"Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them."

Co-funded by the European Union

Studio Production and Directing

Camera - Multicam Settings

Vladimir Maksimovic

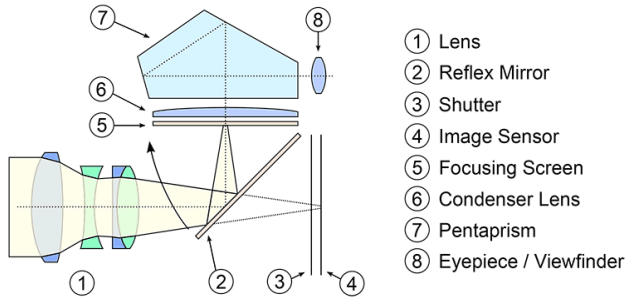
University of Mitrovica (UPKM)

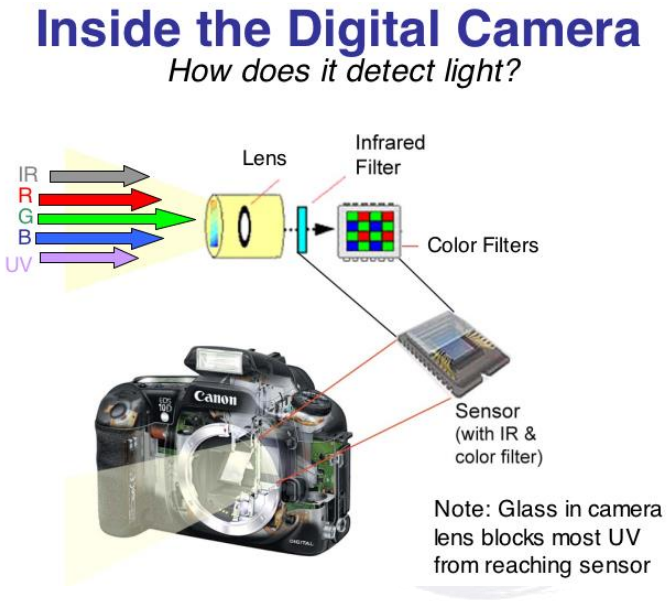
What is a camera and how does it work?

A camera is a device that **captures light and converts it into** an image or video recording. The primary task of a camera is to **"capture" a scene** through a lens and record it via a **sensor or film**.

Basic principle of operation:

1. Ambient **light** enters through the **lens**.
2. The lens focuses the light rays onto the **sensor** (or film tape in analog cameras).
3. **The sensor** (CCD or CMOS) converts light signals into electrical signals.
4. Electrical signals are processed by the **image processor**.
5. The recording is stored on a **memory card** (or external device).
6. Result: a digital image or video recording.





Camera types

- **ENG (Electronic News Gathering) cameras**
  - Used for live streaming and quick field recording.
  - Lightweight and portable, battery-powered, with a built-in recorde
  - Example: TV reporters.

Camera types

- Studio cameras are professional cameras designed for recording in television studios. They are used for live shows, news, talk shows and other productions where high image quality and stability are required

•High image stability and quality control.
•Can be equipped with a **CCU** (Camera Control Unit)
•Modular design – allows replacement of lenses, viewfinders and other
•Suitable for multi-camera productions.

Equipment - Studio cameras

Studio cameras are large professional units mounted on special pneumatic or hydraulic pedestals with wheels for smooth movement. They are equipped with high-quality zoom lenses and viewfinders (monitors) for framing. Typically, 3–5 cameras are used in a studio, depending on the size and format of the program

Equipment - Studio cameras

The camera connects to the CCU/RCU via a multi-core cable. Today, triax or optical cables are more commonly used (previously multicore), which transmit everything through a single connection using multiplexing.

Co-funded by
the European Union

Camera types

- **EFP (Electronic Field Production) cameras**
  - Larger production cameras often using cables to connect to the control room.
  - Used for sports events, shows, concert broadcasts.

Co-funded by the European Union

Camera types

- **Cinematic/film cameras**
  - Use a large sensor, interchangeable lenses, and advanced image control.
  - Provide a "cinematic look" (shallow depth of field, high resolution).

ARRI ALEXA LF

ARRI ALEXA Mini

ARRI AMIRA

Ranger Body Shown

RED GEMINI (Sensor)

Panasonic EVA-1

ARRI ALEXA SXT

Sony Venice

Canon C700FF with Codex

Sony FS7 II

Blackmagic URSA Mini Pro G2

Ranger Body

RED MONSTRO (Sensor)

Panasonic VariCam *(3 Models)*

DSMC2 Body Shown

RED HELIUM (Sensor)

Canon EOS C300 Mark II

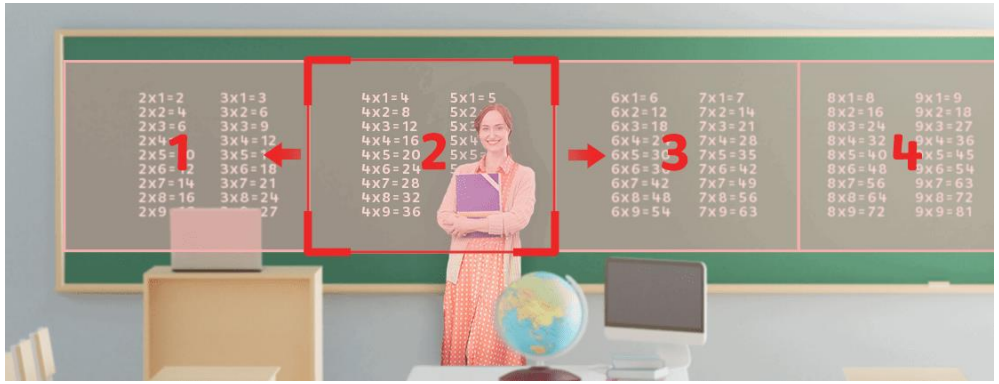
35mm Film

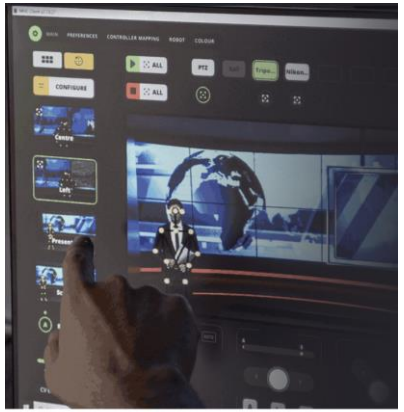
Camera types

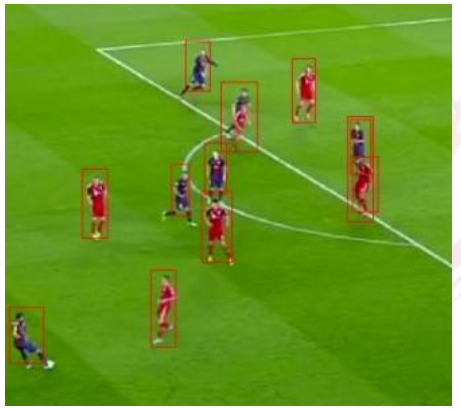
- **PTZ (Pan-Tilt-Zoom) cameras**
  - Remotely controlled cameras capable of moving in multiple directions.
  - Used in studios, video conferences and surveillance.

Camera types

- **Automatic and AI Tracking cameras**
  - Cameras with artificial intelligence that automatically follow a person in the frame.
  - They use face recognition and tracking algorithms.
  - Popular in education, conferences, sports analysis.

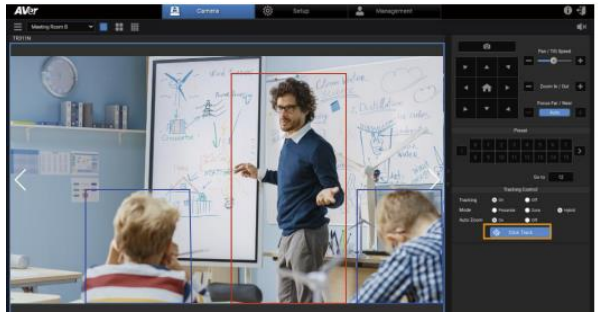






Remote Control

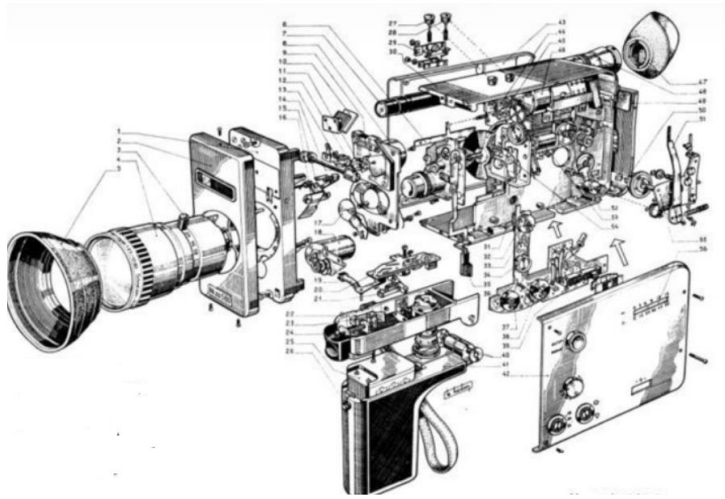
- Software control – PTZ software for adjusting angle and zoom.
- Hardware controllers – Joystick and camera control panels.
- Wireless control – Wi-Fi or NDI camera control from remote locations.



Co-funded by
the European Union

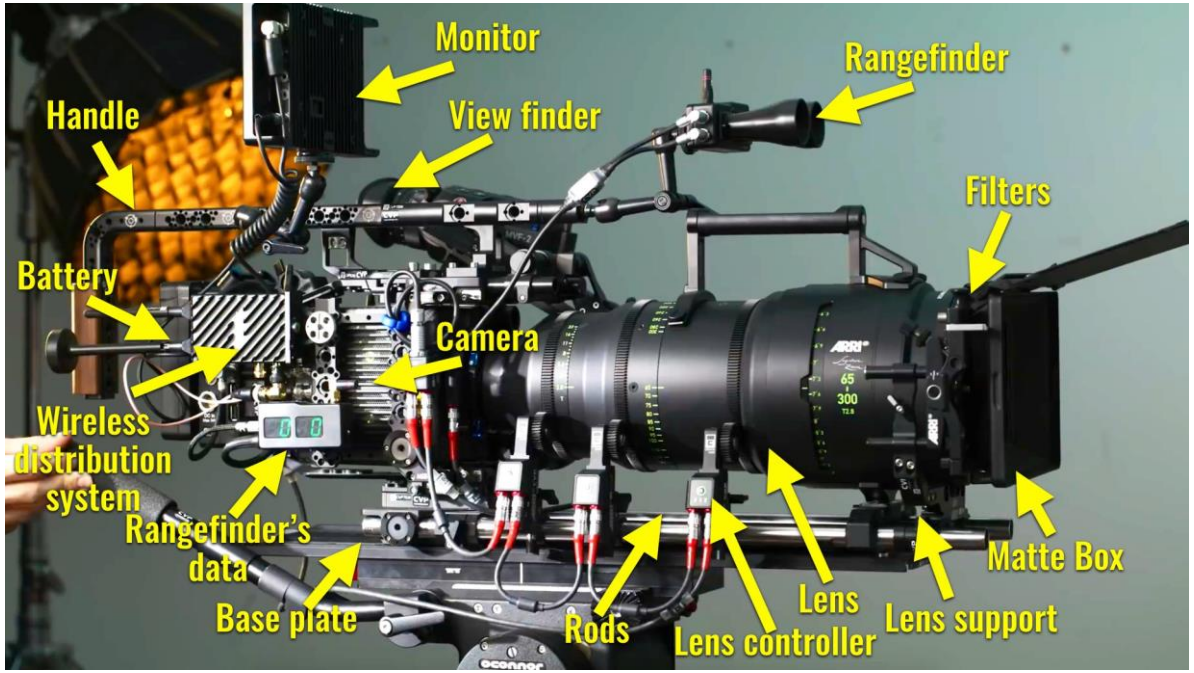
Camera Parts

- Camera Body
  - Lens
  - Image sensor
  - Image Processor
  - Viewfinder
  - Monitor
  - Controls and buttons
  - Memory card slot
  - Battery and battery cradle
  - Connectors



Co-funded by
the European Union

Camera Parts



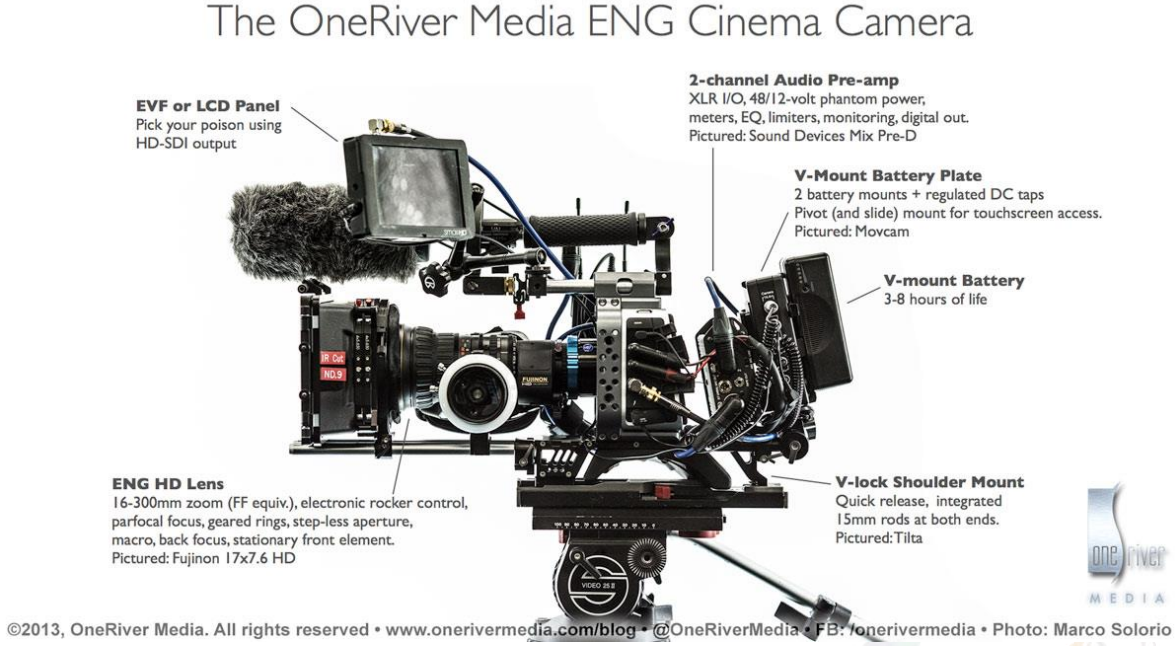
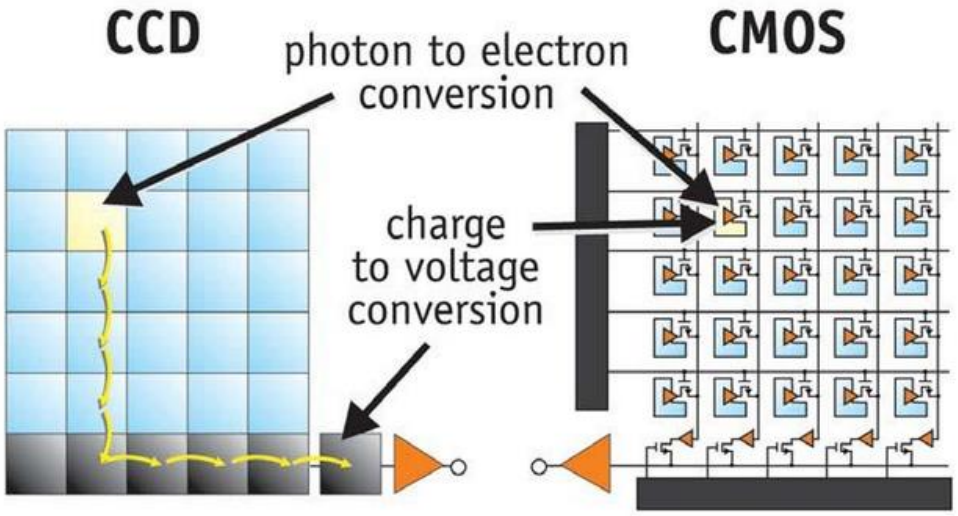


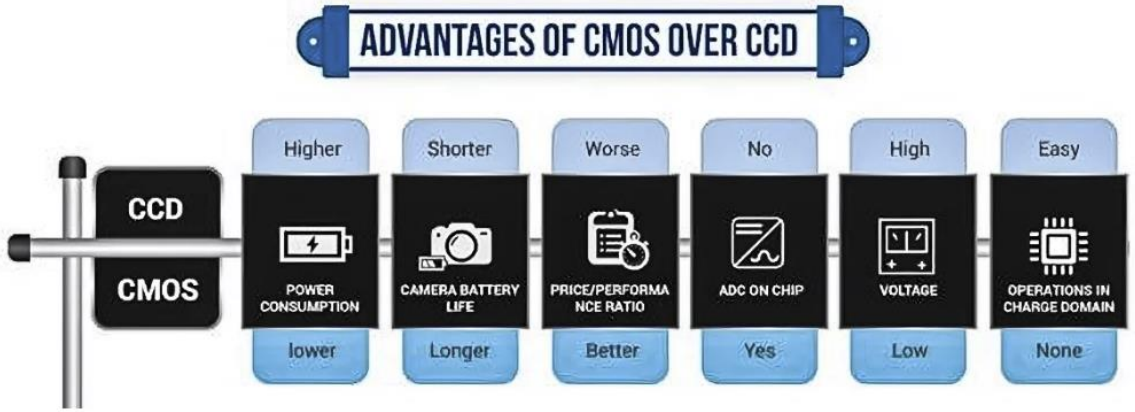
Image Sensor

- The sensor converts light into electrical signals.

•Sensor types:

- **CCD (Charge-Coupled Device)** – better image quality, but more expensive.
- **CMOS (Complementary Metal-Oxide Semiconductor)** – faster image processing and lower power consumption.





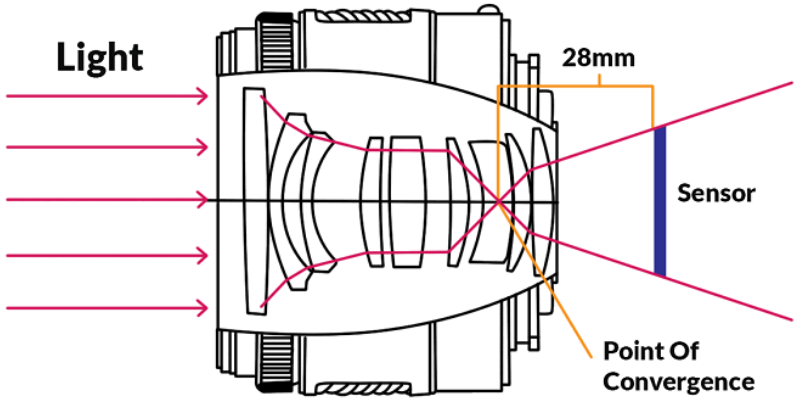
Co-funded by the European Union

Lens

•Directs light onto the sensor and determines the image appearance.

•**Lens types:**

- **Prime lenses** – fixed focal length (better image quality).
- **Zoom lenses** – variable focal length.
- **Macro lenses** – for extreme close-up shots.
- **Telephoto lenses** – for distant subjects.



Co-funded by
the European Union

Viewfinder & LCD Screen

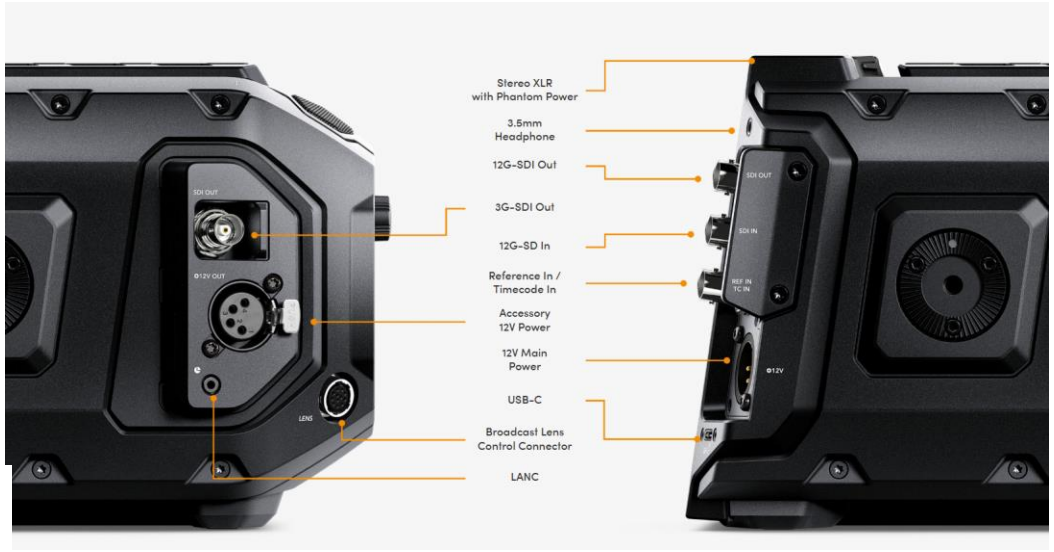
- **Optical viewfinder** (OVF) – used in DSLR cameras.
- **Electronic viewfinder** (EVF) – uses a screen to display the image in real time.
- The LCD screen enables live preview and menu navigation.

Battery and power supply

- Cameras use high-capacity **lithium-ion batteries.**
- Professional cameras can use **V-Mount or Gold-Mount batteries.**
- Alternative power sources: **AC adapters and external powered grips.**

Connectors

- **SDI and HDMI** – video outputs.
- **XLR and 3.5mm** – audio inputs.
- **USB-C or Thunderbolt** – for data transfer.
- **NDI or Ethernet** – network control and image transfer.



Co-funded by the European Union

Basic lens characteristics

- The lens is a key part of the camera because it determines how light enters and forms an image on the sensor. The quality of the lens, its optical characteristics, and adjustment capabilities have a major impact on the recording quality
- Main lens parameters:
  - **Focal length** – measured in millimetres (mm) and determines the angle of view.
  - **Aperture (f-stop)** – controls the amount of light entering the lens.
  - **Depth of field** – depends on the aperture and focal length.
  - **Aberrations and distortions** – optical errors that affect image quality.

Co-funded by
the European Union

Lens types by focal length

- **Wide-Angle Lenses**
  - Focal Length: **Below 35mm**
  - Wide field of view, greater depth of field.
  - Used for landscapes, architecture, and shots in tight spaces.

Co-funded by
the European Union

Lens types by focal length

- **Standard Lenses**
  - Focal Length: **35mm – 50mm**
  - Natural perspective, used in feature films and interviews.

Co-funded by
the European Union

Lens types by focal length

- **Telephoto Lenses**
  - Focal Length: **Above 70mm**
  - Reduces the field of view, isolates the subject from the background.
  - Used for sports, portraits and documentaries.

Co-funded by
the European Union

Lens types by focal length

- **Macro Lenses**
  - Specializing in **very close shots** and small details.
  - Used in scientific, advertising and artistic recordings.

Co-funded by
the European Union

Prime vs Zoom lenses

- **Prime lenses** – fixed focal length, better sharpness and light transmittance.
- **Zoom lenses** – variable focal length, more flexible in different shooting situations.

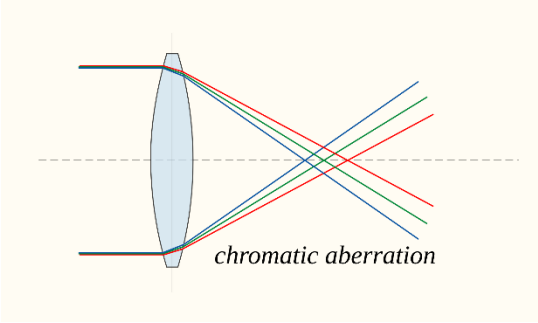
Co-funded by
the European Union

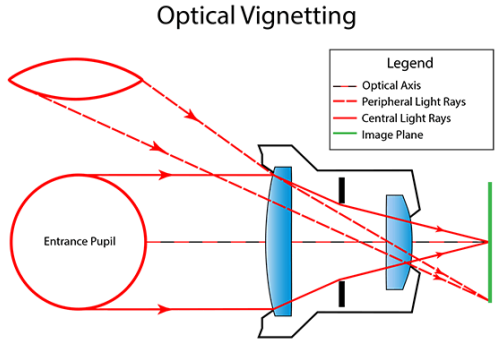
Special lenses

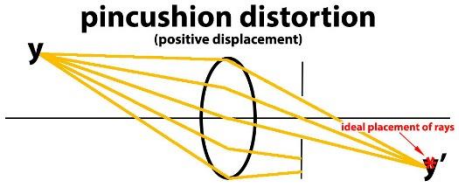
- **Fisheye lens** – extremely wide viewing angle (180°)used for artistic and sports shots.
- **Tilt-Shift lens** – corrects perspective, used in architectural photography.
- **Anamorphic lens** – used in cinema for a cinematic look (widescreen format).

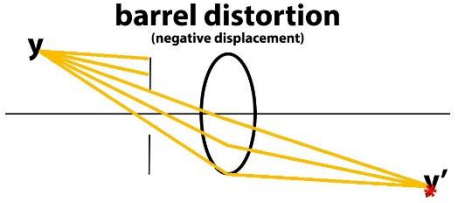
Optical characteristics and aberrations

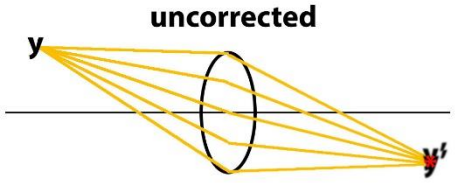
- **The most common optical problems with lenses:**
  - **Chromatic aberration** – colored outlines on the object edges.
  - **Vignetting** – darkening the image corners.
  - **Barrel and cushion distortion** – straight line deformation.





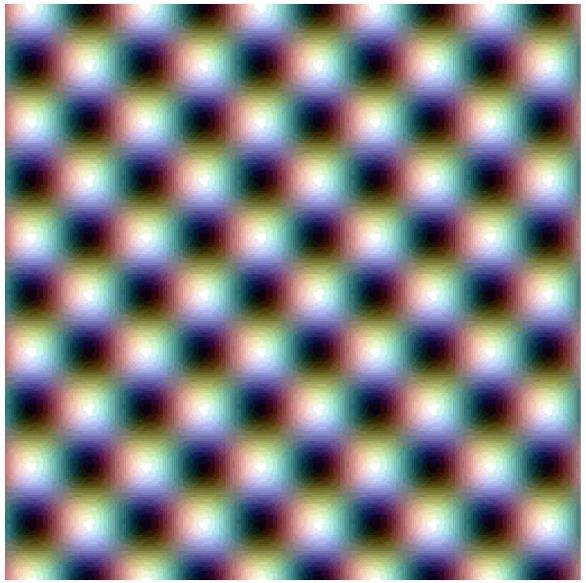


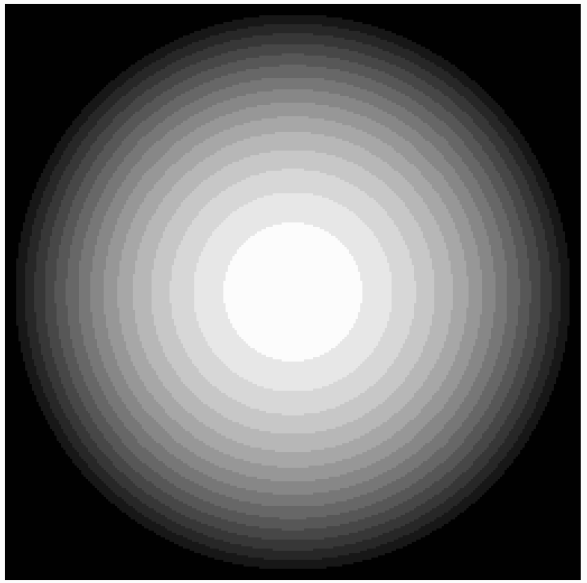


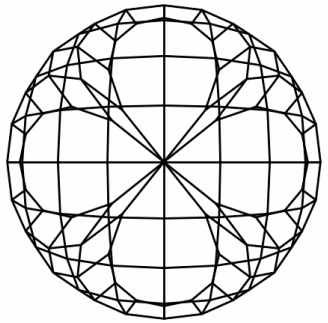


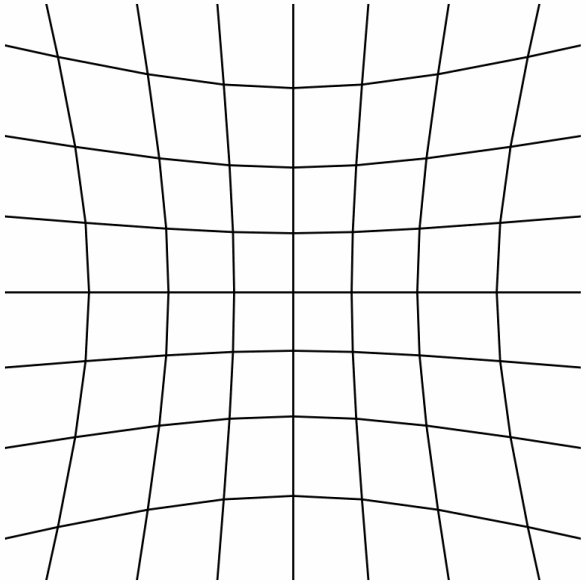
Co-funded by
the European Union

Optical characteristics and aberrations









Objective Appendices

- **Filters** (ND, UV, polarization).
- **Lens hood** – prevents reflections and flare.

Co-funded by
the European Union

Technical Aspects

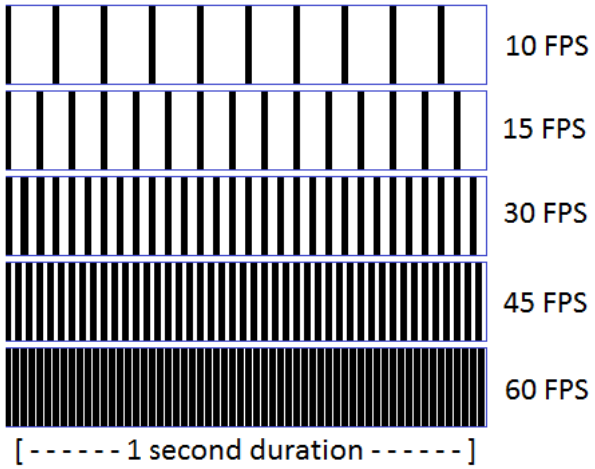
- **Resolution and record formats**
- **The most common resolutions in video production:**
  - **HD (1280x720)** – used in television shows and online video content.
  - **Full HD (1920x1080)** – standard in professional productions.
  - **4K (3840x2160)** – used in movies, commercials and high-end production.
  - **8K (7680x4320)** – top image quality, used in advanced productions.
- **Codecs:**
  - **H.264 / H.265** – efficient compression, used for online streaming.
  - **ProRes / DNxHD** – professional formats with minimal quality loss.
  - **Raw video** – uncompressed sensor data, allows maximum control over image processing.

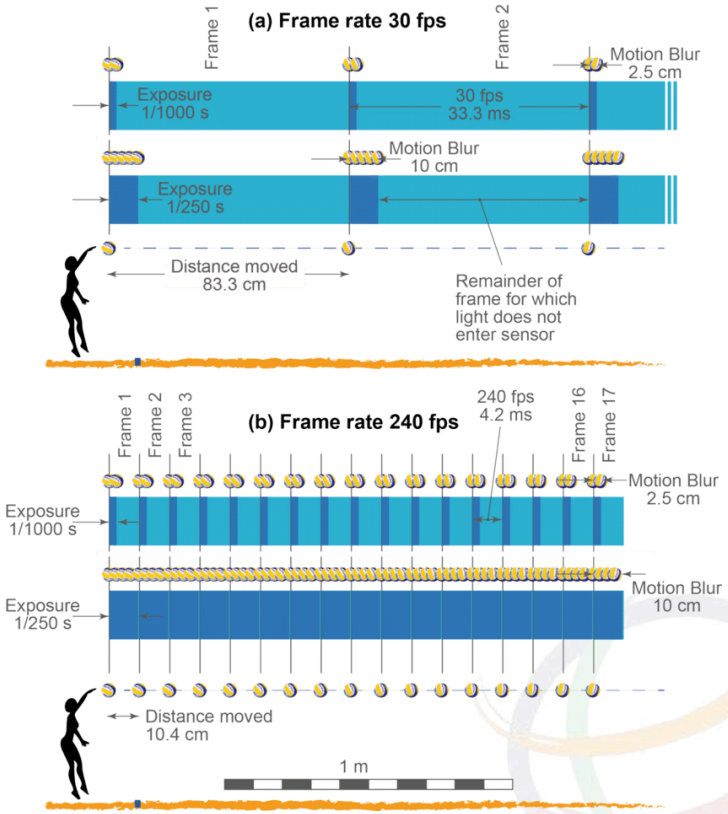
Frame Rate

The frame rate determines how motion appears on screen.

The most common frame rate values:

- **24fps** – used in movies for a “cinematic look”.
- **30fps** – standard for television and news.
- **60fps** – used for sports and action scenes.
- **120+ fps** – slow motion effects.



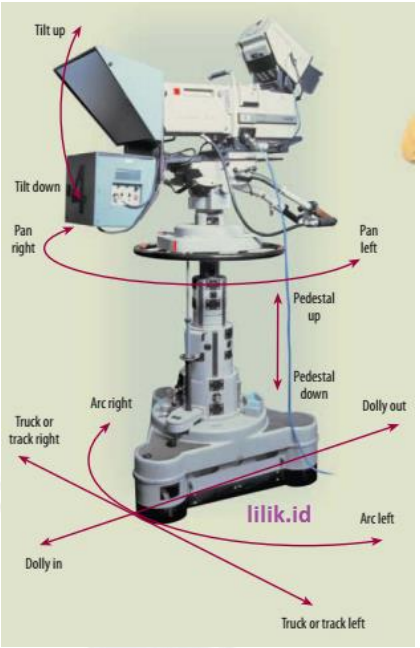


Static Cameras & Stabilizers

- **Static cameras – When and why are they used?**
- **Characteristiccs of static cameras:**
  - **Mounted on a tripod, pedestal or fixed support**.
  - **They do not move** during recording.
  - They are used when stable, controlled shots are desired.
  - They provide a professional look without unwanted vibrations.

Types of static cameras and mounts

- **Tripod – The most common mount for static camera**
  - **Basic tool** for stable shooting.
  - It has **three height-adjustable legs**.
  - **Fluid heads** allow smooth panning movements.
- **Pedestal Camera – Studio Stabilization**
  - Used in television studios and live productions.
  - Mounted on **a hydraulic base** with wheels for easy movement.
  - Allows height adjustment and shake-free movements.



Co-funded by the European Union

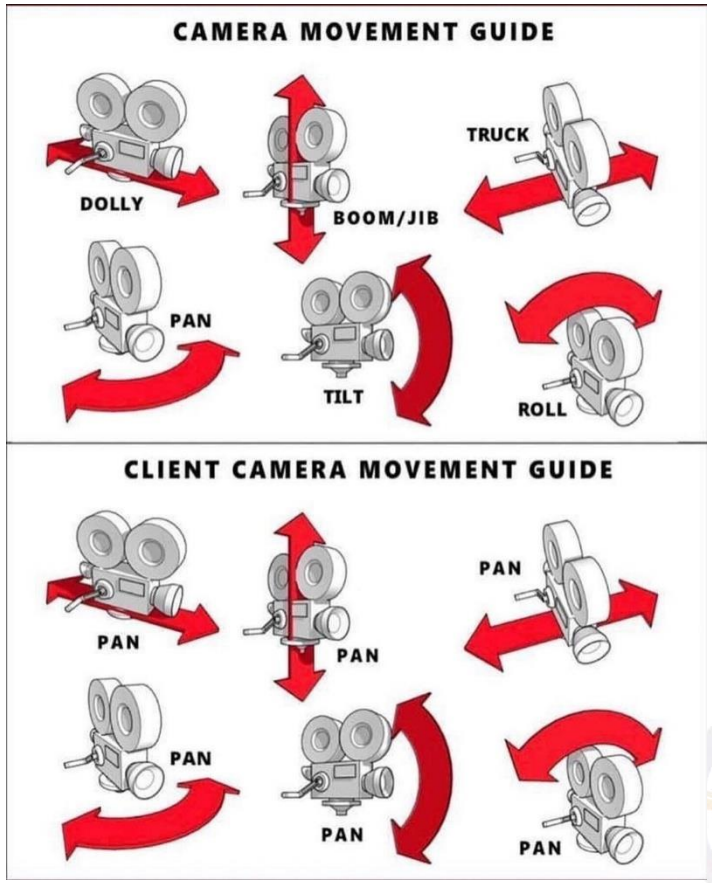
Dynamic camera and movements

- A dynamic camera is used to capture scenes with movement, where the camera is physically moved to achieve a specific visual effect. This technique allows better tracking of subjects, expressing emotions and adds dramatic intensity to scenes.
- **Why use a dynamic camera?**
  - **adds energy and dynamics to scenes** – ideal for action movies and sports.
  - **Provides better immersion** – viewers feel like part of the scene.
  - **Tracks a moving subject** – used in vlogs, interviews, and documentaries.
  - **Changes perspective and sense of space** – it is used in horror films and dramatic scenes.

Co-funded by the European Union

Camera Motion Types

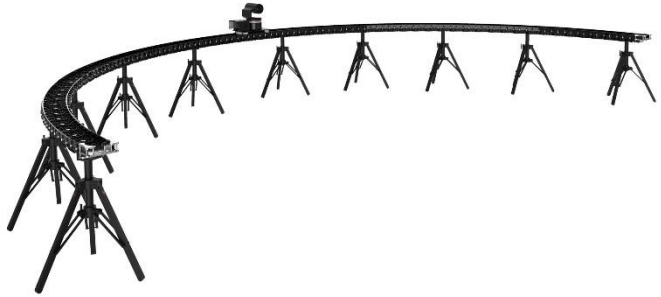
- **Pan and Tilt – Horizontal and vertical camera movement**
  - **Pan** – The camera rotates **left and right from** a static position.
  - **Tilt** – The camera moves **up and down** without changing the position of the tripod.

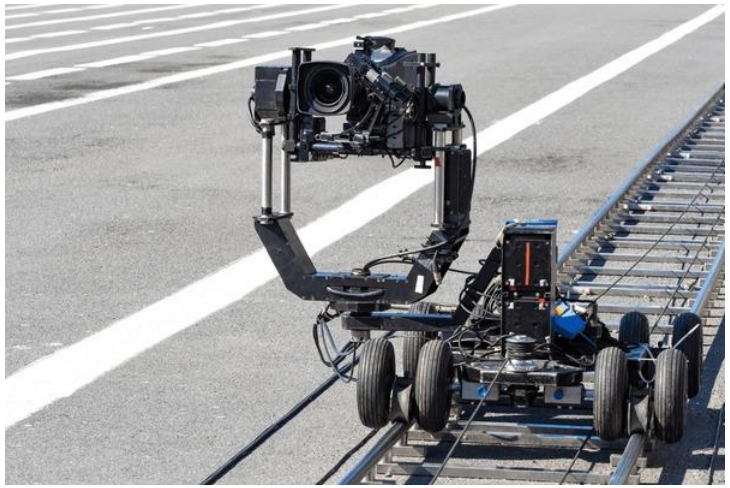


Co-funded by the European Union

Camera Motion Types

- **Dolly and Tracking Shot – Moving toward or with the Subject**
  - **Dolly In/Out** – The camera moves toward (In) or away from the subject (Out).
  - **Tracking Shot** – The camera follows the subject as it moves.
  - The wheels and rails enable smooth camera movements forward, backward or sideways.
  - Used for cinematic movements and subject tracking.





Camera Motion Types

- **Crane and jib – Vertical camera movement**
  - **Crane Shot** – The camera is raised and lowered using a crane.
  - **Jib arm** – Smaller crane that allows smooth vertical movements.
  - It enables high-angle shots and large movements in 3D space.
  - It is used in movies, sport events and concerts.

Co-funded by the European Union

Camera Motion Types

- **Handheld camera – Realistic handheld movement**
  - The camera is held manually, giving a **natural, documentary look**.
  - It can have a **shaky effect**, which adds **authenticity** to the scene.

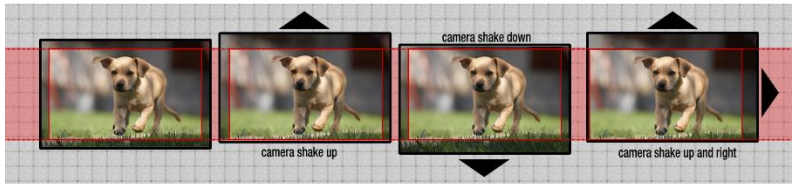
Co-funded by the European Union

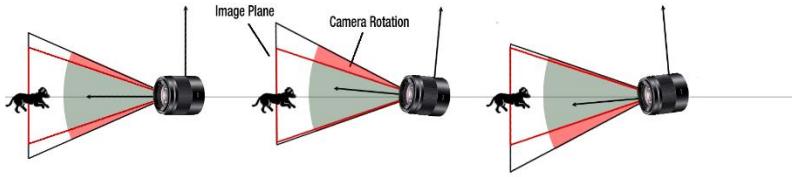
Camera Motion Types

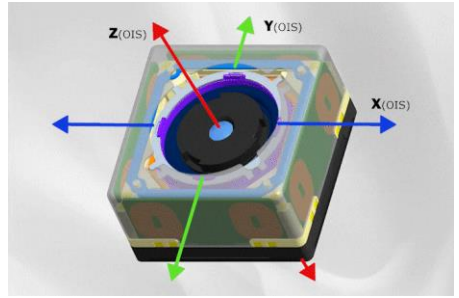
- Steadicam and Gimbal – Stabilized camera movements
  - Steadicam – System with counterweights that allows smooth camera movement.
  - Gimbal Stabilizer – An electronic device that stabilizes the camera while in motion.

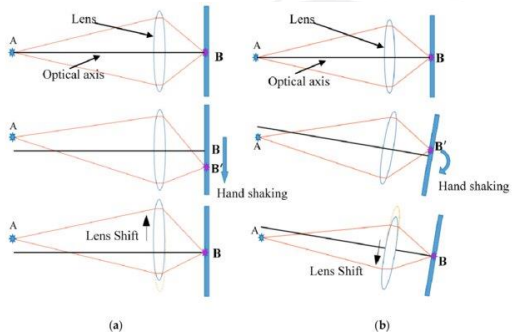
Stabilizers

- **-Why is stabilization important?**
  - Reduces image shake.
  - Enables smooth camera movements.
  - It provides a professional look to the footage.
- **Types of stabilization:**
- **Optical Image Stabilization (OIS)**
  - Built into the lens or the sensor.
  - Automatically corrects small vibrations and hand movements.
  - Used in handheld cameras and DSLR devicess.
- **Electronic Image Stabilization (EIS)**
  - Software-based image correction that reduces vibrations.
  - Less precise than optical stabilization, but useful for smartphones and action cameras.
- **Mechanical stabilization (Gimbal and Steadicam)**
  - **Gimbal stabilizers** use **electronic motors** to compensate for movement.
  - **Steadicam systems** use **weight and counterweights** to balance the camera.
  - These systems enable **fluid camera motions without shaking**.









Co-funded by the European Union

Stabilization accessories

Crane 2

Easyrig Steadicam Camera

Flycam in fibra di carbonio

MediaPro Camera Stabilization System

MediaPro Flycam

MediaPro Long Handgrip Set

MediaPro Ventosa Car Suction Campod Mount

MediaPro Ventosa Car Suction Mount

MediaPro Ventosa Magnetica Car Mount

Ready Rig GS Steadicam

Ronin

Ronin 2

Co-funded by the European Union

Other camera parts

- **Microphones & Audio Equipment**
- **Sound is just as important as image, and the built-in microphones in cameras are often not sufficient for professional production.**
- **Microphone types**
  - **Shotgun microphone** – directional sound, used for interviews and film scenes.
  - **Lavalier microphone (bug)** – a small microphone attached to clothes, used in shows and vlogs.
  - **USB or XLR external microphones** – used for professional audio recordings.
- **On-camera audio jacks**
  - **3.5mm Jack** – standard external microphone input.
  - **XLR inputs** – professional audio connectors for high-quality microphones.
  - **Wireless microphones** – Connect via Bluetooth or Wi-Fi.

Co-funded by
the European Union

Other camera parts

- **Additional camera equipment.**
- **External monitors and recorders**
  - **Field Monitor** – allows real-time image preview.
  - **External recorders (e.g. Atomos Ninja V)** – record higher-quality video than built-in camera recorders.

Other camera parts

- **Connections and connectivity**
- **The camera includes various parts for connecting to external devices.**
- **Video outputs**
- **USB, WiFi and Ethernet ports**
  - **USB-C or Thunderbolt** – used for data transfer and charging.
  - **Ethernet port (RJ45)** – allows **live streaming over the network**

WBnet

Co-funded by the European Union

Questions & Answers

"Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them."

Network of centers for regional short study programs in the countries of the Western Balkans

Call: ERASMUS-EDU-2023-CBHE

Project number: 101128813

ATYCC

UNIVERSITY OF L]UBL]ANA
Faculty of Electrical Engineering

POLITÉCNICA

University of Pristina
Kosovska Mitrovica