Bachelor's thesis

NTNU
Norwegian University of Science and Technology

Kalle Frog Huelssner

Beyond Resolution

An Analysis of Dynamic Range and Color Science in the Arri ALEXA mini and Blackmagic URSA mini pro 4,6k

Bachelor's thesis in Film and Video Production
Supervisor: Aleksander Koren
May 2023

NTNU
Norwegian University of Science and Technology

Kalle Frog Huelssner

Beyond Resolution

An Analysis of Dynamic Range and Color Science in the Arri ALEXA mini and Blackmagic URSA mini pro 4,6k

Bachelor's thesis in Film and Video Production
Supervisor: Aleksander Koren
May 2023

Norwegian University of Science and Technology

NTNU
Norwegian University of
Science and Technology

Bachelor Thesis, FILM2202
Candidate Number: 10034

Beyond Resolution: An Analysis of Dynamic Range and Color Science in the Arri ALEXA mini and Blackmagic URSA mini pro 4,6k

How does the dynamic range and color science of the Arri Alexa Mini and Blackmagic Ursa Mini Pro 4.6K compare, and how do their capabilities translate to real-world filmmaking? Furthermore, what factors have contributed to the Arri Alexa's domination in the cinema world?

5612 words

Table of Contents

Introduction

My research question was born out of the idea of comparing two cinema cameras by filming the same shot on both in order to take a closer look at the effects of different sensor technologies. Therefore, I decided for a bottom-up approach in my research. I analyzed my collected data and used it to lead my research. This way I had a greater understanding of how the technologies affects the actual image. I decided to compare the Arri Alexa Mini and the Blackmagic Ursa Mini Pro 4,6k.

The following is the research question for my bachelor's thesis: *How does the dynamic range and color science of the Arri Alexa Mini and Blackmagic Ursa Mini Pro 4.6K compare, and how do their capabilities translate to real-world filmmaking? Furthermore, what factors have contributed to the Arri Alexa's domination in the cinema world?*

To narrow down my thesis, I chose to concentrate on the aspects of dynamic range and color science. Although there are other significant factors to consider when selecting a camera for a production, I limited myself to these two areas since they have the most significant impact on the final image quality.

To begin, I will introduce the two cameras that I am using in my study and explain the purpose of my tests. Then, I will explore the functionality of camera sensors in detail, focusing on color science and dynamic range. Afterwards, I will present the results of my tests and discuss their implications in the context of the film industry. Finally, I will provide a practical overview of how my findings translate into the world of cinema.

Arri ALEXA Mini

The Arri ALEXA Mini was a natural choice for me. Arri is dominating the professional cinema market, with most of the Oscar nominated movies being shot on Arri cinema cameras. Arri is a well-established brand first starting off in 1917. (Arri, 2023) They had their big breakthrough in 1937 with the revolutionary ARRIFLEX 35. A compact rugged camera designed with a spinning mirror which allowed the cinematographer to see through the lens and even visually focus. (Fauer, 2017)

In 2005 Arri released the ARRIFLEX D-20 Arris first all-digital cinema camera. It was not available to buy, only to rent though their rental stores. This is a practice Arri still does to this day. Several of its high-end cinema cameras and lenses are not available to buy, but instead have to be rented. In 2010 Arri finally released the Arri ALEXA. The camera was very successful because it combined the best parts of old-fashioned film with new digital technology. Arri secured its place in the digital cinema world. With around 80% of the top 100 grossing movies using an Arri digital camera in 2018. (Follows, 2017) They produce a wide variety of products used in cinema production. From follow focus over gimbal to light. Arri is known for quality, durability and a premium price tag. I am very lucky to have access to an Arri Alexa mini through my university. That's why it was naturally for me to take a closer look on Arri and the Alexa Mini.

Blackmagic URSA Mini Pro 4,6k

The camera I will compare against the Alexa Mini is Blackmagic's Ursa Mini Pro 4,6k. Personally, I would not describe Blackmagic as a direct competitor to Arri as they are in different price ranges and have a different target audience. Unlike Arri, Blackmagic appeals to a more semiprofessional audience. Their cameras costs often less than 1/10 of Arris cameras while still featuring a cinema style workflow. Blackmagic's cameras are often seen in smaller indie or independent student-film productions. Like the short film Barber School by Raffaele Vesco (Vesco, 2021) But also rarely seen in bigger pictures like Disney's original film *Rise* directed by Akin Omotoso. (Omotoso, 2022) That means a lot of upcoming cinematographers will most likely shoot some of their earliest work on a Blackmagic camera. I also have easy acces to a Blackmagic camera and that is why I decided to compare these two cameras.

Why not RED?

It may seem unfair that I am comparing two so different priced cameras to each other. RED is one of Arris biggest competitors. Why am I not compare those two? There are several reasons to that question. I wanted to find out what limitations does the BlackMagic URSA brings upon the cinematographer? Is it worth to rent an Arri instead of a cheaper BlackMagic. And it was also about availability. I had access to an Arri and an BlackMagic, sadly I do not have the budget to rent a RED camera for my tests. I also think that including a RED would extend the limits of this thesis.

Background

When I normally look at camera tests on the internet, I often see people filming different graphs which for example tries to show how the camera is losing sharpness at the edges of the sensor or use perfectly lit people inside a studio. For me personally, those tests are not representing the feel of a camera. They cut down the cameras picture into maths. But what are the real life consequences of shooting a camera in a badly lit room? I want to know what type of image is being produced by the tested camera. I want to know what type of feeling is being portrayed by the different sensors. Because that is what the audience is experiencing when seeing the scenes in the cinema.

That is why I went for a more “run & gun” approach for my tests. I used the limited light that the surroundings provided to me to push the camera to its limits. Arri cameras are known to have an unmatched dynamic range. Therefore, I expect to see the biggest difference in low light scenarios. (Stump 2014, 140-141) I will have a greater focus on those tests and explain what dynamic range is later in the text.

I captured various scenes during evening and nighttime, using different lighting sources to illuminate my subject. I used the sun, street lights, fluorescent light from a storefront and I tried to film in complete darkness. I filmed all shots on the Arri Alexa Mini and on the BlackMagic Ursa Mini Pro 4,6k. The choice of lens has a lot to say about the picture. The varying coatings on the glass inside the lens and different materials used in assembly can directly impact the contrast and color representation of the resulting images. Therefore, I choose to use the same Sigma CINE 18-35mm T2 lens for all tests. Both cameras have a Super 35 sized sensor and use internal ND-filters[1].

The Super 35 sensor is equivalent in size to the 35mm film format used in traditional cinema cameras. It is important to not confuse Super 35 sensors with newer full-frame sensors. Both

[1] ND-filters or neutral density filters are used to reduce the light entering the sensor.

are inspired by 35mm film stock. In older Arriflex cameras the film is transported vertically through the camera. This format is called Super 35. While full frame sensors are inspired by 35mm still photography where the film is being transported horizontally through the camera. Resulting in the biggest possible image on 35mm film. Camera manufacturers today often prefer to maintain the traditional sensor sizes because of our familiarity with their resulting aesthetic and the abundance of lenses compatible with those sensors.

When it comes to recording settings, I decided to film mostly in the ProRes codac. Both cameras support ProRes so I think it is naturally to film with said codac. On the Alexa I filmed using ProRes 4444XQ while on the Ursa I used ProRes XQ. Both codacs are an Apple owned standard and nearly identical. The only difference is that Arris ProRes 4444XQ has support for an alpha channel. (Stump 2014, 375) That will not matter to my test since I won't be doing any VFX work. For clarification I used Blackmagic's Davinci Resolve editing software to edit the shots, generate screenshots and provide useful graphs. Over the past years Davinci Resolve has secured its place in the cinema industry as a stable and cost-efficient editing software. Especially known for colour grading. I don't expect the URSA to have an advantage over the ALEXA because of my choice of software. Since I mostly shoot in ProRes the software treats the files from both cameras the same. If I shot RAW, the URSA had an advantage because Davinci Resolve offers more editing possibilities for BlackMagic RAW. RAW files are Bayer pattern sensor data as files. Which provides more flexibility in post-production. (Stump 2014, 296)

SENSOR TEKNOLOGI

To better understand how the cameras behave during my testing I will go in depths how camera sensors work. We can find two different types of sensors in the world of digital cameras, CMOS and CCD sensors. CCD sensors were popular in the early days of digital cinema. They work very differently in comparison to CMOS (complementary metal oxide semiconductor) sensors. CCDs (which stands for charge-coupled device), (Stump 2014, 21) seem to be inspired by the earlies technicolor process where the light coming through the lens gets split up by a prism into different wavelengths resulting in the red light exposing one film and the green and blue wavelengths getting redirected to expose another film. The CCD sensor works in a similar way. But instead of a prism filtering out the light onto two films

CCD sensors use prisms which split up the light on three different sensors. One for red, green and blue.

CCD vs. CMOS

CCD cameras outperformed their CMOS counterpart when it came to lowlight sensitivity and noise in the picture. But CCD cameras also had their throwbacks. Because of the separated wavelengths and the different speed of said wavelengths they all bend and behave different while passing the prism resulting in different size images and focus distances. (Stump 2014, 23) That results in chromatic aberration. Chromatic aberration occurs when the lens is unable to properly focus the red, green, and blue wavelengths, causing the slower red wavelengths in particular to be out of focus. This can result in a reddish glow surrounding objects that are otherwise in focus. This type of effect appears in analogue film as well and since camera manufactures strive to achieve the "film look". While chromatic aberration in itself might not be a flaw great enough to discard CCDs, the limited sensor size proved to be a problem for the film industry/filmmakers.

Picture 1 - Chromatic Aberration (Gourley 2016)

Why do filmmakers and camera producers stive to create a film like look? Newer CMOS cameras create very clean and contrast full images. Pro-Mist filters have become very popular, they create glow around light sources and gives the picture less contrast. Why do we develop cameras that create super clean pictures just to reverse that by attaching filters to the lens? I think it has something to do with nostalgia and how we experienced film when we grew up. When we think about movies that shaped our definition of real cinema we think about the Harry Potter movies, Fight Club, the Godfather movies, Apocalypse now, the original Star Wars trilogy and many more. All shot on film. Even today big filmmakers like

Christopher Nolan and Quentin Tarantino still use film for their movies. Reenforcing our expectation of how a cinema movie should look.

CCD sensors are complex and difficult to engineer resulting in relatively small sensors in comparison to analogue film and CMOS sensors. Having a smaller sensor size results in a very different experience of depth of field. That is partly caused by a concept called telecentricity[2]. In the context of a CCD sensor that means that the distance light travels inside the sensor is much longer in proportion to the distance light would travel in a single sensor system. Which results in a much greater depth of field and increased sharpness. (Stump 2014, 23-25) That in combination with the above stated chromatic aberration results in much more sharp objects which suffer from a red glow. That can in the worst case draw the viewers' attention on unwanted objects and away from what is important.

Picture 2 - Visualization of depths of field (Stump 2014, 25)

This change in depths of field also thrives away from my earlier mentioned film look. The traditional 35mm film look typically features a shallower depth of field, which is a look that we are accustomed to. This is because the limited depth of field can draw our attention to the subject in focus and guide our eyes to what is important in the frame. Having the possibility to focus pull is a significant tool for a cinematographer to tell his story. By using a small sensor and having such a great depths of field area this tool is significantly restricted.

Each sensor collects light values, there are thousands microscopic light meters on the sensor, collecting light values. These values are called Photosites. (Stump 2014, 2) In CCD sensors

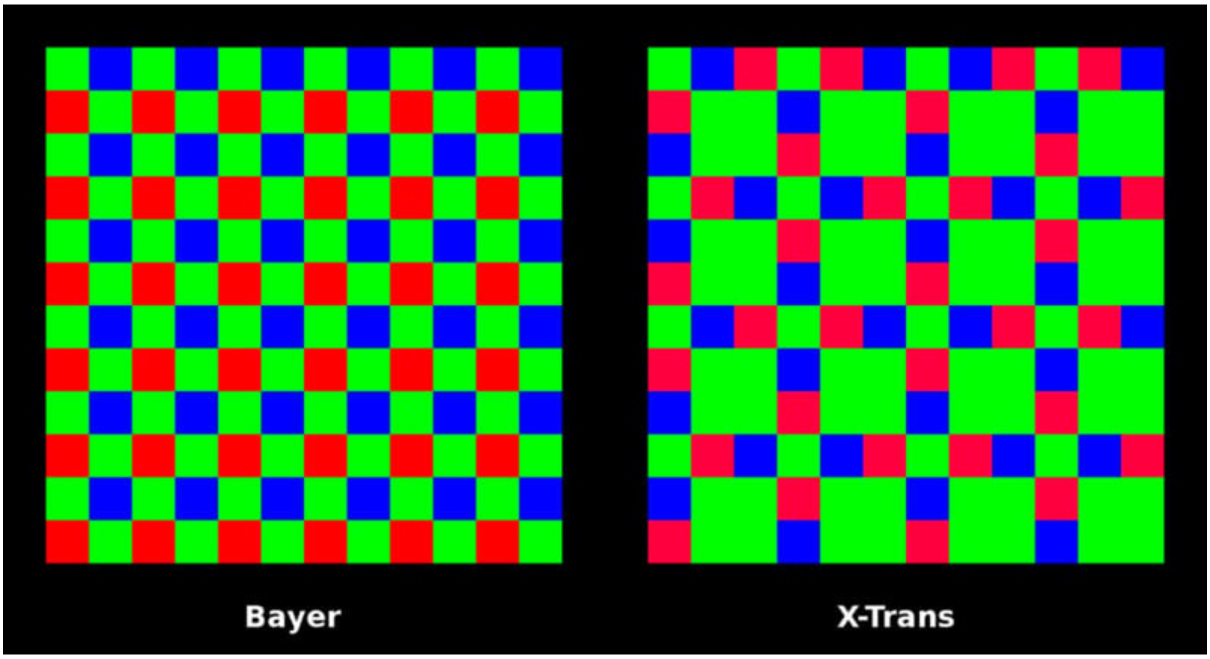
[2] A telecentric lenses increases the lengths light must travel before hitting the sensor and forces the light into a more parallel path to achieve that.

each photosites charge is transferred through a limited number of output nodes to then be converted into voltage. That limits the speed in which CCD sensors can operate. CMOS sensors on the other hand don't need to transfer the photosites charge though output nodes. Due to the individual addressability of each photosite in a CMOS sensor, the writing speeds are significantly faster, enabling the camera to record at higher frame rates and resolutions.

CMOS sensors can be placed and sized exactly like analogue film. Meaning that much of the already developed and produced lens technology can seamlessly be used in a digital single sensor workflow. That's one of the reasons why camera manufactures decided to focus on CMOS sensors and push its technology beyond what CCD sensors are capable of. Turning CCD sensors into a relic of the past barely seen on the modern camera marketspace.

Bayerpattern

CMOS sensors used in most cameras are monoplanar, meaning the sensor can only detect light sensitivity and no color information. To create a color image the sensor uses a Bayer Pattern color filter in front of the sensor. This filter has a mosaic pattern usually consisting out of 50% green, 25% red and 25% blue squares. But that is not the case for all cameras. Fujifilm has famously their own X-Trans filter array. Fujifilm has not disclosed the exact precent values of each color, but it is known to have more green squares than the 50% being used in the Bayer pattern.



Picture 3 - Bayer Pattern vs. Fujifilm X-Trans pattern (Liles 2017)

The sensor is than capable of detecting the amount of light for each color captured by the photosites. (Stump 2014, 29-30) A RAW picture taken through a Bayer filter is not an RGB picture. It only consists of red-only, blue-only and green-only squares. Since around 50% of the squares are green the RAW picture has a heavy green tint. The file size on the other hand is only one third of the size of a normal RGB image. (Stump 2014, 33)

Now the Bayer image must be converted into a normal RGB image. David Stump calls this “De-Bayering”. Each single-colored square gets mathematically assigned RGB values based on the color information interpreted from the neighboring single-colored squares. (Stump 2014, 33)

Analytics

Dynamic range

Dynamic range is measured in stops. Stops are a measurement that determents how much light is entering a camera. One more stop of light means to double the original value, while going down with one stop means halving the original value. This type of measurement is being used greatly to communicate a change in exposure between for example the director of cinematography and his gaffer. Dynamic range can be calculated but it is mostly a sales pitch. In the world of technology, manufactures always advertise with the highest numbers. 4k, 6k, 8k, 12k the more pixels a camera has the better it is. For people who are new to the world of cameras that might be the only way for them to differentiate. I think the same can be said for dynamic range. What the manufacturer advertises and what the actual product delivers can vary quite a lot.
According to the manual of the Blackmagic URSA mini Pro 4,6k the camera should have 15 stops of dynamic range (Blackmagic Design 2020, 35)
Most modern film stock has between 12-14 stops. (Stump 2014, 39) The Arri ALEXA Mini is being advertised with 14+ stops of dynamic range. (Arri 2023) Even though Arri´s adverticed dynamic range is vague I would presume that the URSA will outperform the ALEXA due to its higher advertised dynamic range.

For my tests I went outside into the Norwegian winter and filmed my subject in a dark environment. Beforehand I want to excuse eventual differences in framing and local lengths. While filming we experienced everything from no snowfall to heavy winds and high amounts of snow. In other words: a typical march day in Trøndelag. I didn't want to expose the cameras to those harsh weather condition for too long that's why I focused on the exposure and not so much on getting exactly the same frame twice.

The first shot I filmed on a rooftop. I positioned the subject under a light in front of a dark metallic part of a house. In the background we get a glimpse of the horizon. At that time the sun has not totally set. But there is a thick layer of clouds between us and the sun meaning we had to rely on the lamp above the door to light the subject. I positioned the subject under the light to see how the cameras react to the highlights in the light and the darker tones in the shot. This way I am testing the cameras dynamic range capacities. To simplify it I am looking for the image that holds more information before the highlights are blown[3] and the shadows are crushed[4].

Picture 4 - Rooftop, lamp - Blackmagic URSA mini Pro 4,6k - ProRes XQ - 2K

[3] "Blown highlights" is a common way of saying that the pictures highlights are so overexposed that it holds no information anymore.
[4] "Crushed shadows" is the opposite of blown highlights. When a dark part of an image is so dark that it does not hold any information anymore.

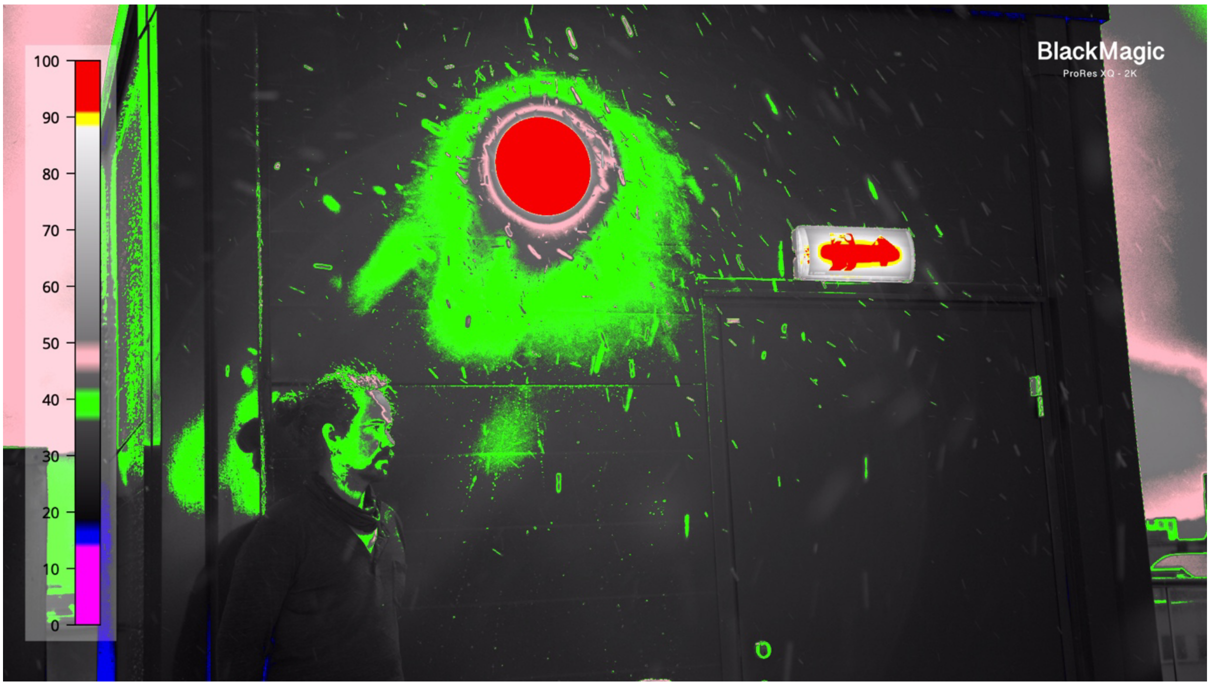
Picture 5 Rooftop, lamp - Arri ALEXA mini - ProRes 4444XQ - 2K

The results of these tests were surprising, particularly the colors produced by the cameras. For clarification I filmed everything in S-Log 3 to get the most dynamic range. S-Log is a gamma curve that flattens the image to allow the most dynamic range to be captured. This results in the image being grey and flat of colors. (See picture 4) It is therefore necessary to apply color correction in the postproduction. To guarantee an even test I created an own LUT[5] which worked on both cameras. Meaning all pictures have undergone the exact same changes in postproduction. As I mentioned before, all screenshots of data being presented are created by using Blackmagic´s Davinci Resolve and shot in the ProRes codac.

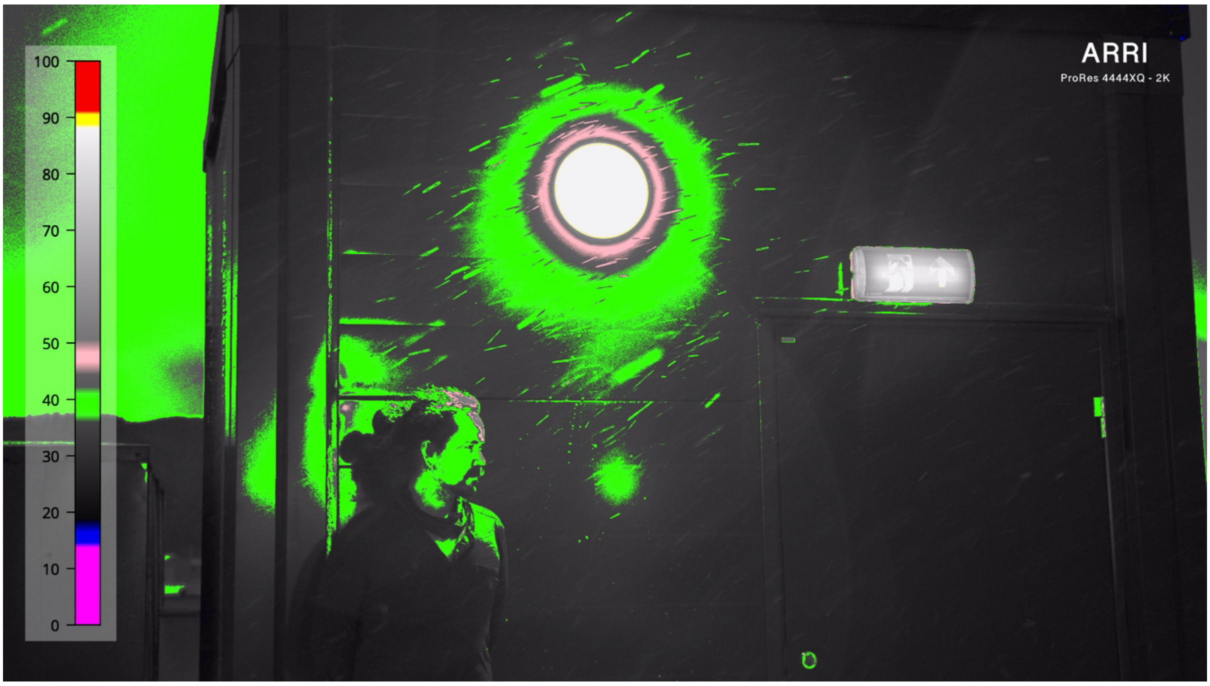
[5] A LUT, or Lookup Table, is a file that acts as a recipe. Changing to colour space to allow the footage to be graded on and for different displays. (Stump 2014, 98)

Picture 6 Rooftop, lamp - Arri ALEXA mini - ProRes 4444XQ - 2K - without LUT

Before analyzing the colors, I will analyze the dynamic range. If we consider the advertised stops of both cameras the URSA should outperform the ALEXA in this point. To visualize that as good as possible I applied a tool called false color. This tool provides a visualization of exposure levels shown in the picture. (Stump 2014, 308) Since this test is about the pure data in the picture, I removed the LUT before applying the tool.



Picture 7 Rooftop, lamp - Falsecolor - Blackmagic URSA mini Pro 4,6k - ProRes XQ - 2K



Picture 8 Rooftop, lamp - Falsecolor - Arri ALEXA mini - ProRes 4444XQ - 2K

On the left side on each frame is a scale which explains the shown colors. Red means it is blown out and that part does not hold any information anymore while purple means that its crushed and there is also no information left. Both shots are exposed for the subject, meaning that the person in the frame is exposed the same way in both shots. On the URSA we can clearly see that the light and the exit sign are completely blown out making it difficult to recreate the information without losing light on the subject. There are also some blue areas around the building meaning that it is getting close to being crushed.
The ALEXA on the other hand don't show any yellow, red or purple. Just a tiny dot of blue in the right corner. That means everything inside the shot is completely fine and can be edited without any worries about unwanted crushing or blowing.

Either Blackmagic overpromises with its advertised 15 stops of the URSA or Arri´s overdelivers on their advertised 14+ stops of dynamic range. During my research I found an article about an independent lab test performed by Gunther Machu testing the URSA´s dynamic range. In his tests the URSA resulted in a score of 12.5 stops of dynamic range. (Machu 2020) The Arri ALEXA mini LF on the other hand scored solid 14 stops of dynamic range in their tests. (Machu 2021) The ALEXA mini LF uses the same sensor technology as the ALEXA mini I used in my tests. Its main difference being resolution and sensor size. That shows us how much of a difference only 1.5 stops of dynamic range make.

We have now learned that high dynamic range results in the camera being able to capture image information in both the bright and the dark areas in a shot at the same time. But how does that exactly translate to the real world? To explain that I will look at one scene from Sam Mendes´s *1917* and one shot from the movie *Nomadland,* both have also been shot on the Arri ALEXA mini.

As the intention was to create the illusion of a single continuous shot throughout the entire film, camera settings and ND filters had to be carefully chosen beforehand, as there were limited opportunities to make adjustments during filming. The initial shot follows a character as they move through a dimly lit building. The camera then shifts to the left, revealing an open window through which another character can be seen.

Picture 9 – Soldier inside a dimly lit house (Mendes 2019, 00:38:42)

Picture 10 – Soldier outside the house (Mendes 2019, 00:38:49)

These types of shots are very challenging for cameras. Going from exposing the inside of a building to exposing the outside takes a lot of dynamic range. Cameras which do not offer high amounts of dynamic range will struggle to capture such shots. Having a high amount of dynamic range in a camera provides the cinematographer with a great deal of artistic freedom in how they capture a scene. For instance, it enables them to create spectacular camera movements that may limit the possibility of lighting and changing camera settings or filters, as seen in the example given.

Oscar winning *Nomad land* directed by Cloé Zhao presents its story in a documentary style narrative. Cinematographer Joshua James Richard decided to film by only using natural light while also trying to have a light camera rig to allow him to stay agile while filming. He shot mostly on the Arri ALEXA mini with some scenes being shot on the ALEXA Amira. (Mascha 2023)

The movie shows nicely the dynamic range capabilities of the ALEXA cameras. In the picture bellow we see the main character of the movie glazing on the mechanic who is repairing her van. It looks like both characters are only lit though the mechanic's lamp. While one lamp is slightly lighting up the background to separate the main character from the background. The ALEXA achieves to capture all the necessary detail and still retaining an compelling image.

Picture 11 – Fern (Frances McDormand) at the mechanic (Zhao 2020, 01:09:51)

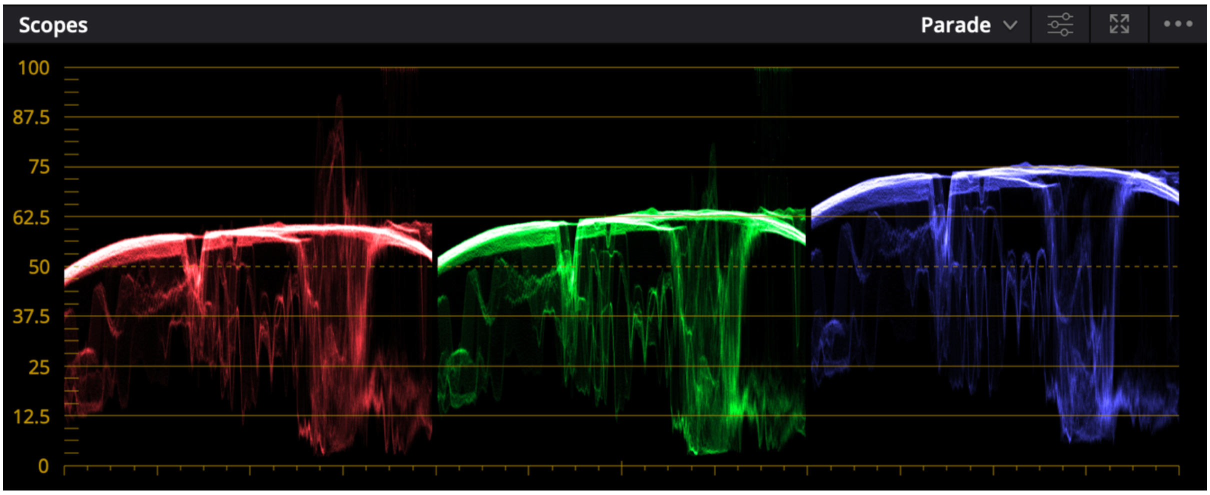
Color representation

Color is maybe the most subjective part of a cameras picture. But in my opinion, it is also the most important part. If we look back at picture 4 and 5, we can see that the ALEXA produces a more yellow tinted picture. The URSA on the other hand has a bluer tint. This is a trend that is shown in every test I have filmed.

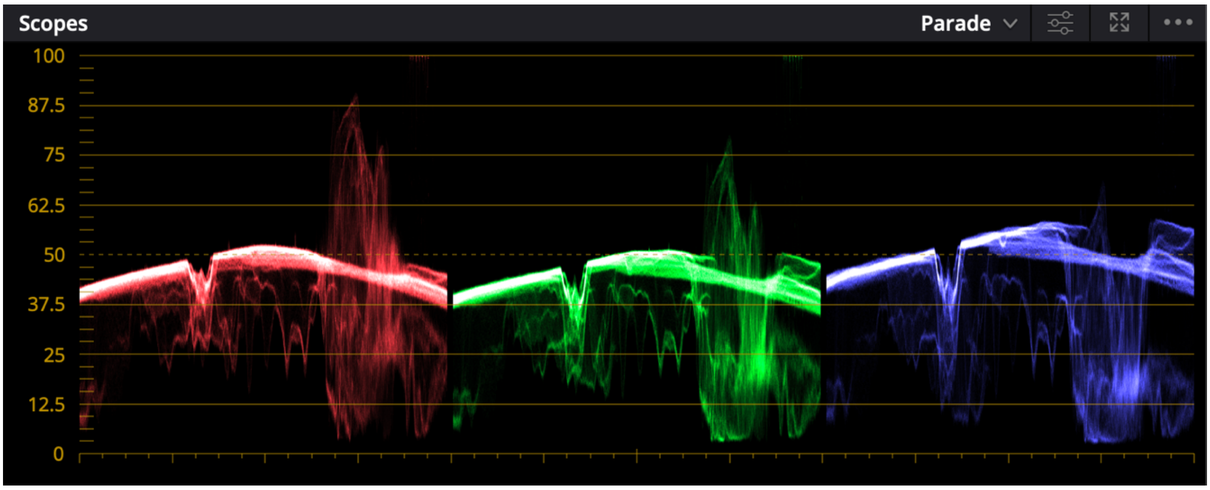
Picture 12 - Crane – BlackMagic URSA mini Pro 4,6k – ProRes XQ – 2K

Picture 13 - Crane - Arri ALEXA mini - ProRes 4444XQ - 2K

These two images serve as excellent illustrations of how the colors are depicted in each of these two cameras. We can tell that the URSA is a lot more vibrant than the ALEXA. While the ALEXA seems to be softer and warmer. When I first revied all my footage I was not expecting this much of a difference. Initially, I had some doubts about whether I had incorrectly adjusted the white balance setting, but upon inspection, I discovered that it was set to the same level. If we take a closer look an another of Davinci Resolves tool we can clearly see the difference.



Picture 14 - Scopes - URSA



Picture 15 - Scopes - ALEXA

In this tool we can see the different colors represented in its picture. The darker a color the lower it is represented at the scale. Due to the higher vibrance and less dynamic range the scope from the URSA ranges from 50% - 62.5%. With the blue tones ranging from 62.5% - 75%. Also, in the darker tones the blue is a bit lighter. That leads to the blue color taking over and being pushed into the foreground.

If we look closer at the line, we can see two dips. One small dip left from the center and one bigger dip/rise at the right side of the center. The first smaller dip represents the crane in the background. And the second represents the subjects face. At the URSA the face is darker than the horizon. We can see a clear drip in the scope. Some red and green tones rise above the horizon that are the highlights on the right side of the subject's face. In cinematography you always try to separate your subject from the background. That can be achieved in a lot of different ways. One of them being that the face should be the brightest object in the scene or else you will risk that the viewers' attention will wonder away from the subject.

If we look at ALEXAS scope, we can tell that the more of the face rises above the background. Meaning it is lighter than the background. We can also tell from the scope that the blue tones align more with the red and green tones. Giving the picture a warmer look. That we can clearly see in the clouds which are more yellow than the clouds in the picture produced by the URSA.

Arri´s color philosophy

As we saw the ALEXA produces warmer, truer to life image than the URSA. Arri takes pride in its color science, they thrive to achieve pictures that are as close to real life as possible. Maybe that is also why cinematographer Joshua James Richard decided to shoot *Nomadland* on ALEXA cameras. He wanted the movie to have an earthy, realistic, and natural look. Personally, I have to say that he totally succeeded. The camera captures stunning and authentic skin tones, while Arris's color processing adds warmth and texture to the character's skin. The movie also has been graded very subtly to preserve the natural colors.

Picture 16 – Girl with balloon (Zhao 2020, 00:48:42)

The film's documentary style is complemented by its aesthetics, which strike a perfect balance between scenes featuring real people and their heart-breaking stories and visually stunning shots of Fern's personal journey and the beautiful landscapes. This effective balance creates a powerful emotional impact that lingers with viewers long after the movie ends.
By maintaining a color scheme that closely resembles reality, the film succeeds in enhancing the authenticity of the storytelling. The personal narratives shared by the individuals in the movie feel honest and relatable, contributing to a genuine portrayal of their experiences. Overall, the movie strikes a well-crafted balance between all of these elements, resulting in an emotionally resonant and thought-provoking story.

Color has been used to underline a movie's emotion since the beginning of cinema. Even in black and white films, that technic was called for monochrome imaging. Entire frames were tinted with one color which was supposed to represent the scene's emotions. (Haansen 2006, 165) Over the years the use of colors got a bit more subtle, but just as important.

Important is also the depiction of skin color in films which has been a topic of conversation since the early days of color film. Kodak and other companies offered Shirley cards to filmmakers and technicians, featuring a Caucasian woman, to assist with color calibration of cameras, printers, and related equipment. The initial goal for digital color displays and video cameras was to accurately reproduce said white skin color. (Roth 2009, 117) Kodak started to design color films with the representation of darker brown tones in mind first after Kodak received complaints from chocolate and furniture manufacturers. They complained that the

Kodak film stock does not represent the brown tones in the right way. Quite shocking that this development was done without even thinking about the representation of darker skin tones. (Roth 2009, 120) Thanks to advances in camera technology over the years, we have made significant progress in creating a more inclusive cinema world. The development of high dynamic range and color science, which considers all skin tones, has been instrumental in this progress.

Conclusion

I have discussed the functioning of various camera sensors, the concept of dynamic range, and the varying interpretations of colors by the two cameras. However, what practical implications do these factors have in real-world scenarios? The choice of what camera to use for a movie has a lot to say about the aesthetics, workflow, and possibilities. There are various factors that determine which camera is selected for a movie.

After my tests, I think it comes down to two things. Firstly, the workflow, Arri cameras are surprisingly easy to use. Their cameras are designed with only a handful of buttons and a user-friendly menu, making it easy to quickly adjust settings on set without wasting valuable time and causing unnecessary stress. Secondly and most importantly is the aesthetics of the images. As seen in my tests Arri´s cameras separate itself from other brands. Their color science philosophy, which aims to replicate real-life colors and achieve natural skin tones, has positioned them as a leading player in the film industry. Their success in doing so has set a new standard for color accuracy in cinema. The dynamic range of the camera offers cinematographers a powerful tool to capture scenes that would be impossible to film with other cameras.

After comparing the URSA and the ALEXA in my limited tests, it is clear that the ALEXA outperforms the URSA in every aspect. This is not surprising given that the ALEXA is priced at around ten times more than the URSA. However, I believe that the URSA is still capable of producing quality images and provides a user-friendly workflow. It's just important to understand the camera's limitations and plan your shoot accordingly.

References

Arri. "About ARRI." Accessed May 14, 2023. https://www.arri.com/en/company/about-arri.

Arri. “ALEXA Mini, more than just a camera” Accessed May 14, 2023. https://www.arri.com/en/camera-systems/cameras/alexa-mini

Blackmagic Design, August 2020 "Installation and Operation Manual Blackmagic URSA Mini and URSA Mini Pro" Accessed May 14, 2023. https://www.bhphotovideo.com/lit_files/629690.pdf

Deikova, Mascha. "Nomadland – A Masterclass in Naturalistic Cinematography with DP Joshua James Richards." *CineD.* March 02, 2023. Accessed May 14, 2023. https://www.cined.com/nomadland-a-masterclass-in-naturalistic-cinematography-with-dp-joshua-james-richards/

Fauer, Jon "ARRI History." *Film and Digital Times*, September 11, 2017, accessed May 14, 2023, https://www.fdtimes.com/2017/09/11/arri-history/.

Follows, Stephen. "Digital vs Film on Hollywood Movies." *StephenFollows.com*, May 30, 2017. accessed May 14, 2023. https://stephenfollows.com/digital-vs-film-on-hollywood-movies/.

Hanssen, Eirik Frisvold. "Early discourses on colour and cinema : origins, functions, meanings." Stockholm: Stockholm University, 2006.

Machu, Gunther. "ARRI Alexa Classic & Mini LF Lab Test: Rolling Shutter, Dynamic Range and Latitude." *CineD*. April 21, 2021. Accessed May 14, 2023. https://www.cined.com/arri-alexa-classic-mini-lf-lab-test-rolling-shutter-dynamic-range-and-latitude/

Machu, Gunther. "URSA Mini Pro 4.6K G2 vs. G1 Dynamic Range and Latitude Test." *CineD*. January 09, 2020. Accessed May 14, 2023. https://www.cined.com/ursa-mini-pro-4-6-g2-vs-g1-dynamic-range-and-latitude-test/

Roth, Lorna. 2009 "Looking at Shirley, the Ultimate Norm: Colour Balance, Image Technologies, and Cognitive Equity." *Canadian Journal of Communication*. 34 (111-136) DOI: 10.22230/cjc.2009v34n1a2196

Stump, David. "Digital Cinematography: Fundamentals, Tools, Techniques, and Workflows." 1st ed. Burlington: Focal Press, 2014.

Filmography

1917. Directed by Sam Mendes. 2019; UK: Dreamworks Pictures, 119 min https://play.google.com/store/movies/details/1917?id=scngx3aP8PM.P

Barber school. Directed by Raffaele Vesco. 2021; Portugal: Matteo Bertoli. 5 min https://www.youtube.com/watch?v=dqukELZjeLg

Nomadland. Directed by Chloé Zhao. 2020; USA: Cor Cordium Productions, Hear/Say Productions, Highwayman Films. 107 min, Blue Ray.

Rise. Directed by Akin Omotoso. 2022; USA: Faliro House Productions, Walt Disney Pictures, Walt Disney Studios. 113 min. https://www.disneyplus.com/en-gb/movies/rise/6Yv1uRnw2uAJ

Pictures

Gourley, Kevin. 2016. "CHROMATIC ABERRATION – WHY IT MATTERS!" *KGPhotoWorkshops Blog,* accessed May 14, 2023. https://www.kgphotoworkshops.com/blog/2016/12/15/chromatic-aberration/

Liles, Jonathan Moore. 2017 "X-Trans vs Bayer Sensors: Fantastic Claims and How to Test Them." *Peta Pixel,* accessed May 14, 2023. https://petapixel.com/2017/03/03/x-trans-vs-bayer-sensors-fantastic-claims-test/

NTNU
Norwegian University of
Science and Technology