

Lesson 2

How Video works

There are 3 areas to understand exactly how video works. Having an understanding of how footage is captured will allow you to make better filming decisions. The main concept to understand are **frame rates as these have the most impact on how your video is going to look. Resolution and Shutter Speeds are also important to understand in relation to frame rates as I will outline in these notes.**

The Persistence of Vision

When images move in rapid succession they appear to be moving. If you think of flipbooks that you may have made as a child, a different image appeared on each page. As you flipped through the images they began to move. The faster that you flipped through the book the more fluid the movement becomes. The eye cannot see the individual images anymore, as they are moving too fast. What we see is the movement of the images. This is due to what is called the persistence of vision. Video works in the same way. Individual frames are captured in succession and when played back create the movement in our movies. How many of these frames that are captured per second is called frame rates.

Frame Rates

Frame rates are the number of frames captured in a second of filming. For example at 24 frames a second there are 24 individual frames captured in one second of filming. The more frames that are recorded the more fluid and less blurred the movement becomes. For this effect to work and for the eye not to see the individual frames rates of more the 15 frames per

second are needed. Anything less than this and the human eye will begin to see the individual frames that make up the footage. Frames per second are abbreviated to FPS.

When motion picture cameras were developed they were hand cranked by the operator. This meant that the number of frames captured a second varied on the speed that the operator rotated the crank. This was not a problem as movies at this time were silent. However when sound came into motion pictures this created the need for a new standard. This was because at a slower rate the dialogue did not match the movement of the actor's lips.

In the 1920s motion picture cameras were mechanical which meant that cranking was done away with. Also sound was also now recorded directly onto the filmstrip itself as an optical track that was later

converted to sound electronically. For all these reasons 24 frames a second became the standard as this captured enough movement and matched perfectly with the sound in film.

This was the standard throughout the 20th century. As cameras developed and became digital it meant that higher frame rates could be captured but 24 FPS remained the standard. This is because people grew up with as the standard and is what people are used to. It also provides a natural movement and blur in scenes.

So 24 FPS is the standard for film. But this is not the standard for TV. This varies throughout the world for broadcasting reasons. We will look at this a little later.

To create slow motion footage higher FPS are used. This is because so many more frames are captured that when slowed down there is more frames to use, to fill in the gaps as such.

Resolution

When you have decided on your desired frame rate you will need to select resolution as well.

Resolution is the size of each of the individual frames that are captured.

In digital video images are created by Pixels. A pixel is a single block of colour. The more pixels that are in an image the bigger the image can be and the more colour variations and detail that is available.

There are 4 resolutions typically used for video.

SD – standard definition. This is about 480 pixels on the short side and 640 on the long side.

720 HD – This is 720 pixels on the short side of the image and 1280 pixels on the long part of the image. This is the lowest High Definition option you can choose.

1080 HD or Full HD – This is 1080 pixels on the short side of the image and 1920 on the long part. The higher volume of pixels means a bigger image per frame and more definition.

4K – this is a new resolution and provides a picture quality that is 4 times the size of Full HD.

Fewer cameras and TVs have this option at the moment but this is quickly changing.

So what one is right to use?

It depends on your purpose. There is no reason to shoot in 4K if the video is only to be shown online. However shooting in higher res is not a bad idea as the quality can be reduced after if needed. As 4K is still new and not available to everybody yet it is recommended that you shoot in Full HD where

possible. If memory is an issue and you need to save space 720 HD will give a good quality picture. You should avoid SD if possible as the quality is very low and only really suitable for playback on stand monitors.

A note on Video output for TV; there are differences worldwide on the encoding for colour. NTSC is the video system or standard used in North America and most of South America and Japan. In NTSC, 30 frames are transmitted each second. Each frame is made up of 525 individual scan lines. PAL (common in Europe and parts of Asia) delivers a frame rate of 25 fps (frames per second) with 625 lines. It is important to understand these if you are creating footage for Television. Frame rates can be reduced so capturing footage at 30 FPS will cover you for all regions.

Shutter Speed

Shutter speeds and FPS is where a lot of people new to video can become confused as they both related to time.

Frames per second are how many individual frames are captured in one second of recording.

Shutter speed is how long each of one of the individual frames is exposed for.

Shutter speed has 2 primary roles in video. One is controlling exposure, the duration of time that each frame is exposed to light for. The faster the shutters speed, the less light that exposes the film/sensor and the darker the image. The longer the shutter speed is the more light that reaches the film/sensor and the brighter the images will be. This is shutter speeds role in exposure. This will be explored much more in depth in later lessons.

For the moment let's concern ourselves with shutter speeds other role in video, controlling motion.

This might seem like a strange concept as video is all about movement but we can control the motion of our subjects in video. This is how sharp or how blurred the movement is. Faster shutter speeds will give sharper more defined motions and slower shutter speeds will give blurred motions. For this reason faster shutter speeds are used for frantic, fast paced action and slower shutter speeds are used for surreal or dreamy effects. However, faster and slower motion can look unnatural over extended periods. If shutter speed is too fast movement will look almost staccato and if it is too slow the movement is too blurred and unrealistic. So how can you avoid this? There is a rule of thumb that can be followed:

Shutter speed should be double your frame rate.

This means that if you set a frame rate of 24 FPS your shutter speed should be $1/48^{\text{th}}$ of a second. This is not a speed we can set on the camera so we use the closest which is $1/50^{\text{th}}$.

Another example is if the FPS is at 60 FPS the shutter speed should be double, which is $1/120^{\text{th}}$.

Again there is no $1/120^{\text{th}}$ so we use the closest at $1/125^{\text{th}}$.

This rule is referred to as the 180-degree rule. It is so called due to the rotary shutter that was used in motion picture cameras. Following this rule is recommended but you can deviate from it for creative purposes. For example faster speeds are great for action sequences as it gives a sense of energy and tension. Slower speeds are good for dream or other worldly sequences. You have some room with them but compared to photography shutter speed is more restrictive when it comes to video.

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