An Architecture for Motion Capture Animation

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General Outline

- Computer Animation Systems
- Motion Capture (MoCap)
- MoCap Animation System
- System’s Architecture
- Conclusions
- Future work / Work in progress

Motion Capture (MoCap)

- Motion recording by sampling at points of a real subject
- Advantages
  - natural looking motion.
  - speed of production.
- Drawback
  - data complexity and size.

MoCap Hardware Technology

- Optical
  - ☑ high sampling rates.
  - ☒ no angular data.
  - ☒ requires post-processing.
- Magnetic
  - ☑ real-time animation.
  - ☒ high encumbrance (lots of cables).
  - ☒ low sampling rate.
- Hybrid

Computer Animation Systems

- Keyframing
  - interpolation between key poses.
- Procedural
  - procedure parameters over time.
- Simulation
  - physical constraints and rules.

Our Motivation

- MoCap is different from traditional animation data

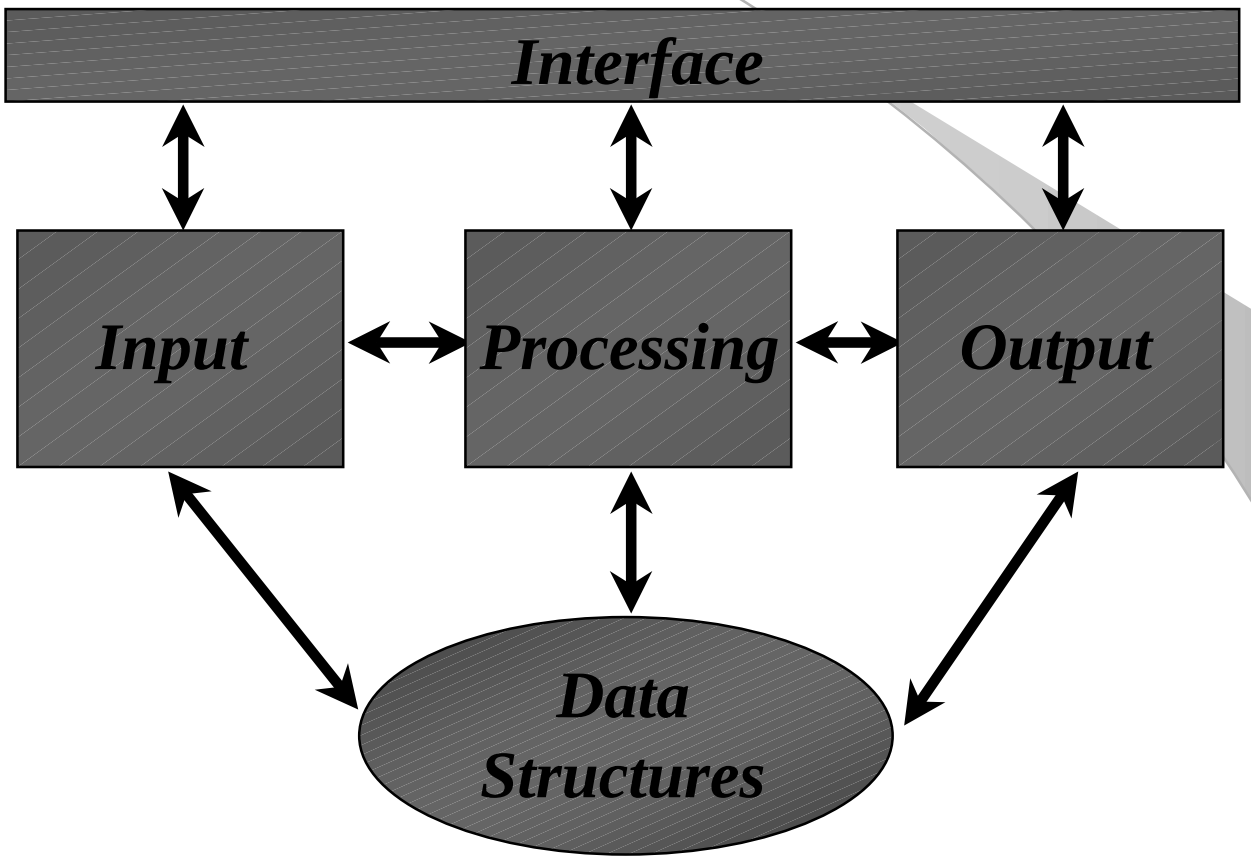
- Existing systems are not suitable for MoCap processing

There is a need for specialized MoCap processing systems

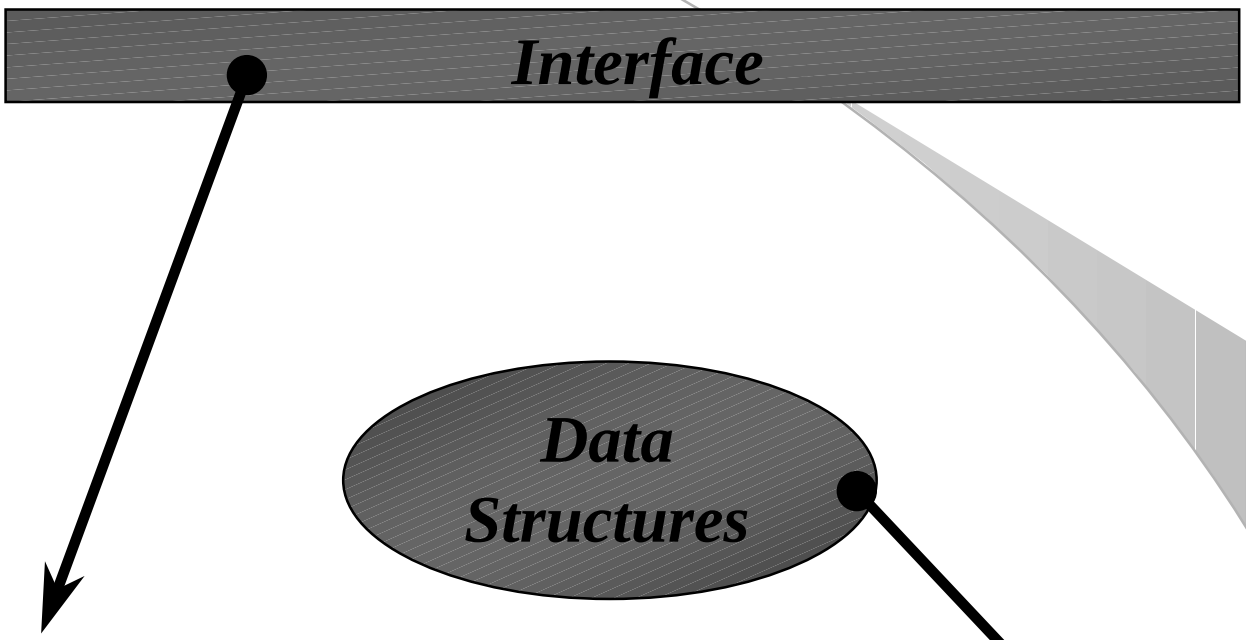
Our MoCap Animation System

- MoCap as main animation tool
- Modular architecture
  (*Input*, *Processing*, *Output* and *Interface*)
- Specialized GUI objects sharing a dynamic state structure

System’s Architecture



System’s Architecture

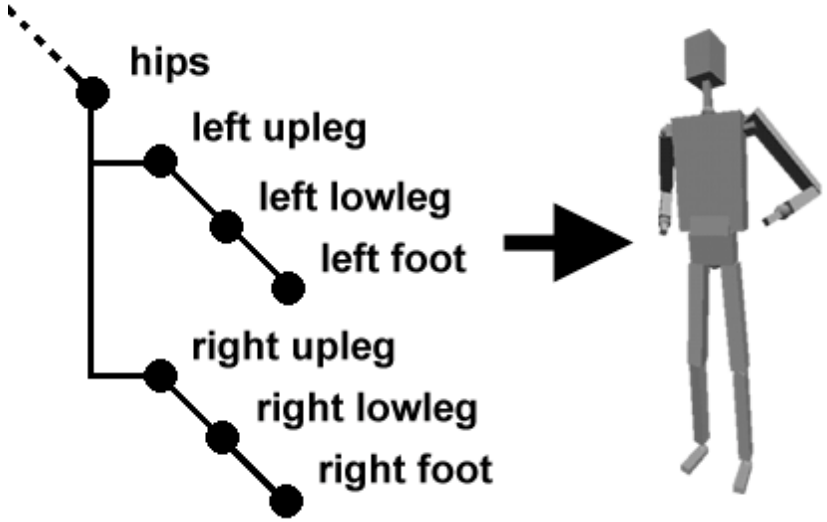


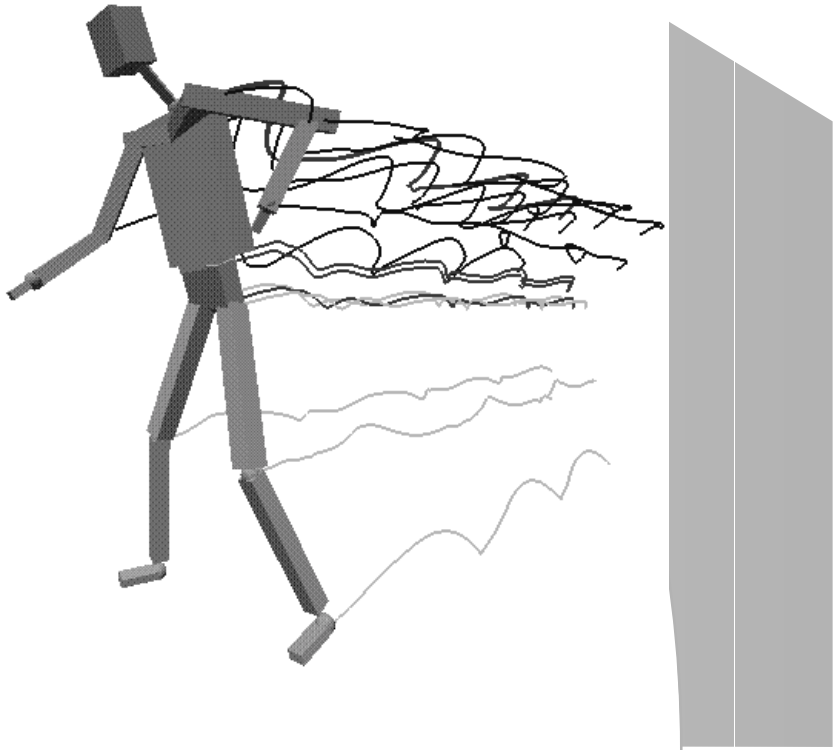
- Entities
- Operations
- Control

- Actor
- Motions

System's Data Structures

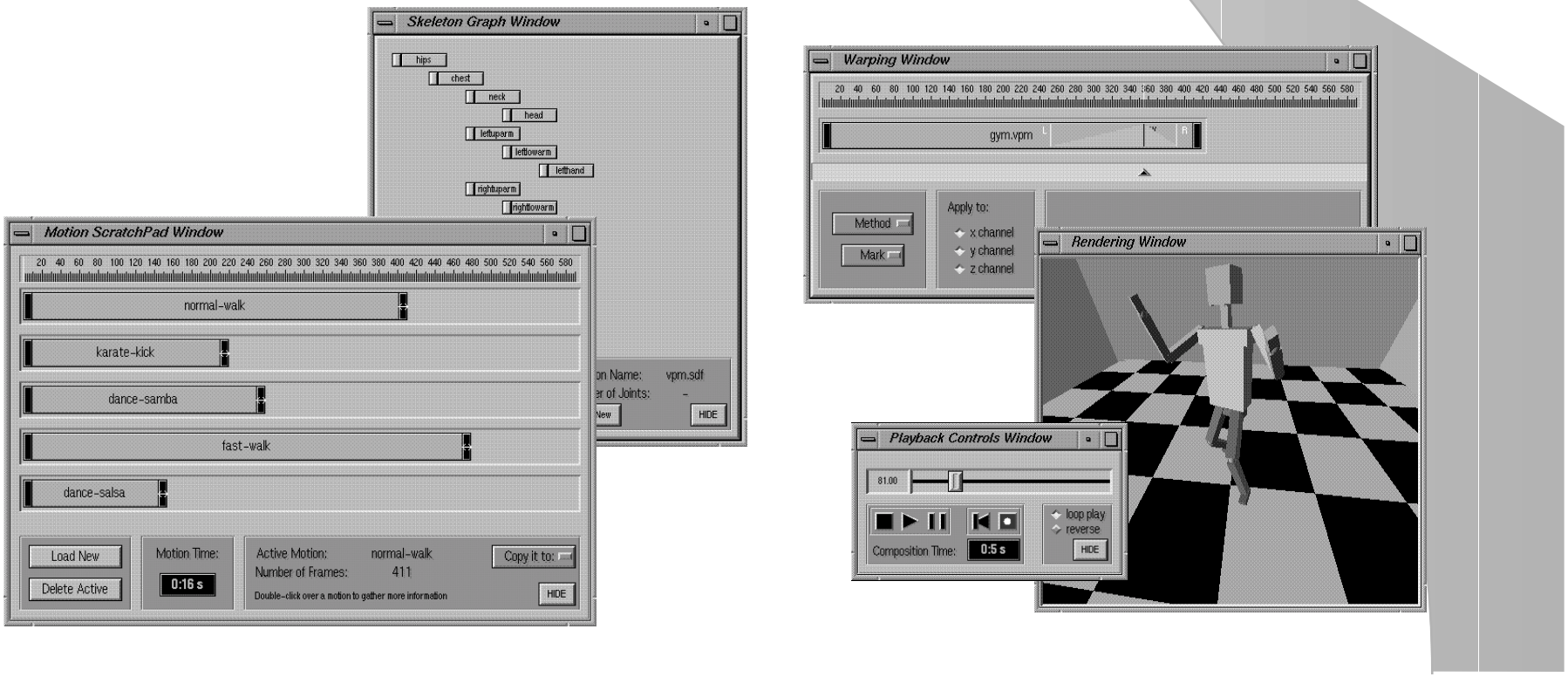
- Basic entities
  - virtual actor: topology + geometry.
  - motions: sampled data.



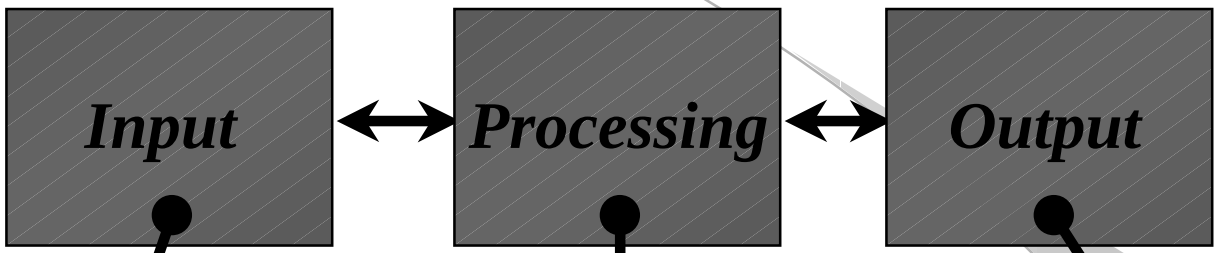


System's User Interface

- Graphic objects (widgets)
  - designed to work with MoCap data.
  - based on video post-production paradigm.



System's Architecture



- Interpretation
- Pre-processing
- Relative angle extraction

- Motion operations

- Reusable motion libraries
- MoCap format converter

System's Architecture - *Input*

- Interpretation
  - support to different file formats.
- Pre-processing
  - detection of holes in MoCap data.
- Relative angle extraction
  - conversion of positional data to relative angles.

Relative Angle Extraction

- Needed for motion processing
  - can be mapped onto a position-independent skeleton hierarchy.
  - easy integration with other animation techniques (forward & inverse kinematics).
- 3 DOF Euler angles extracted via geometric algorithms

System's Architecture - *Processing*

- Motion operations
  - motion analysis, modification and reuse.
  - preserve the original quality of the motion.

- Extensibility
  - inclusion of new operations as plug-ins.

Motion Operations

- Unary (filtering, warping)
  - one motion as operand.
  - modification of motion's characteristics.
- Binary (concatenation)
  - two motions as operands.
  - creation of longer animations.
- N-ary (blending)
  - two or more motions as operands.
  - mix different motion styles/characteristics.

System's Architecture - *Output*

- Data portability
  - conversion between file formats.
- Skeleton hierarchy data
  - relative angles information.
- Rendering pipeline
  - frame by frame rendering in professional systems.

Implementation Issues

- C Language + UNIX
- Rendering: OpenGL
- Standard GUI facilities: XForms
- Real-time frame rates
- Tested on SGI, RS6000 and Linux

Conclusions

- MoCap based systems
  - correct representation of MoCap abstractions.
  - integration with capturing systems.
  - what is the minimum set of operations?
- Proposed Architecture
  - deals with some limitations of the process.
  - easy integration of new techniques.

Future Work / Work in Progress

- Other motion operations
  - motion cyclification.
  - multiresolution filtering.
- New techniques
  - motion time-warping.
  - motion/sound synchronization.
- Other animation tools/techniques
  - Inverse kinematics.
  - Procedural.

Additional Info

http://www.visgraf.impa.br/mocap