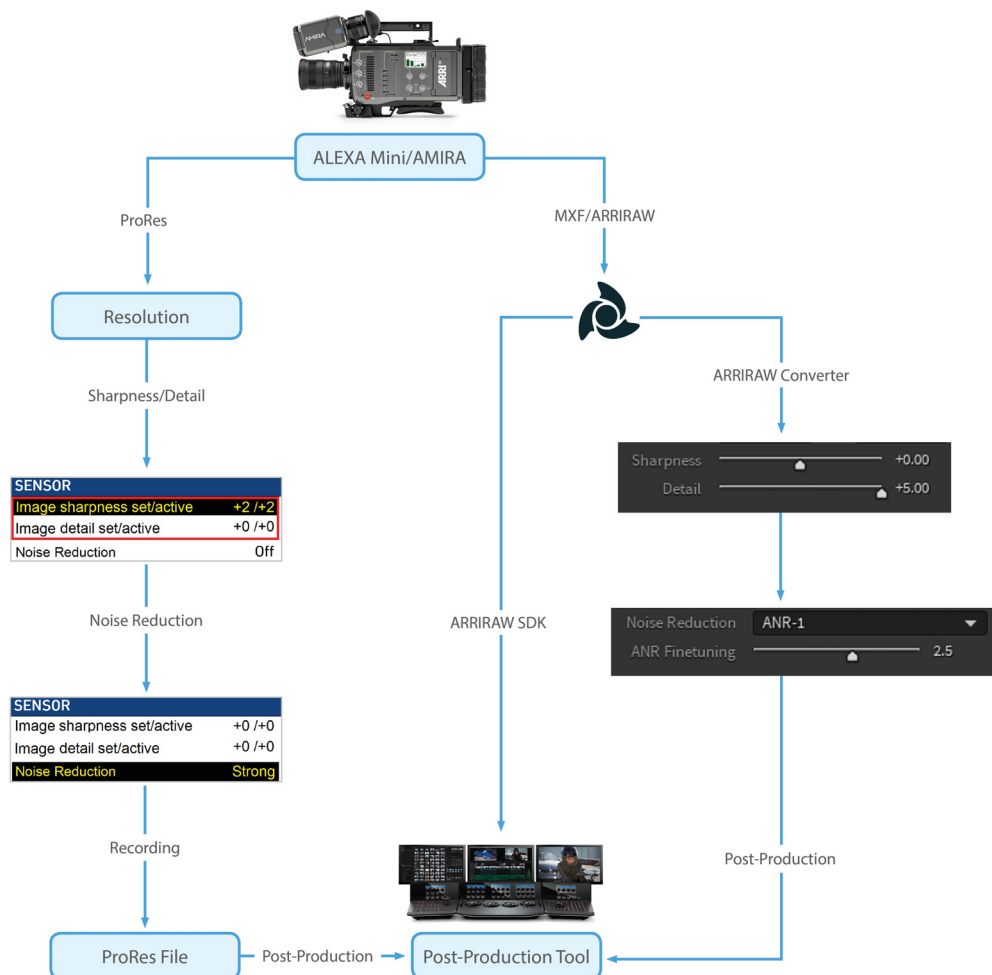

Fig. 10: ALEXA Mini and AMIRA workflow

All set camera values for sharpness, detail and noise reduction will be used for ProRes files except in specific cases. Detail values above *0* cannot be set for recording resolutions with an up scaler in the image path. The recording resolution should be set first for this reason.

If you use higher sharpness and detail values, it might be beneficial for the image to activate the noise reduction filter, because higher sharpness and detail values also increase the image noise.

To adjust sharpness, detail and noise reduction parameters after the recording, use the recording format MXF/ARRIRAW and open them in the ARRIRAW Converter or in post-production tools which have implemented the ARRIRAW SDK.

5 Downloads and Links

- High resolution images of this white paper:
  https://arriwebgate.com/directlink/6db03d1ad27cd719
- Link to ALF-2 white paper (AMIRA & ALEXA Mini – Color By Numbers):
  https://www.arri.com/resource/blob/31924/
  a987b5462abe89c58f3f7903d4123891/2018-03-arri-amira-alexamini-color-by-
  numbers-data.pdf
- Link to ALEXA SXT ALM white paper:
  https://www.arri.com/en/learn-help/learn-help-camera-system/downloads

6   Contact

ARRI - Arnold & Richter Cine Technik GmbH & Co. Betriebs KG

Türkenstraße 89

80799 München

If you have any questions, please feel free to contact us via email at
digitalworkflow@arri.de.