Cinematography

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Cinematography (from Greek: *kinesis* κινησις (movement) and *grapho* γραφω (to record)), is the making of lighting and camera choices when recording photographic images for the cinema. It is closely related to the art of still photography. Many additional issues arise when both the camera and elements of the scene may be in motion, though this also greatly increases the possibilities at the same time.

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History

For more details, see History of film.

Roundhay Garden Scene directed by the w orld's first filmmaker, Louis Le Prince, in 1888.

The first attempt at cinematography can be traced back to the world's first motion picture film, *Roundhay Garden Scene*. It was a sequence directed by Louis Le Prince, French inventor and showman, on October 14 1888 in the garden at *Oakwood Grange* in Roundhay, Leeds, West Yorkshire, England. This groundbreaking event happened seven years before the Lumière Brothers' *Sortie de l'usine Lumière à Lyon* made the first paid exhibition on December 28, 1895 at Le Grand Café, in Paris, France.. This date is known as the birth of cinema since it was the first time the cycle of production-distribution-exhibition happened. The European city soon became the motion picture capital of the world.

Cinematography is an art form unique to motion pictures. Although the exposing of images on light-sensitive elements dates back to the late 1600s, motion pictures demanded a new form of photography and new aesthetic techniques.

In the infancy of motion pictures, the cinematographer was usually also the director and the person physically handling the camera. As the art form and technology evolved, a separation between director and camera operator emerged. With the advent of artificial lighting and faster (more light sensitive) film stocks, in addition to technological advancements in optics and various techniques such as color film and widescreen, the technical aspects of cinematography necessitated a specialist in that area.

Cinematography was key during the silent movie era - no sound apart from background music, no dialogue - the films depended on lighting, acting and set.

In 1919, in Hollywood, the new motion picture capital of the world, one of the first (and still existing) trade societies was formed: the American Society of Cinematographers (ASC), which stood to recognize the cinematographer's contribution to the art and science of motion picture making. Similar trade associations have been established in other countries, too.

The ASC defines cinematography as

> a creative and interpretive process that culminates in the authorship of an original work of art rather than the simple recording of a physical event. Cinematography is not a subcategory of photography. Rather, photography is but one craft that the cinematographer uses in addition to other physical, organizational, managerial, interpretive and image-manipulating techniques to effect one coherent process.[1]

Aspects of cinematography

Numerous aspects contribute to the art of cinematography.

Film stock

Cinematography can begin with rolls of film or a digital imaging sensor. Advancements in film emulsion and grain structure have led to a wide range of film stocks available to cinematographers. The selection of a film stock is one of the first decisions they must make during any film production.

Aside from the film gauge selection — 8 mm (amateur), 16 mm (semi-professional), 35 mm (professional) and 65 mm (epic photography, rarely used except in special event venues) — the cinematographer has a selection of stocks in reversal (which, when developed, create a positive image) and negative formats along with a wide range of film speeds (varying sensitivity to light) from ISO 50 (slow, least sensitive to light) to 800 (very fast, extremely sensitive to light) and differing response to color (low saturation, high saturation) and contrast (varying levels between pure black (no exposure) and pure white (complete overexposure)).

Advancements and adjustments to nearly all gauges of film created the "super" variety wherein the area of the film used to capture a single frame of an image is expanded, although the physical gauge of the film remains the same. Super 8 mm, Super 16 mm and Super 35 mm are all formats that utilize more of the overall film area for the image than their "regular" non-super counterparts.

The larger the film gauge, the higher the overall image resolution clarity and technical quality.

In the realm of digital imaging, various film stocks are no longer applicable, but the cameras themselves feature image adjustment capabilities that go far beyond the abilities of one particular film stock. The cameras can be adjusted to varying

degrees of color sensitivity, image contrast, light sensitivity and so on. One camera can achieve all the various looks of different emulsions, although it is heavily argued as to which method of capturing an image is the "best" method. It should be mentioned that the digital method of image adjustments (ISO, contrast etc) are executed by estimating the same adjustments that would take place if actual film were in use and are thus vulnerable to the cameras sensor designers perceptions of various film stocks and image adjustment parameters. Sensors generally have an optimal ISO rating past which faster speeds will result in noticeable increases in image noise, thus compromising the quality.

The lab

Laboratory work can also offer a considerable variance in the image produced. By controlling the temperature and varying the duration in which the film is soaked in the development chemicals and by skipping certain chemical processes (or partially skipping them), cinematographers can achieve very different looks from a single film stock in the laboratory.

Filters

Filters, such as diffusion filters or color-effect filters, are also widely used to enhance mood or dramatic effects. Most photographic filters are made up of two pieces of optical glass glued together with some form of image or light manipulation material between the glass. In the case of color filters, there is often a translucent color medium pressed between two planes of optical glass. Color filters work by blocking out certain color wavelengths of light from reaching the film. With color film, this works very intuitively wherein a blue filter will cut down on the passage of red, orange and yellow light and create a blue tint on the film. In black and white photography, color filters are used somewhat counter intuitively; for instance a yellow filter, which cuts down on blue wavelengths of light, can be used to darken a daylight sky (by eliminating blue light from hitting the film, thus greatly underexposing the mostly blue sky), while not biasing most human flesh tone. Certain cinematographers, such as Christopher Doyle, are well known for their innovative use of filters. Filters can be used in front of the lens or, in some cases, behind the lens for different effects.

Lens

Focal length

The camera does what a human eye does. That is, it creates perspective and spatial relations with the rest of the world. However, unlike one's eye, a cinematographer can select different lenses for different purposes. Variation in focal length is one of the chief benefits of such an advantage. The focal length of the lens in particular, determines the angle of view and,

therefore, the field of view. Cinematographers can choose between a range of wide angle lenses, "normal" lenses and telephoto lenses, as well as macro lenses and other special effect lens systems such as borescope lenses. Wide-angle lenses have short focal lengths and make spatial distances more obvious. A person in the distance is shown as much smaller while someone in the front will loom large. On the other hand, telephoto lenses reduce such exaggerations, depicting far-off objects as seemingly close together and flattening perspective. The differences between the perspective rendering is actually not due to the focal length by itself, but by the distance between the subjects and the camera. Therefore, the use of different focal lengths in combination with different camera to subject distances creates these different rendering. Changing the focal length only while keeping the same camera position doesn't affect perspective but the angle of view only. A Zoom lens allows a camera operator to change their focal length within a shot or quickly between setups for shots. As prime lenses offer greater optical quality and are "faster" (larger aperture openings, usable in less light) than zoom lenses, they are often employed in professional cinematography over zoom lenses. Certain scenes or even types of filmmaking, however, may require the use of zooms for speed or ease of use, as well as shots involving a zoom move.

Diaphragm aperture

Like in photography, the control of the exposed image is done in the lens with the control of the diaphragm aperture. As to properly expose, the cinematographer needs that all lenses be engraved with T-Stop, not f-stop, so that the eventual light loss due to the glass doesn't affect the exposure control when setting it using the usual meters. The choice of the aperture also affects image quality (aberrations) and depth of field (see below).

Depth of field and focus

Focal length and diaphragm aperture affect the depth of field of a scene — that is, how much the background, mid-ground and foreground will be rendered in "acceptable focus" (only one exact plane of the image is in precise focus) on the film or video target. Depth of field (not to be confused with depth of focus) is determined by the aperture size and the focal distance. A large or deep depth of field is generated with a very small iris aperture and focusing on a point in the distance, whereas a shallow depth of field will be achieved with a large (open) iris aperture and focusing closer to the lens. Depth of field is also governed by the format size. 70 mm film has much more depth of field for the same focal length lens than does 35 mm. 16 mm has even less and most digital video cameras have less depth of field than 16 mm. But if one considers the field of view and angle of view, the smaller the image is, the shorter the focal length should be, as to keep the same field of view. Then, the smaller the image is, the more depth of field is obtained, for the same field of view. Therefore, 70mm as less depth of field than 35mm for a given field of view, 16mm more than 35mm, and video cameras even more depth of field than 16mm. As videographers try to emulate the look of 35 mm film with digital cameras, this is one issue of frustration - excessive depth of

field with digital cameras and using additional optical devices to reduce that depth of field.

In *Citizen Kane*, cinematographer Gregg Toland used tighter apertures to create very large depth of field in the scenes, often rendering every detail of the foreground and background of the sets in sharp focus. This practice is known as deep focus. Deep focus became a popular cinematographic device from the 1940s onwards in Hollywood. Today, the trend is for more shallow focus.

To change the plane of focus from one object or character to another within a shot is commonly known as a *rack focus*.

Aspect ratio and framing

The aspect ratio of an image is the ratio of its width to its height. Beginning in the 1910s, motion pictures settled on a ratio of four to three (four units wide to three units high). Often written as 4:3, this ratio may be reduced to 1.33:1 and this aspect ratio is commonly known as 1.33. The introduction of sound-on-film narrowed the aspect ratio briefly, before the Academy ratio of 1.37 was introduced in 1932 by means of thickening the frame line. For years, cinematographers were limited to this shape of image, but in the 1950s, thanks to the unanticipated popularity of Cinerama, widescreen ratios were introduced in an effort to pull audiences back into the theater and away from their home television sets. These new widescreen aspect ratios granted cinematographers a wider frame within which to compose their images. Many different proprietary photographic systems were invented and utilized in the 1950s to create widescreen movies, but one dominates today: the anamorphic process, which optically squeezes the image to photograph twice the horizontal area to the same size vertical as standard "spherical" lenses. The first commonly used anamorphic widescreen format was CinemaScope, which used a 2.35:1 aspect ratio, although it was originally 2.55:1. CinemaScope was used from 1953 to 1967, but due to technical flaws in the design and its ownership by Fox, several third-party companies, led by Panavision's technical improvements in the 1950s, now dominate the anamorphic cine lens market. Changes to SMPTE projection standards altered the projected ratio from 2.35:1 to 2.39:1 in 1970, although this did not change anything regarding the photographic anamorphic standards; all changes in respect to the aspect ratio of anamorphic 35 mm photography are specifically correlative to camera or projector gate sizes, not the optical system.

After the "widescreen wars" of the 1950s, the motion-picture industry settled into 1.85:1 (which is a cropped version of 1.37:1) as a standard for theatrical projection in the United States and the United Kingdom. Europe and Asia opted for 1.66:1 at first, although 1.85:1 has largely permeated these markets in recent decades. Certain "epic" or adventure movies utilized the anamorphic 2.39:1.

In the 1990s, with the advent of high-definition video, television engineers created the 1.78:1 (16:9) ratio as a mathematical

compromise between the theatrical standard of 1.85:1 and television's 1.33:1, as it was not physically possible to safely create a television tube with a width of 1.85:1. Until that point, nothing had ever been originated in 1.78:1. Today, this is a standard for high-definition video and for widescreen television.

Lighting

Light is necessary to create an image exposure on a frame of film or on a digital target (CCD, etc). The art of lighting for cinematography goes far beyond basic exposure, however, into the essence of visual storytelling. Lighting contributes considerably to the emotional response an audience has watching a motion picture. The control of light quality, colour, direction and intensity is a major factor in the art and science of cinematography.

Camera movement

One aspect of cinematography that strongly separates it from still photography (aside from having a moving subject) is the ability to move the camera, which represents the audience's viewpoint or perspective, during the course of filming. This movement plays a considerable role in the emotional language of film images and the audience's emotional reaction to the action on the screen. From the most basic movements of panning (horizontal shift in viewpoint from a fixed position; like turning your head side-to-side) and tilting (vertical shift in viewpoint from a fixed position; like tipping your head back to look at the sky or tilting your head down to look at the ground) to dollying (placing the camera on a moving platform to move it closer or farther from the subject), tracking (placing the camera on a moving platform to move it to the left or right), craning (moving the camera in a vertical position; being able to lift it off the ground as well as swing it side-to-side from a fixed base position), and a combination of all of the above.

Cameras have been mounted to nearly every imaginable form of transportation.

Most cameras can also be handheld, that is the camera operator literally holds the camera in their hands and moves from one position to another while filming the action. Personal stabilizing platforms came into being in the late 1970s through the invention of Garrett Brown, which became known as the Steadicam. The Steadicam is a body harness and stabilization arm that connects to the camera that allows the operator to move naturally while completely isolating the movements of their body from the movements of the camera. After the Steadicam patent expired in the early 1990s, many other companies began manufacturing their concept of the personal camera stabilizer.

Special effects

The first special effects in the cinema were created while the film was being shot. These came to be known as "in-camera" effects. Later, optical and digital effects were developed so that editors and visual effects artists could more tightly control the process by manipulating the film in post-production.

For examples of many in-camera special effects, see the work of early filmmaker Georges Méliès.

Frame rate selection

Motion picture images are presented to an audience at a constant speed. In the theater, it is 24 frames per second, in NTSC (US) Television, it is 30 frames per second (29.97 to be exact), in PAL (Europe) television it is 25 frames per second. This speed of presentation does not vary.

However, by varying the speed at which the image is captured, various effects can be created knowing that the faster or slower recorded image will be played at a constant speed.

For instance, time-lapse photography is created by exposing an image at an extremely slow rate. If a cinematographer sets a camera to expose one frame every minute for four hours, and then that footage is projected at 24 frames per second, the event that took four hours to record will now take 10 seconds to present (1 frame per minute for 4 hours equals 240 frames, projected at 24 frames per second equals 10 seconds). This compresses the event that took place in four hours into just 10 seconds. At this speed, one can present the events of a whole day (24 hours) in just one minute. The inverse of this, if an image is captured at speeds above that at which they will be presented, the effect is to greatly slow down (slow motion) the image. If a cinematographer shoots a person diving into a pool at 96 frames per second, and that image is presented back at 24 frames per second, it will take 4 times as long to watch the dive as it did for it to actually happen.

In motion pictures the manipulation of time and space is a considerable contributing factor to the narrative storytelling tools. Film editing plays a much stronger role in this manipulation, but frame rate selection in the photography of the original action is also a contributing factor to altering time.

"Ramping" is a process whereby the capture frame rate of the camera changes over time. For example, if in the course of 10 seconds of capture, the capture frame rate is adjusted from 60 frames per second to 24 frames per second, when played back at the standard film rate of 24 frames per second, a unique time-manipulation effect is achieved. For example, someone pushing a door open and walking out into the street would appear to start off in slow-motion, but in a few seconds later within the same shot the person would appear to walk in "realtime" (normal speed). The opposite speed-ramping is done in *The Matrix* when Neo re-enters the Matrix for the first time to see the Oracle. As he comes out of the warehouse "load-point", the

camera zooms into Neo at normal speed but as it gets closer to Neo's face time seems to slow down, perhaps visually accentuating Neo pausing and reflecting a moment, and perhaps alluding to future manipulation of time itself within the Matrix later on in the movie.

Role of the cinematographer

In the film industry, the **cinematographer** is responsible for the technical aspects of the images (lighting, lens choices, composition, exposure, filtration, film selection), but works closely with the director to ensure that the artistic aesthetics are supporting the director's vision of the story being told. The cinematographers are the heads of the camera, grip and lighting crew on a set, and for this reason they are often called **directors of photography** or **DPs**.

Directors of photography make many creative and interpretive decisions during the course of their work, from pre-production to post-production, all of which affect the overall feel and look of the motion picture. Many of these decisions are similar to what a photographer needs to note when taking a picture: the cinematographer controls the film choice itself (from a range of available stocks with varying sensitivities to light and color), the selection of lens focal lengths, aperture exposure and focus. Cinematography, however, has a temporal aspect (see persistence of vision), unlike still photography, which is purely a single still image. It is also bulkier and more strenuous to deal with movie cameras, and it involves a more complex array of choices. As such a cinematographer often needs to work co-operatively with more people than does a photographer, who could frequently function as a single person. As a result, the cinematographer's job also includes personnel management and logistical organization.

Evolution of technology: new definitions

Traditionally the term "cinematography" referred to working with motion-picture film emulsion, but it is now largely synonymous with videography and digital video due to the popularity of digital cinematography.

Modern digital image processing has also made it possible to radically modify pictures from how they were originally captured. This has allowed new disciplines to encroach on some of the choices that were once the cinematographer's exclusive domain.

References

1. **^** (John Hora, *The American Cinematographer Manual*, 9th Edition.)

See also

- Cinematography section of the Movie Making Manual|Cinematography WikiBook
- Cinematographer
- Digital cinema
- Fictional film
- Film crew
- Filmmaking
- Film theory
- History of cinema
- List of film formats
- List of film techniques
- List of motion picture-related topics (Extensive alphabetical listing and glossary).
- List of video-related topics
- Photographic film
- Films about cinematography:
  - *Visions of Light* (1993)
  - *Cinematographer Style* (2006)

External links

- The History of Cinematography (http://www.kodak.com/US/en/motion/hub/history1.jhtml) at Kodak.
- Cinematography.com discussion forums (http://www.cinematography.com)
- Cinematography Mailing List archives (http://www.cinematography.net)
- JackCabbage: Film Lighting - Discussion and Selected Readings (http://jackcabbage.blogspot.com/2008/06/lighting-selected-readings.html)

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