Motion Capture
Part I

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A motion capture system

Outline

Introduction: what is Motion Capture?

History and Motion Capture technologies.

Passive Markers Motion Capture.

Video Based Motion Capture

Specialized motion capture: face, gaze and hand.

From MoCap to Animation (post-processing)

What is motion capture?

Ensemble of techniques and methodologies to acquire **automatically** the motion of the objects of interest.

Characteristics: sampling rate, accuracy, 2D/3D, real-time, motion amplitude, invasivity,….

Technology: opto-electronical, magnetical, ultrasound….

Specific body parts: gloves, gaze trackers….

Applications are increasing (medical applications at the origin, now interest in the enterteinment, robotics, reverse engineering …)

Motion Capture and Synthesis

Reproduce digitally the motion of the body.

Time series of the position of the body segments
or
Time series of the motion of the articulations.

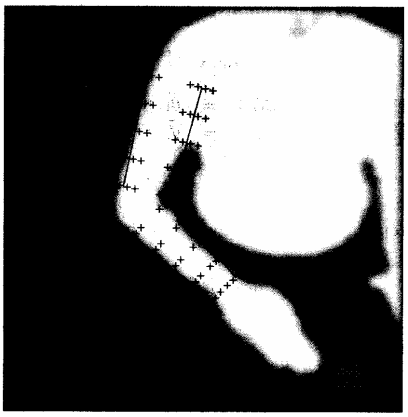
Analysis

Application of the time series to a 3D digital model of the body.

Synthesis

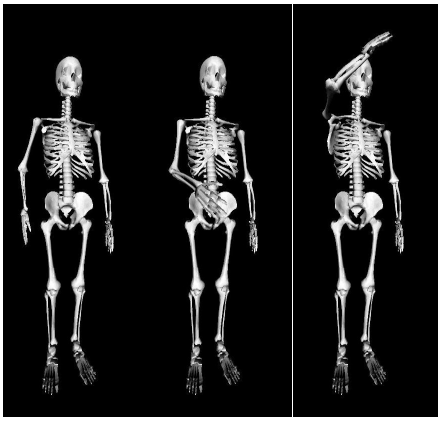
What is captured?

Silhouette (-> Skeleton)



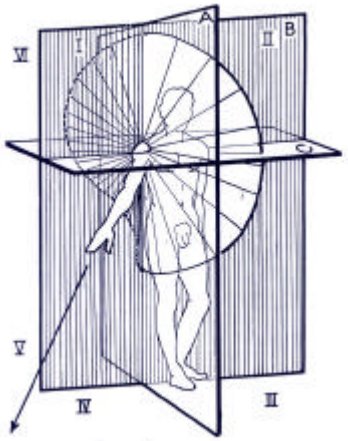
Computer vision techniques

Skeleton



Bony segments or articulations
(marker-based systems)

Description of the human skeleton



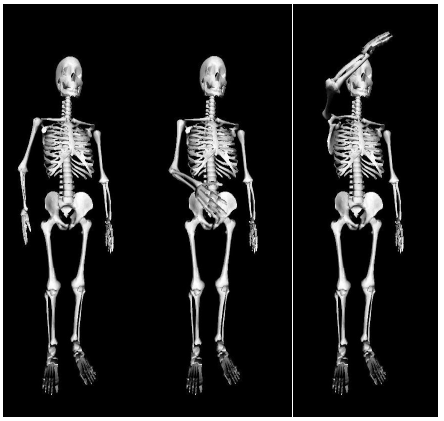
A – Frontal plane
B – Sagittal plane
C – Horizontal plane

Abduction/adduction
Flexion/extension
Axial rotation (V)

Definition of the interesting degrees of freedom.

Marker-based techniques

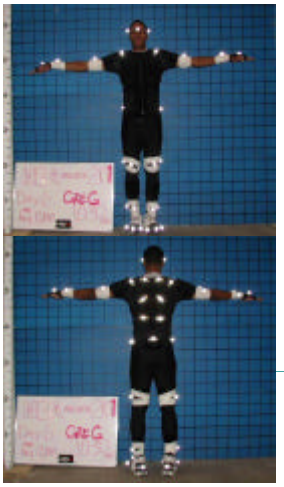
Skeleton

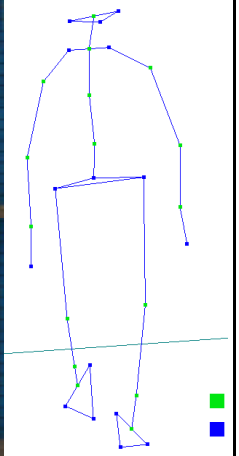


Here, the problem is to find a suitable ***marker*** for the segments and a suitable HW/SW system for ***marker detection***.

Bony segments or articulations.

How the motion of the skeleton is captured?





Markers on the bony segments

Markers on the body joints

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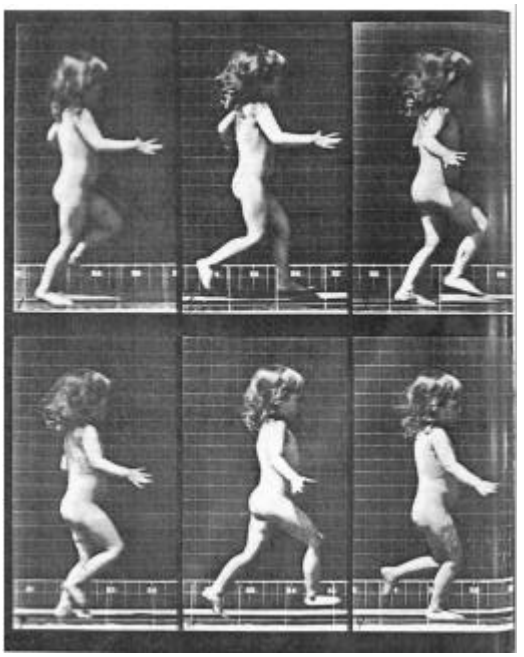
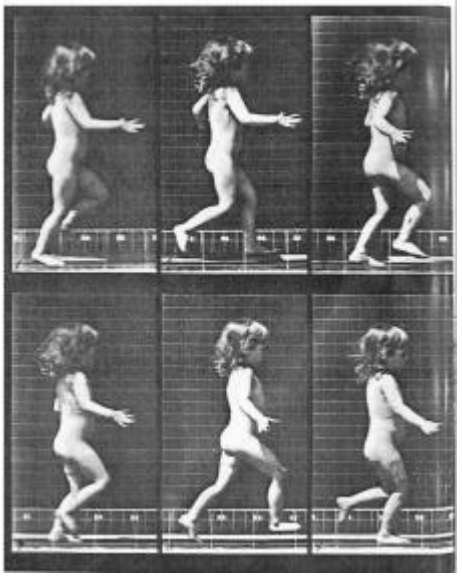
Edward Muybridge 1878-1901



Zoopraxinoscopio



Zoetrope, 1820 circa

E. Muybridge,
Humans figures in motion, 1901
+
zoopraxinoscope

History

Video technology (semi-automatic marker detection, slow-motion, 1975)

Optoelecontric active markers: Selspot™ 1977 (Selspot II 1993), Watsmart™ 1985, Optotrack™ 1992, Polaris™ 1998.
http://www.ndigital.com/home.html

Automatic video marker detection:
Vicon™ 1981. http://www.oxfordmetrics.com/
Elite™ 1988. http://www.bts.it/
MotionAnalysis™ 1992, Eagle™ 2001. http://www.motionanalysis.com/
Smart™ 2000. http://www.motion-engineering.com/

Magnetic systems:
Sensors: Polhemus 1987, Fastrack 1993. http://www.polhemus.com/
Systems: Flock of birds 1994. http://www.ascension-tech.com/

Where are we now (optoelectronic)?

Optotrack, 1991.

LED + cameras

•Measure the position of the joints.
•Time multiplexing for the markers (3 at 450Hz or 750Hz with additional hardware). No-tracking, real-time.
•Power for the LEDs has to be delivered on the subject's body (markers get hot on the skin!!).
•Accuracy 0.1mm (X,Y), 0.15mm (Z, depth).

Where are we now (magnetic)?

***Magnetic technology*: Fastrack & older Polhemus sensors.**

They measure: pitch, yaw and roll; X, Y, Z of the segments.

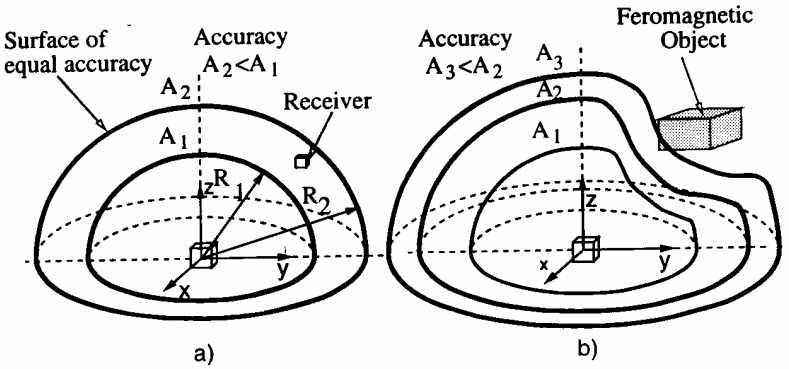
Electro-magnetic induction.

The transmitter is a triad of electromagnetic coils, enclosed in a plastic shell, that emits the magnetic fields. The transmitter is the system's reference frame for receiver measurements.

The receiver is a small triad of electromagnetic coils, enclosed in a plastic shell, that detects the magnetic fields emitted by the transmitter. The receiver is a lightweight cube whose position and orientation are precisely measured as it is moved.

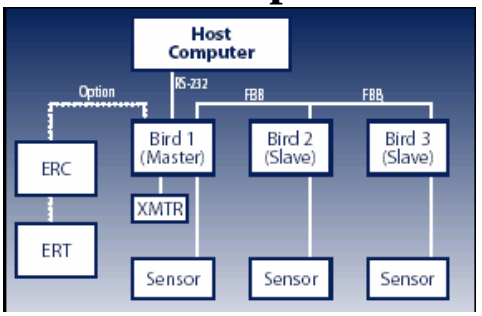
Fast-track Motion Capture

- Higher accuracy through oversampling and DSP signal processing (0,5" and 1.8mm accuracy). Range of 75cm for high accuracy.
- Sensitive to ferromagnetic (metallic) objects.



- Latency: 4msec.
- Sampling rate: 120Hz. Rate drop with multiple receivers because of multiplexing.

Flock of birds Motion Capture



- Each receiver has its own DSP.
- All the DSP are connected with a fast internal bus.
- Latency is increased (8ms).

When more than one transmitter is adopted (exprimental):

larger field (single transmitter at a time)

higher accuracy (time-slicing)

Not really un-obtrusive! Low accuracy. Real-time.

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