

Motion Capture Data Processing



Talk Overview

- MOCAP systems
- Data Acquisition Process
- Motion Data Processing
- Rotoscoping

Motion Recording Principles

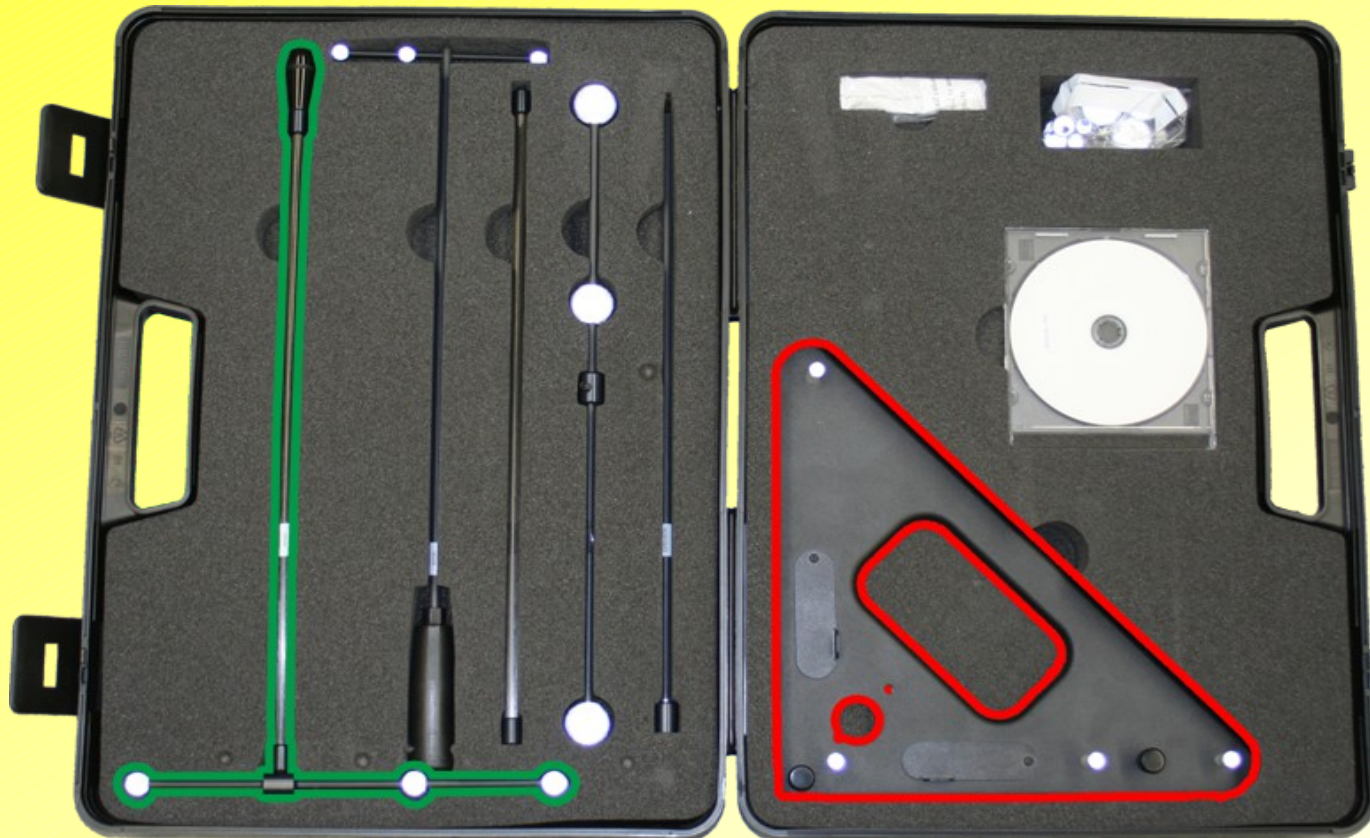
- Electromagnetic
- Optical (passive, active) – in rest of talk
- Ultrasonic
- Inertial
- Markerless and hybrid systems

Motion Data Acquisition

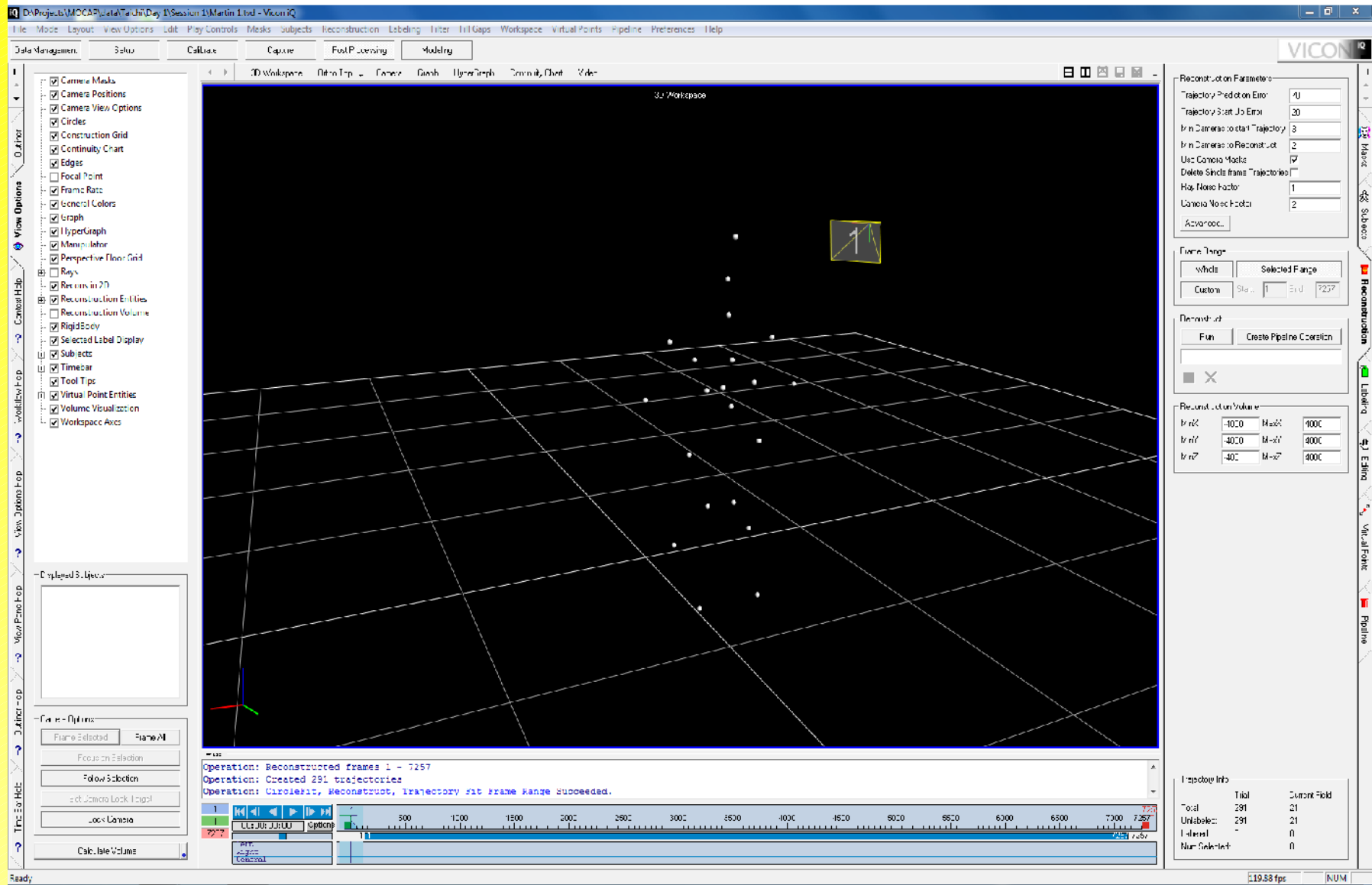
- Calibration
- Center of coordinate system definition
- Measurement process
- Data capture post-process

System Preparation

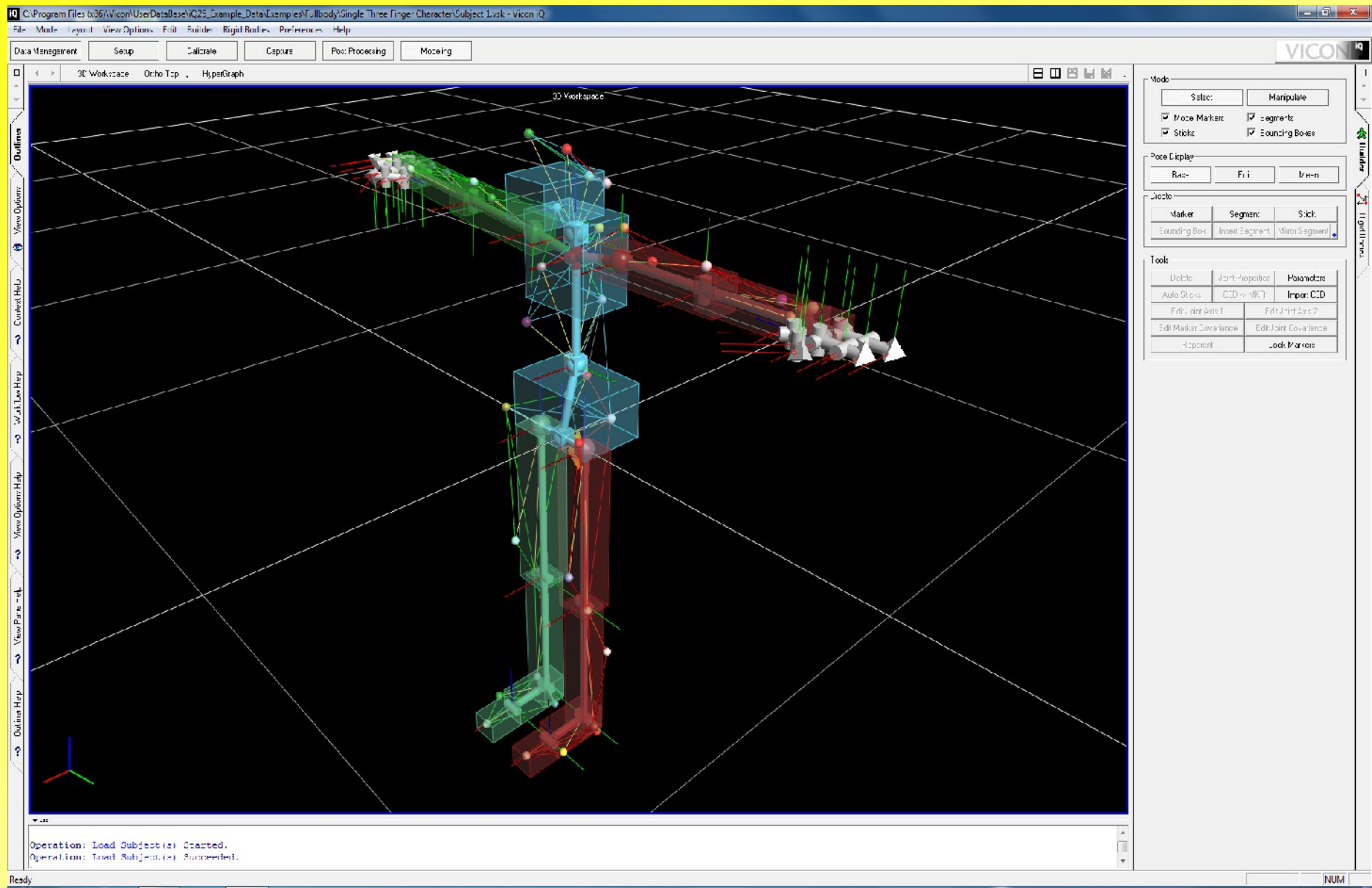
- Setup of cameras, placement, focusing
- calibration
- central point definition



Motion Data Acquisition



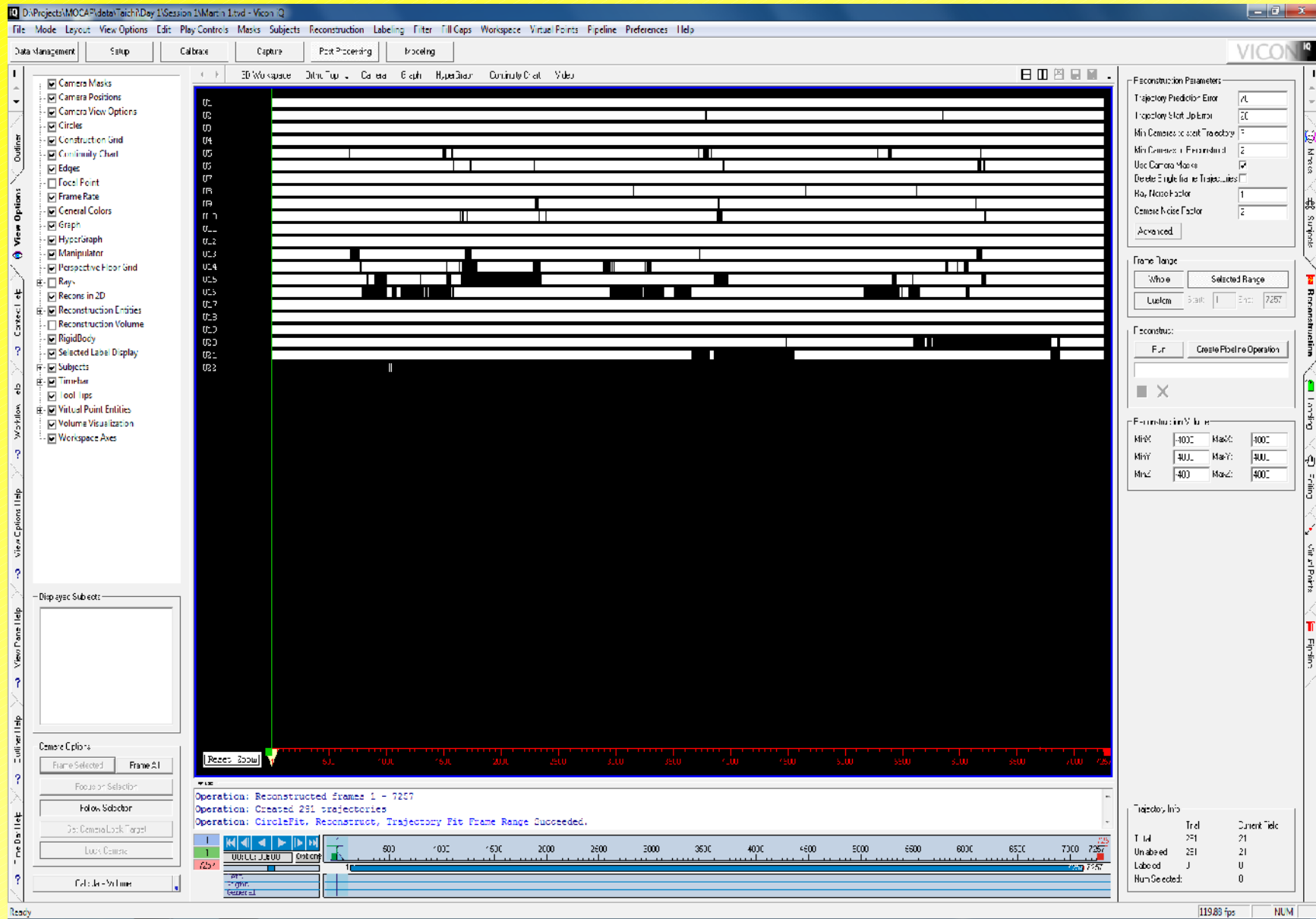
Motion Data Acquisition



Motion Data Acquisition



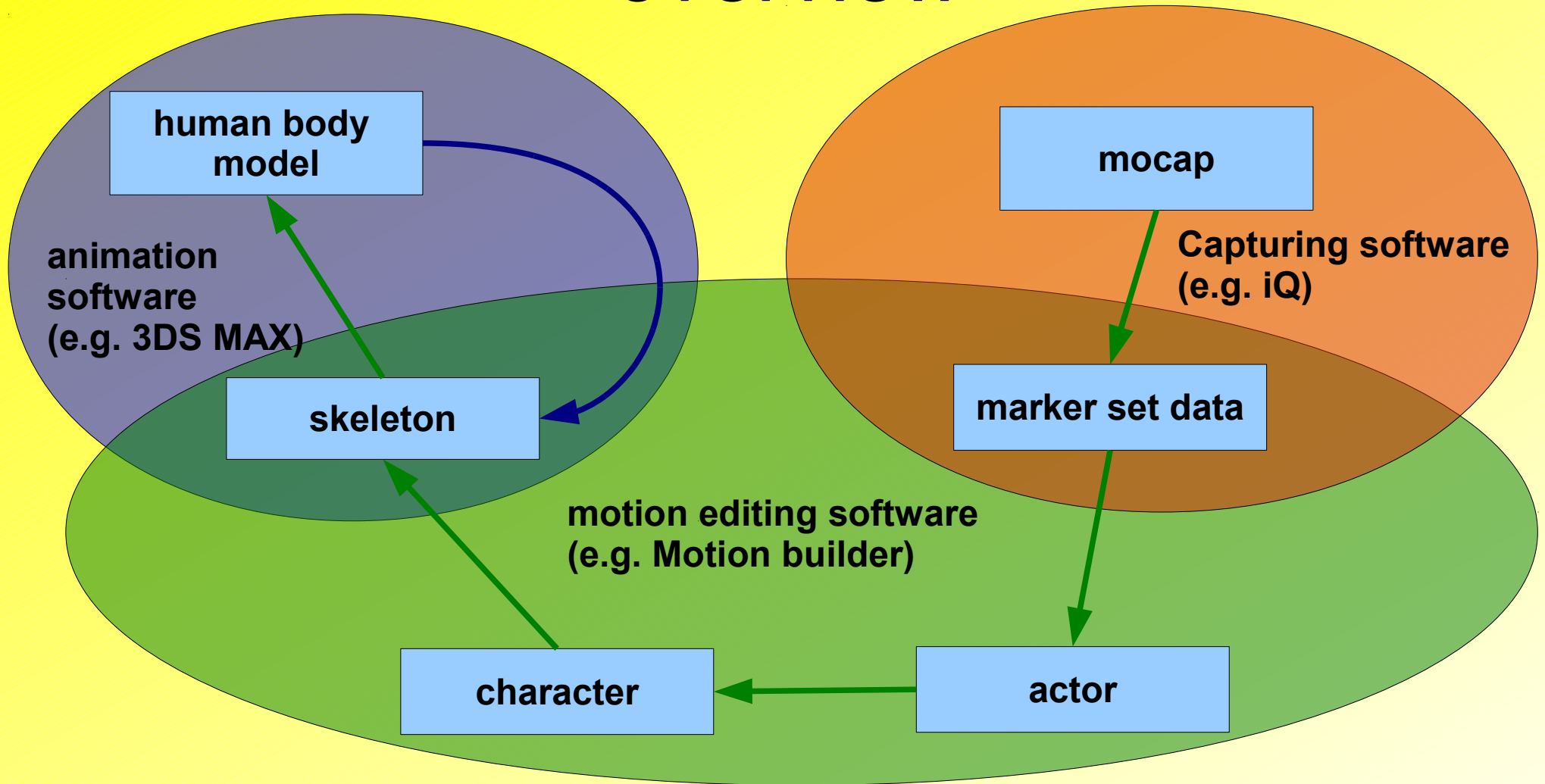
Motion Data Acquisition



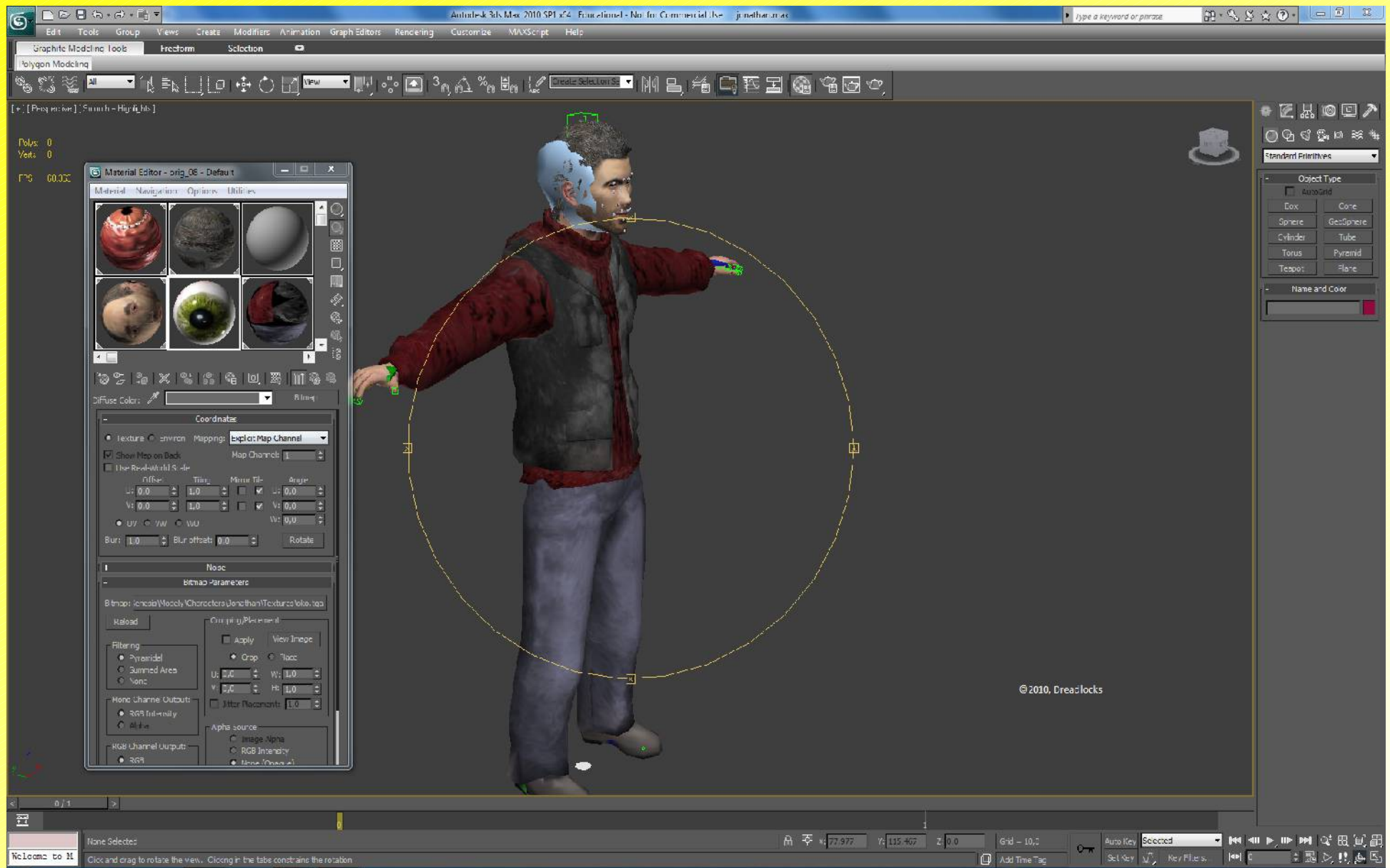
Motion Data Processing

- cleaning animation curves to get smooth natural motions
- changing characteristics of the motion
- applying captured motions to another targets

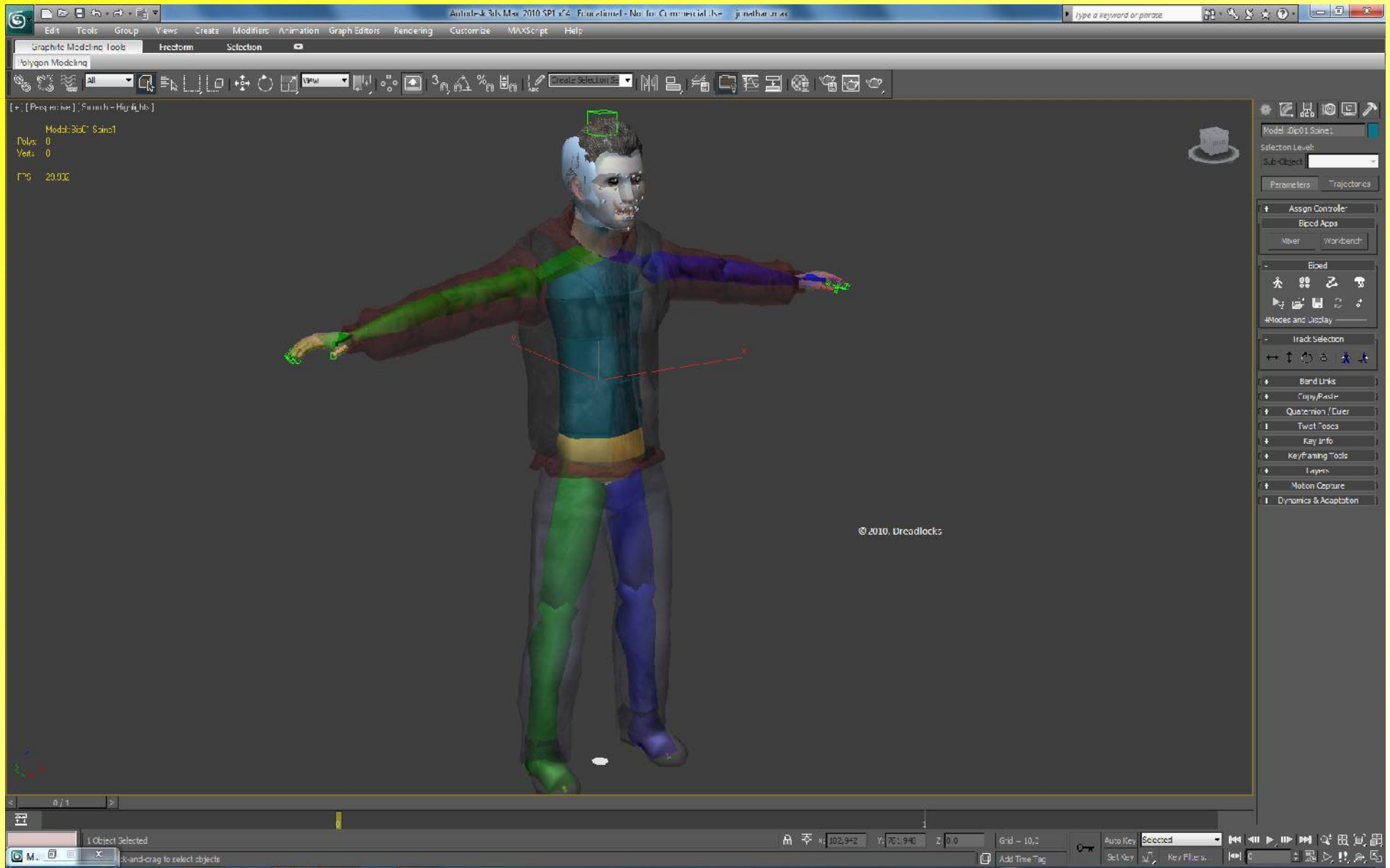
Data-to-Model Mapping overview



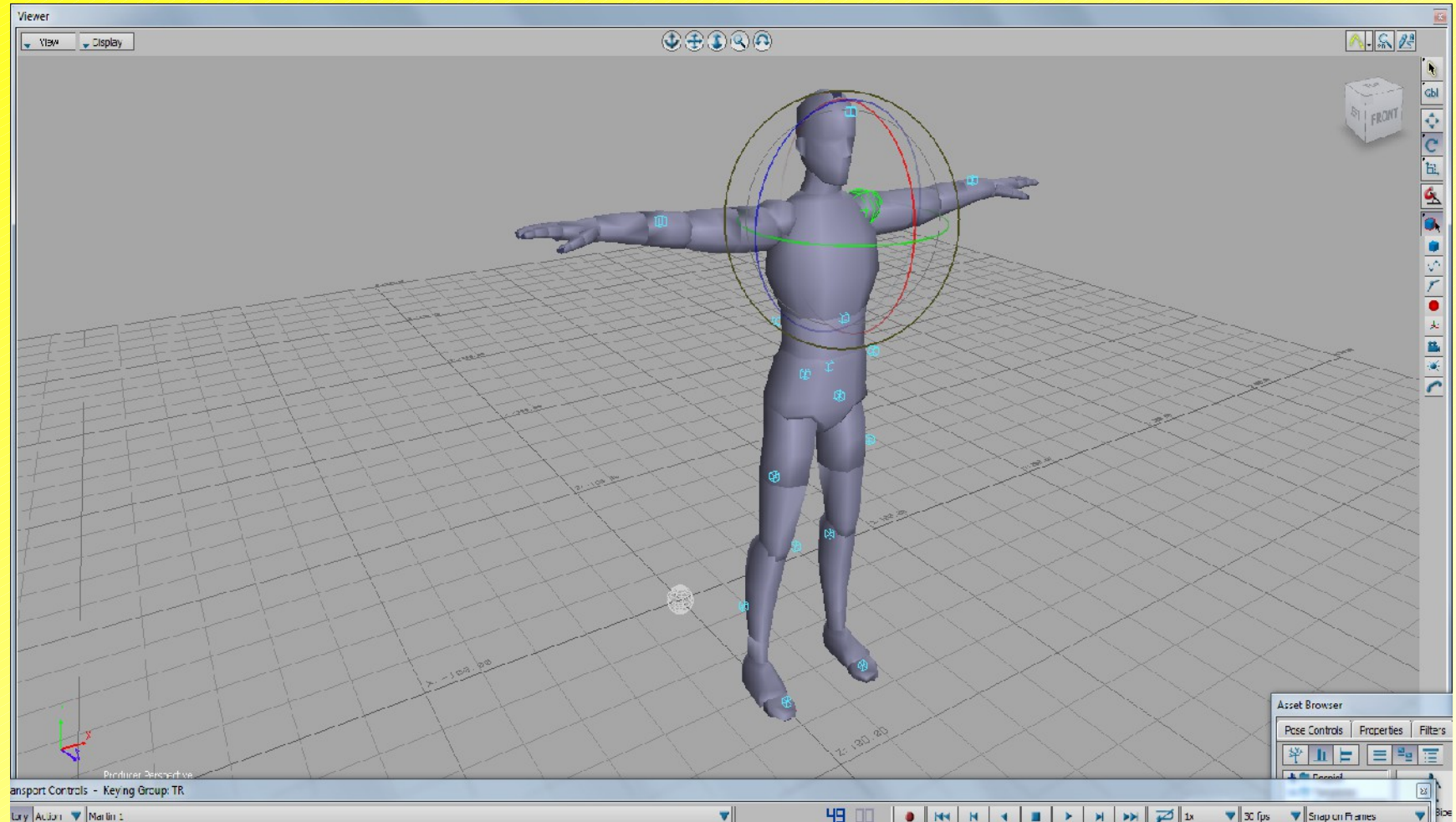
Model Preparation



Model Preparation

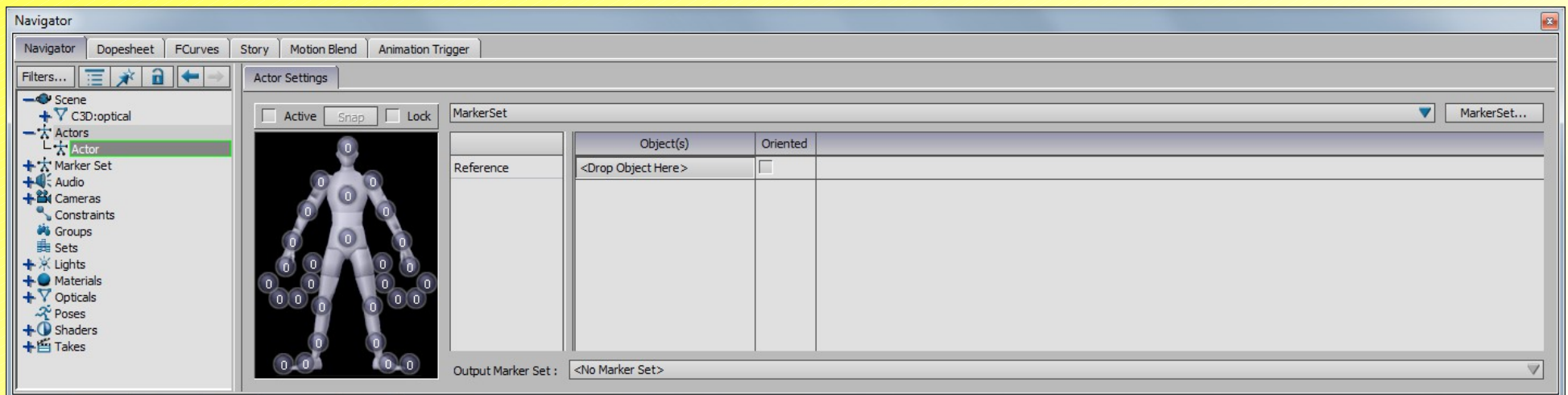
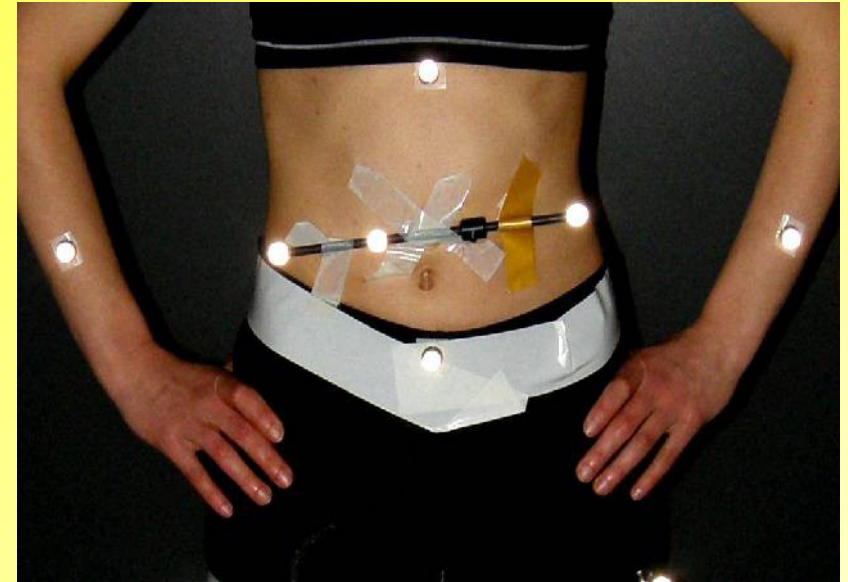
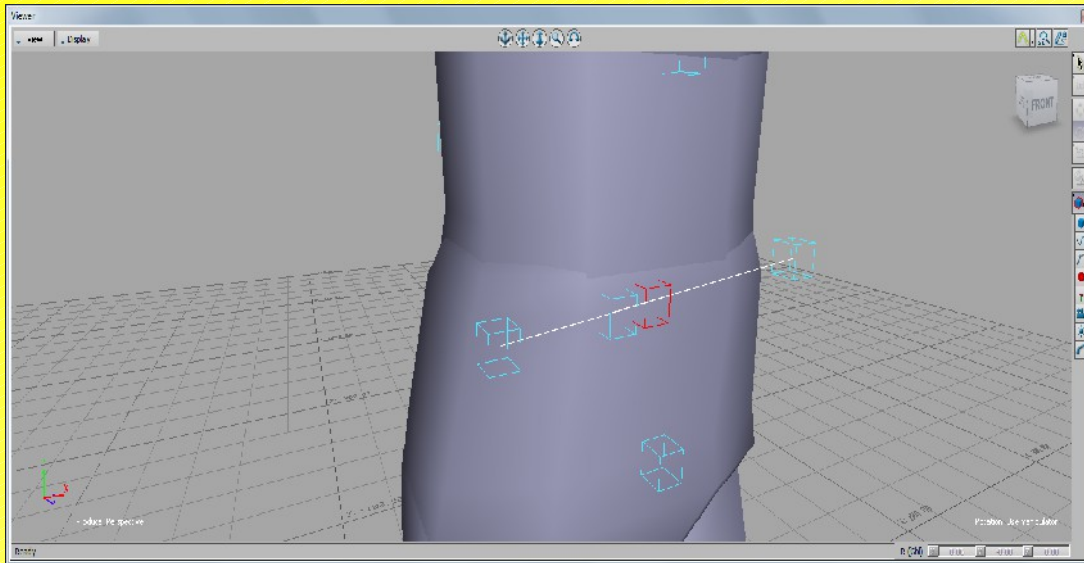


Data-to-Model Mapping

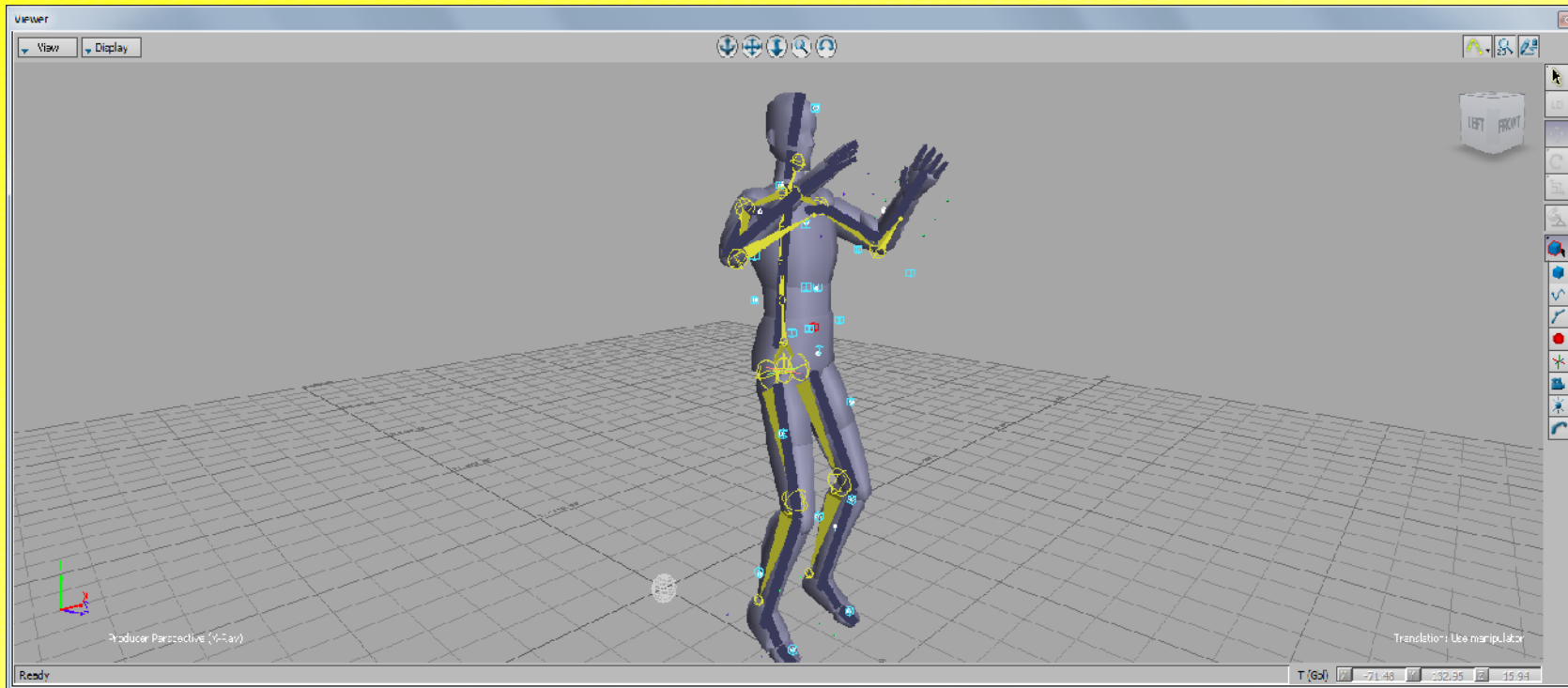


Motion Builder – Actor definition

Data-to-Model Mapping solid body definitions



Data-to-Model Mapping character – actor connection



Importing skeleton from modeler and its connection to the actor controller
next > model skeleton update

MOCAP Data Processing

Two kinds of representation:

- in time domain $f_i(t)$
- in frequency domain

Typical operations:

- Motion Warping
- Motion Concatenation
- Motion Retargeting

Motion Warping

manipulating time or value

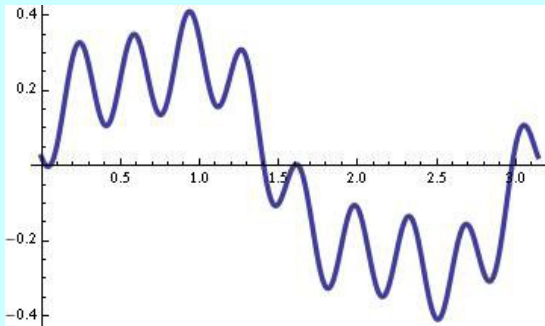
- time warping $t \rightarrow t'$ specifying a time function g

- time **offset** and time **scale**

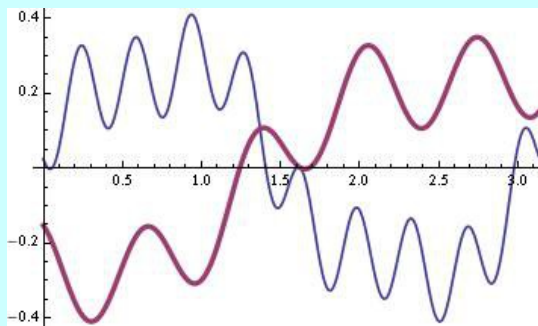
$$f'(t) = f(g(t)), g: \mathbb{R} \rightarrow \mathbb{R}$$

$g(t) = t + k$ (offset)

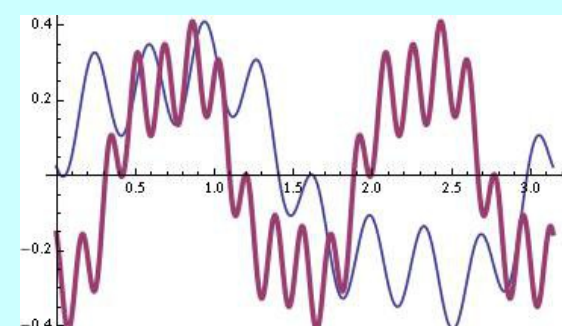
$g(t) = kt$ (scale)



$f(t)$



$g(t) = 0.5t - \pi/4$

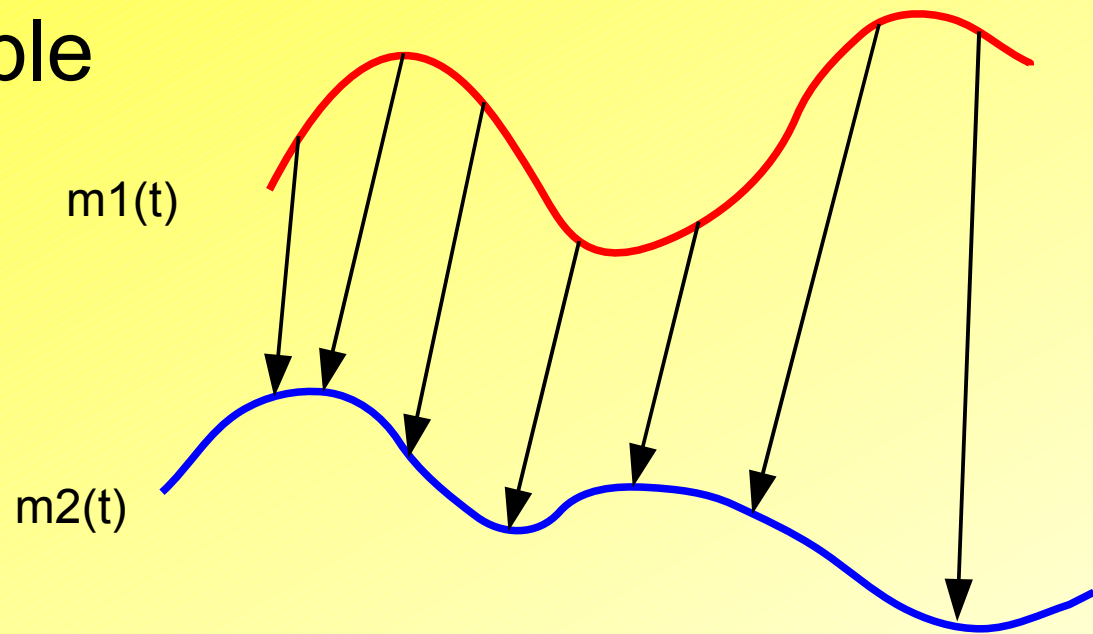


$g(t) = 2t - \pi/4$

Motion Warping

Time warping

- interpolating a table
- aligning events



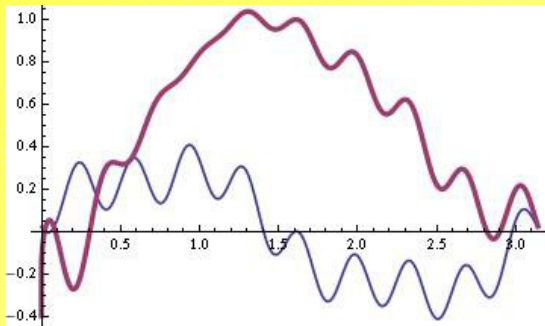
Dynamic Time Warping

- synchronizing two motions

Motion Warping

Manipulating value

$$f'(t) = h(f(t)), h: R^n \rightarrow R^n$$

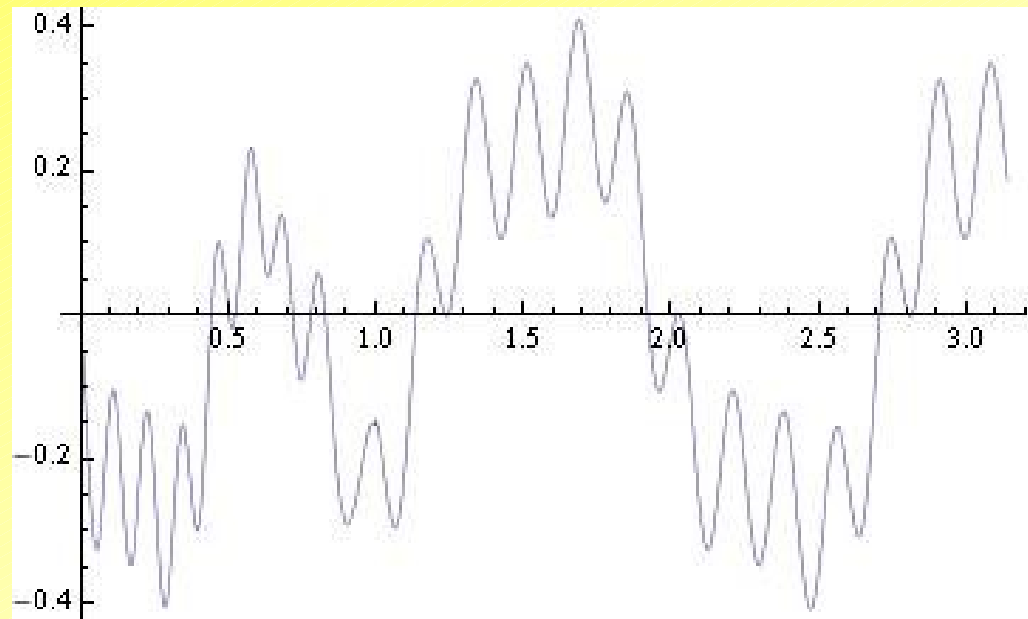
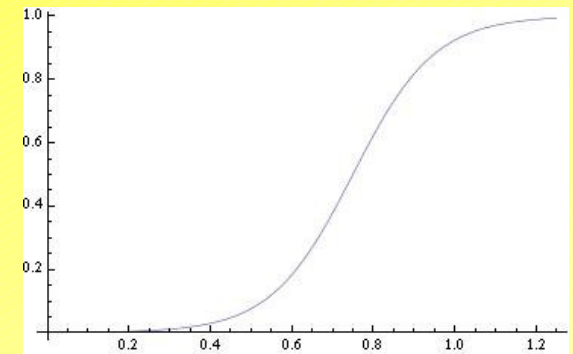
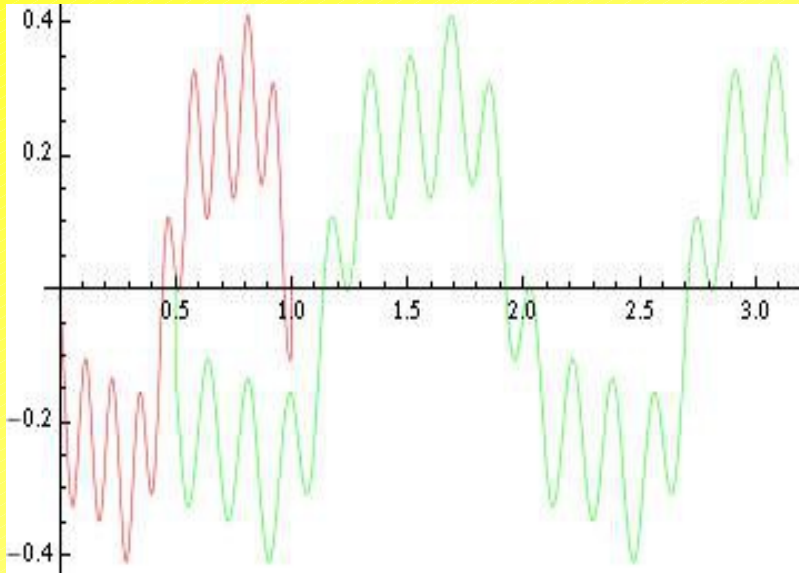


$$f'(t) = a(t)f(t) + b(t)$$

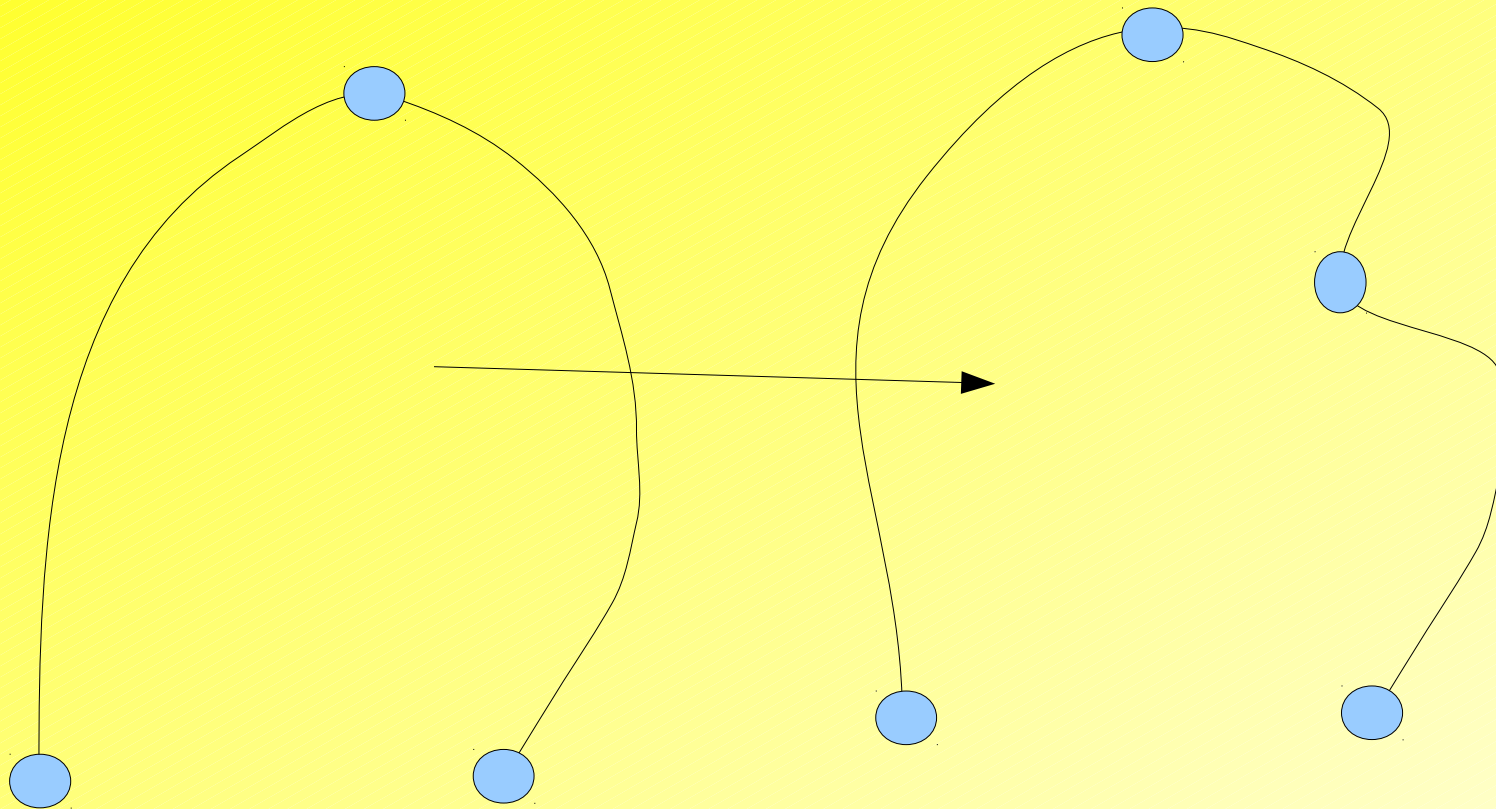
- Concatenation
- Blending
- Transition
- Cyclification
- Change style
- Filtering
- Retargeting

Concatenation

$$f'(t) = (1 - w(t))f_1(t) + w(t)f_2(t), w: \text{transition function}$$



Retargeting



The modified motion must meet the given constraints

Space Time Constraints

- Let motion is expressed as: $m(t, \mathbf{x})$
where $\mathbf{x}$ is configuration vector
- Then edited motion is: $m(t, \mathbf{x}) = m_0(t, \mathbf{x}) + d(t, \mathbf{x})$
- A constraint can be expressed as: $f(m(t, \mathbf{x})) = c$
- to achieve constraints with minimal motion changes $\Rightarrow$ minimize $d(t, \mathbf{x})$ subject to
 $f(m(t_c, \mathbf{x})) = c$

Signal Processing

- Low pass filtering (noise and detail removal)
- High pass filtering (style change)
- Representation:

$$F(t) = K_0 + \sum_i K_i \sin(it + \varphi_i)$$

- Interpolate two motions

$$F_s(t) = (1 - w)K_0 + wM_0 + \sum_i ((1 - w)K_i + wM_i) \sin(it + (1 - w)\varphi_i + w\psi_i)$$

Rotoscoping

- animation technique
- based on tracking objects from

video



References

- M. Gleicher: ***Retargetting Motion to New Characters***. In SIGGRAPH '98: Proceedings of the 25th annual conference on Computer graphics and interactive techniques, pages 33-42, New York, NY, USA, 1998. ACM.
- M. Gleicher: ***Motion editing with spacetime constraints***. In Proceedings of the 1997 symposium on Interactive 3D graphics (I3D '97). ACM, New York, NY, USA, pages 139-148.
- A. Golam and K. C. Wong. Dynamic: ***Time Warp Based Framespace Interpolation for Motion Editing***. In Graphics Interface , pages 45-52, May 2000.
- A. Witkin and Z. Popovic: ***Motion Warping***. In Siggraph'95 Conference Proceedings, pages 105-108, Los Angeles, US, August 1995. ACM Siggraph.
- A. Bruderlin and L. Williams: ***Motion Signal Processing***. In SIGGRAPH '95: Proceedings of the 22nd annual conference on Computer graphics and interactive techniques, pages 97-104, New York, NY, USA, 1995. ACM.