

# Motion Capture History and Pipeline

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# Motion Capture

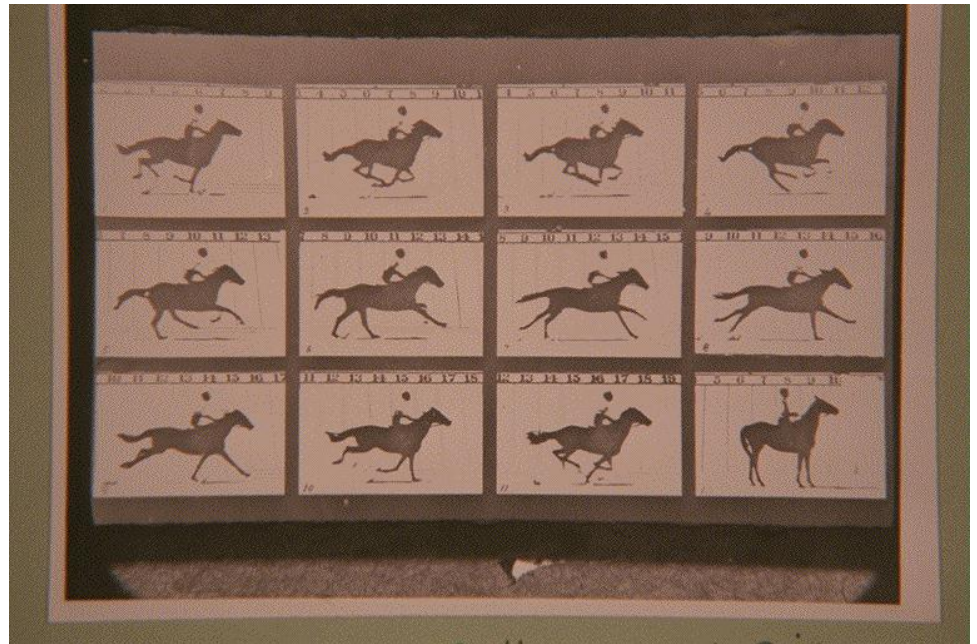
- “Recording of motion for immediate or delayed analysis and playback”
  - David J. Sturman [1]

# History of Motion Capture

- Eadweard Muybridge (1830-1904)
- Etienne-Jules Marey (1830-1904)
- Harold Edgerton (1903-1990)

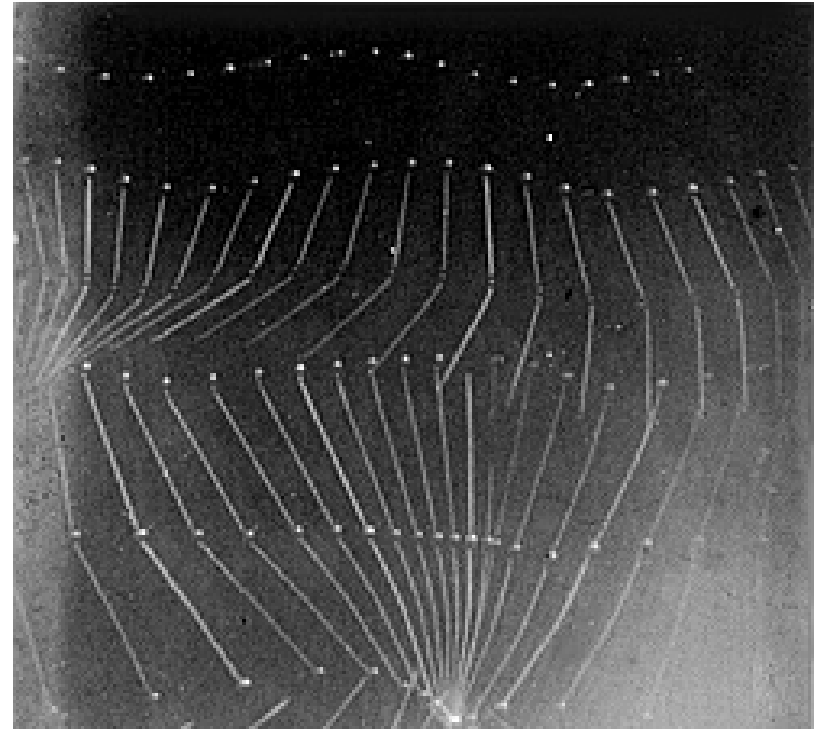
# Eadward Muybridge

- The Flying Horse
- Zoopraxiscope
- Animal Locomotion

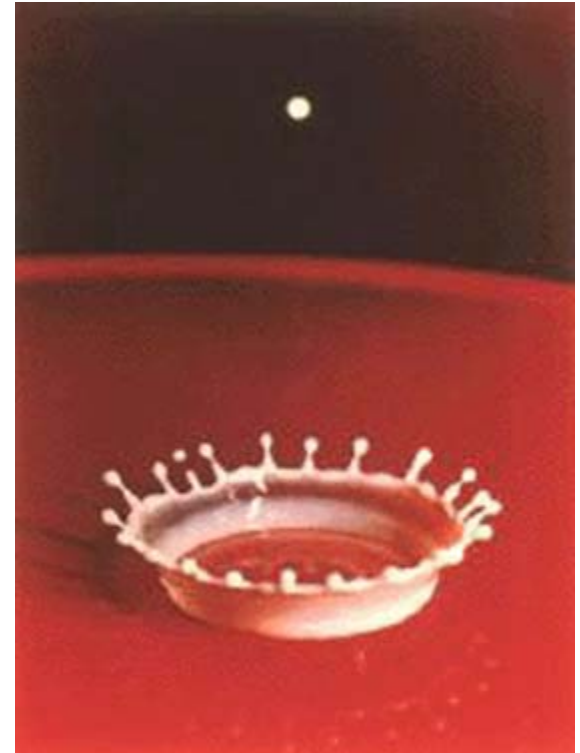
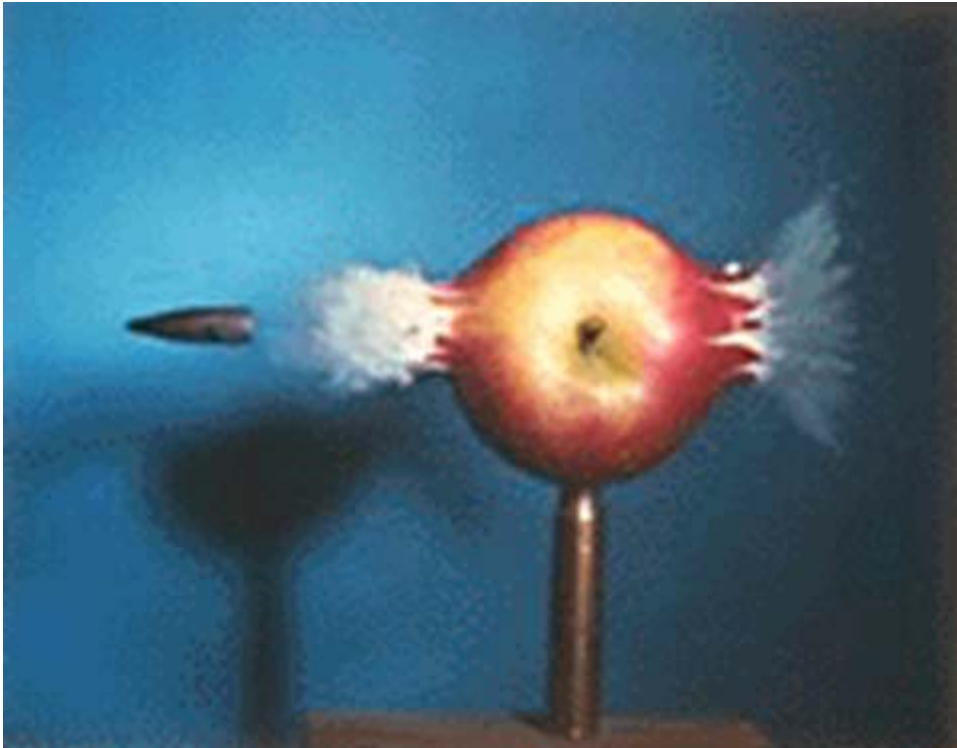


# Etienne-Jules Marey

- First person to analyze human and animal motion with video
- Created photographic gun



# Harold Edgerton



# Rotoscope

- Allowed animators to trace cartoon characters over photographed frames of live performances.
- Invented in 1915 by Max Fleischer
- Koko the Clown
- Snow White

# Video-based Motion Analysis

- Research problem for 20+ years
- Difficulties
  - Complex varying environment
  - Segmentation issues
  - Occlusion
- Simplifying assumptions

# Video-based Motion Analysis

- Research Areas
  - Tracking
  - 3D Reconstruction (video-based motion capture)
  - Recognition

# 3D Reconstruction

- Single camera
  - Model assumptions required
- Multiple cameras
  - Require at least 2 cameras, unique with 3
  - Camera calibration
- Motion capture
  - Use reflective markers to simplify video information

# 1980's

- Military and medical purposes
- First computer graphics use in research labs
- First production use
  - Brilliance by Robert Abel (1985 Superbowl ad)
  - Waldo C. Graphic (1988)
  - Mike the Talking Head (Siggraph 88)
  - Don't Touch Me (1989)

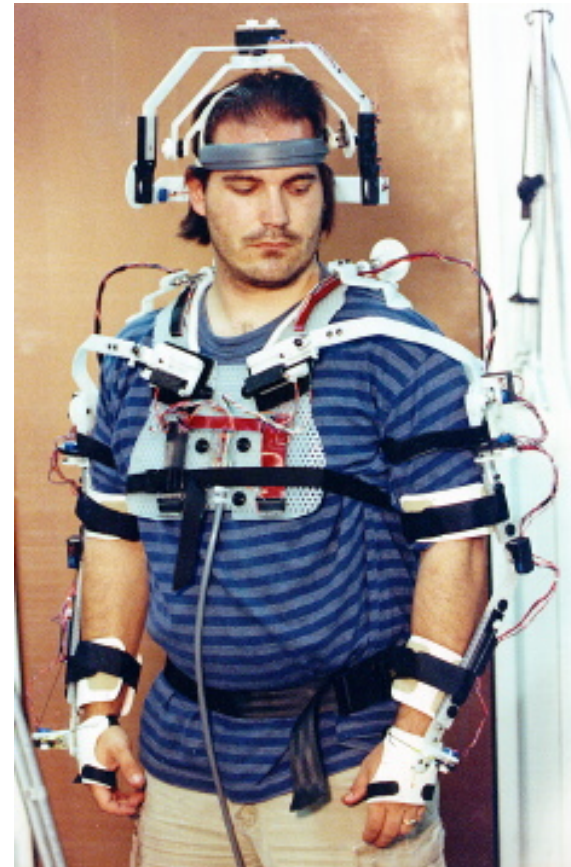
# Motion Capture Systems

*Active*

*Passive*

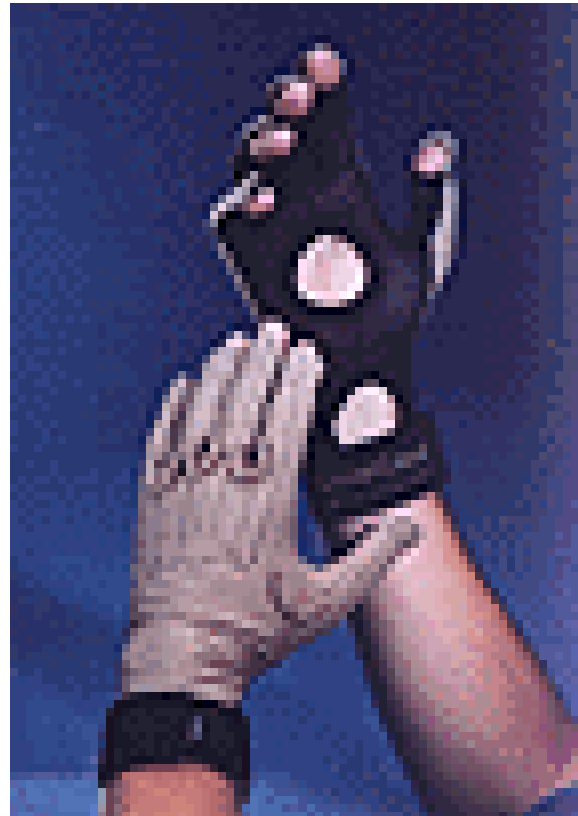
# Electromechanical suits

- Linked structures
- Potentiometers determine rotation of each link
- Ungainly
- Wouldn't want to fall



# Optical fiber system

- Fiber-optic sensor
- Rotation based on transmitted light
- Data can be difficult to work with



# Electromagnetic systems

- Electromagnetic sensors placed on joints of moving object
- Measures orientation and position of sensor with respect to electromagnetic field generated by transmitter



# Acoustic system

- Acoustic sensors placed on moving object
- Set of microphones receive sound wave
- Other sounds in frequency range can disrupt capture
- Accuracy not as high as other systems

# Strobing LED system



# Optical motion capture system

- Reflective markers
- Multiple cameras digitize different views of performance
- Occlusion
- Position sensitive cameras



# Applications

- Medicine
- Sports
- Entertainment
  - Games, television, film
- Visualization
- Law

# Feature Films

- Titanic
- Final Fantasy
- Lord of the Rings
- Polar Express
- Monster House
- Pirates of the Caribbean

# Motion Capture Pipeline

- Planning
- Shooting (iQ)
- Data processing (iQ, MotionBuilder)
- Skeleton creation (Maya)
- Mapping to characters (MotionBuilder)
- Binding (Maya, MotionBuilder)

# Planning

- Character/Prop setup
  - Target skeleton/character topology
  - Ready stance considerations
- Marker setup
  - Heavy marker redundancy
  - Three markers per segment
  - Place markers close to bone

# Planning

- Shot list
  - Number of characters involved in performance
  - Performance space dimensions
  - Interactions in shot
  - Shots to be blended or looped
  - Length of shots
  - Size and location of props
  - Gross proportional differences

# Planning

- Technical Issues
  - Output format
  - File naming conventions
  - Frames per second
  - Target software platform
  - Database management

# Project 1 Assignment

- Create an animation storyboard requiring motion capture
  - Must include a different marker scheme than normal. You have to be able to blend two motions together
- Plan the motion capture session
  - Should fill out all 3 forms as many times as needed

# References

1. Sturman, David J., “ A Brief History of Motion Capture for Computer Character Animation”, “Character Motion Systems”, Siggraph 94, Course 9.
2. Menache, Alberto, “Understanding Motion Capture for Computer Animation and Video Games”
3. <http://www.kingston.ac.uk/Muybridge/>

# References

<http://www.anotherscene.com/cinema/firsts/marey.html>

<http://cmp1.ucr.edu/exhibitions/edgerton/edgerton.html>

Siggraph 2001 Course 51: