High speed videography

VIDEOGRAPHY

• The word combines "video" from Latin, meaning "I see" or "I apprehend", with the Greek terminal ending "graphy", meaning "to write".

Why Videography?

• Video cameras record live-action scenes. This allows the user to create a permanent and detailed chronicle of events. Video cameras record dozens of pictures (or frames) a second that when viewed in succession, clearly distinguish the translation of an object or person over time.

High speed videography Introduction

 High-speed videography is simply the technique of recording an event at a high frame rate and playing the images back at a much slower rate, thus slowing down the event so you can actually see what's happening. High-speed video gives you a better understanding of the actual motion you are studying. With high-speed video, problems can be seen and solved.

- With a high-speed video camera recording at 1,000 fps, the user would be able to view 100 frames of that same event.
- Early high-speed cameras used film to record the high-speed events, but today high-speed cameras are entirely electronic using either a charge-coupled device (CCD) or a CMOS active pixel sensor, recording typically over 1,000 frames per second.

- CCD Cameras -CCD
 (couple-charged
 device) cameras are a
 type of image capture
 device that utilize an
 image sensor to
 register visible light as
 a recordable electronic
 signal to
 visually archive capture
 d stills and video.
- CMOS Cameras -Complementary metal oxide semiconductor (CMOS) cameras use image sensors that operate at lower voltages than charged coupled devices (CCDs), reducing power consumption for portable applications.

Key features of high speed camera

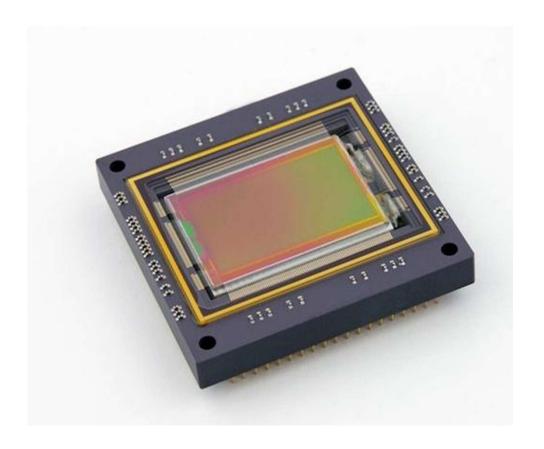
- A Fast Sensor
- Shutter Speed
- Sensitivity
- Light
- Lens



The fast sensor

The sensor simply "counts" photons that hit the sensor's pixels. The high-speed video camera will send a signal to the sensor to start counting photons and some time later, a signal to stop. During this time, an electrical charge will build up in each photo site proportional to the number of photons counted. At the end of this time the charge at each photo site is read out of the sensor and converted into a digital (binary) number using an analog-to-digital converter (A/D).

- The resulting digital number represents the charge for a photo site (or pixel) and is stored in camera memory along with all the other pixels from that image. Then, the next image is exposed, etc.
- All of this is done at hundreds or thousands of frames each second using high speed electronics



SENSOR

Shutter speed

- Proper exposure and shutter speed is essential for high speed photography.
- A high velocity object may be blurred in the image if the shutter does not adequately integrate the light on the sensor
- To prevent this, the shutter rate is recommended to be 10 times the subject's velocity.

 A formula to calculate the maximum permissible exposure time (T) is :-

$$T = L/500 \times V$$

Where L is the largest subject dimension, and V is the subject speed per second.

Sensitivity

- High-speed camera recording quality is also dependent upon the sensitivity.
- For more demanding high-speed events, enhanced light sensitivity may be required. It is also possible to expand the camera aperture which will reduce the depth-of-field (or, range of focus), but will help keep the subject from blurring due to insufficient sensitivity.

Light

• In high speed videography the use of proper lighting is important. The camera needs massive amounts of light to make up for the low exposure time. The lighting is needed most for the 1200fps mode; the shutter is opening and closing 1200 times each second, allowing very little exposure time.

Natural light

Fluorescent

CFL (compact fluorescent light)

Tungsten light









Lens

 Lens are most critical in high speed videography.

 Lenses are meant to refine optical aberrations that occur when recording video, and there is a wide variety of camera lenses for various recording scenarios.

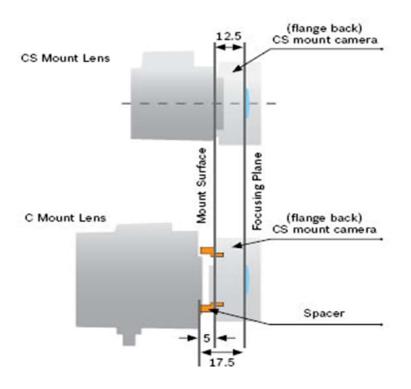
Types of lenses

C-mount lenses

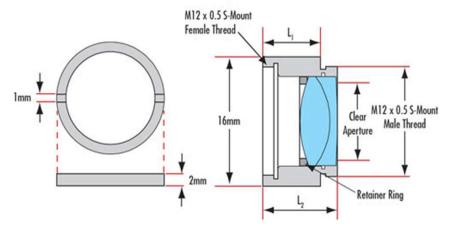
CS-mount lenses

S-mount lenses

F-mount lenses



S-Thread Achromat / Thick Lens Mount



Camera mounting

- Camera positioning is accomplished by the use of various types of mounts.
 Extendable and adjustable arms are common so cameras can be repositioned.
- Stands, such as unipods and tripods, offer a stable base while making the camera accessible to operators.
- Many cameras come with the option of handheld or shoulder-mounted operation.



Camera features

• Antiblooming- Excessive charge can bleed into adjacent pixels and cause bright spots or streaks to appear on the image, a condition known as blooming. Antiblooming gates remove excessive charge and can significantly reduce blooming, but often at the cost of reduced sensitivity.

Auto-Lens: Auto-lens operation is a mode in which the lens iris automatically adjusts to maintain a predetermined level of light on the image pickup device. Cameras with auto-lens mode may also provide automatic lens focusing. • **High Definition**: High definition is a video standard that has higher picture sharpness, larger picture, more colors, and higher quality sound than regular video standards. The low-end threshold for HD video is considered 1,280 x 720 pixels.

• Low-Light Camera: These are meant to be used in dark situations where an otherwise suitable camera will not have reached an exposure level capable of capturing an image. The cameras contain image sensors that are exceptionally perceptive of subtle light sources.

 Outdoor Rated: Outdoor-rated devices are designed to withstand outdoor temperature variations, rain, snow, and other weather conditions • Radiation Hardened: Devices are designed to withstand high levels of radiation. These cameras can be used in nuclear facility applications, or in scientific research that will expose the device to radiation. These types of cameras almost always record in monochrome. CID cameras are commonly radiation hardened.

 Underwater Rated: Devices are designed to work when completely submerged in water.

• Pan/Tilt: These devices have integral or optional mounting features enabling sideto-side (pan) and up-and-down (tilt) controllable motion.

Application of high speed videography

- In Military-ballistics and wind tunnel examinations, etc.
- Manufacturing companies-packaging, assembly and production lines, machine troubleshooting.
- •In Medical Industries-analyze water droplets, chemical injections, biomechanics, fluid dynamics, etc.



Sports

 Biomechanics- movements of animals e.g. jumping in frogs and insects, suction feeding in fish, the strikes of mantis shrimp, or the aerodynamic study of pigeons helicopter like movements.

In forensic

- In ballistics
- Bullet trajectory
- Gun shot wound



- 2. Blood spatter pattern analysis
- Wild life forensic
- 2. Forensic ornithology
- Road accidents







THANK YOU....

