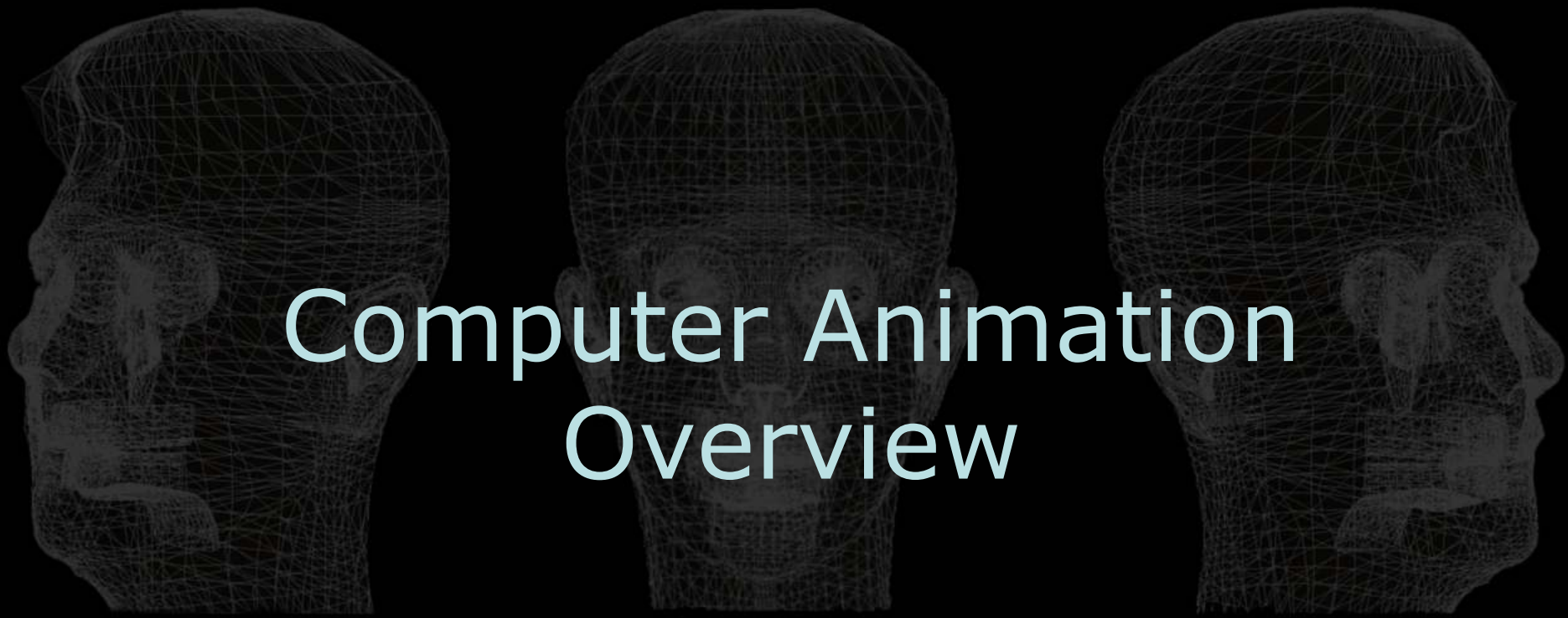
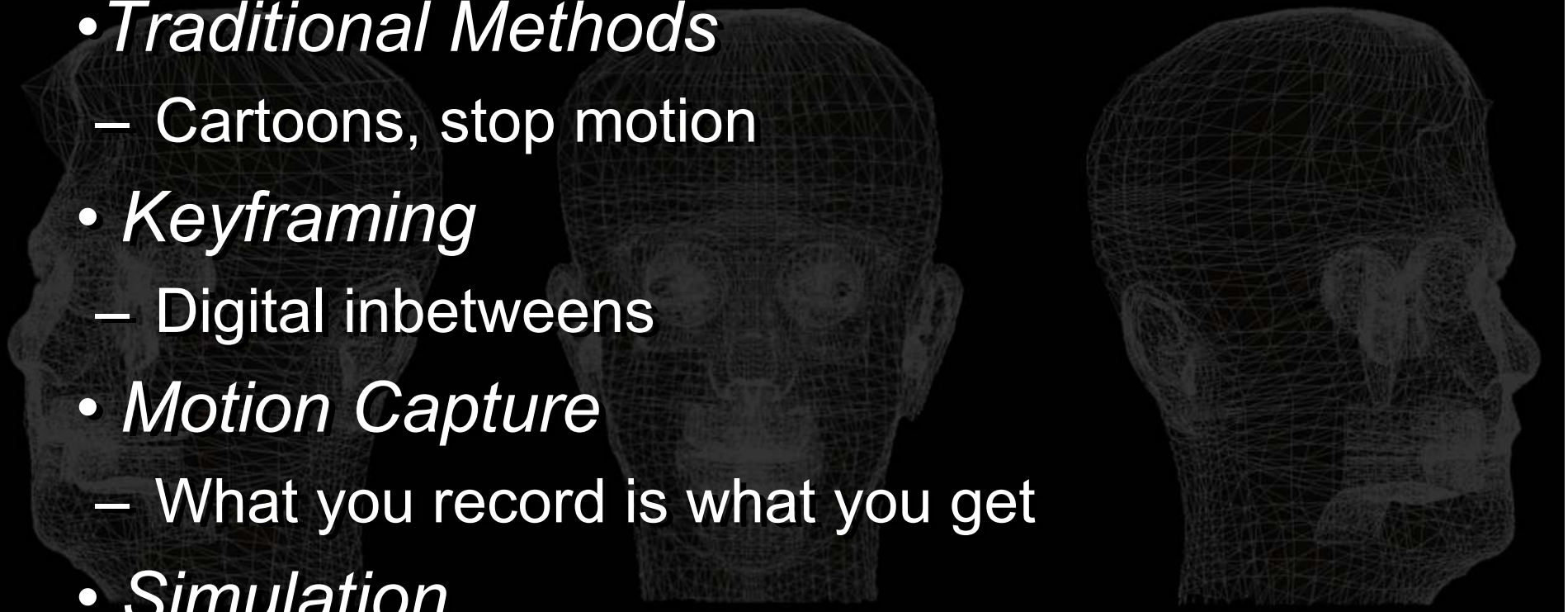
CS 6204

Character Animation, Research and Applications



Computer Animation Overview

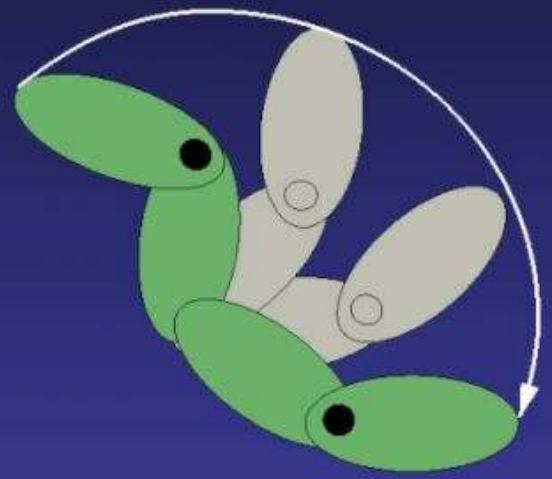
Animation – A broad Brush



- *Traditional Methods*
  - Cartoons, stop motion
- *Keyframing*
  - Digital inbetweens
- *Motion Capture*
  - What you record is what you get
- *Simulation*
  - Animate what you can model (with equations)

Animation Techniques

Keyframing



Keyframing

- Traditional animation technique
- Dependent on artist to generate ‘key’ frames
- Additional, ‘inbetween’ frames are drawn automatically by computer

Keyframing

How are we going to interpolate?

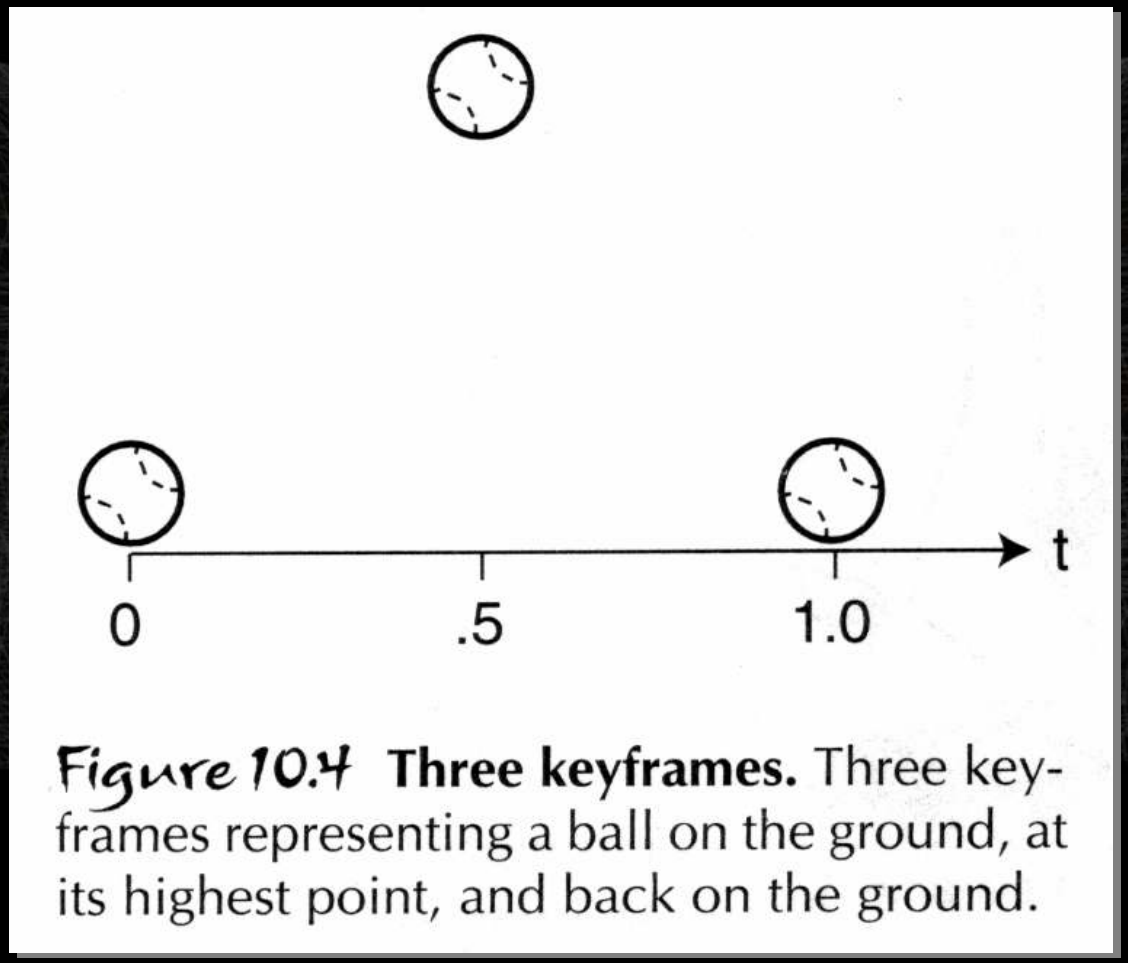
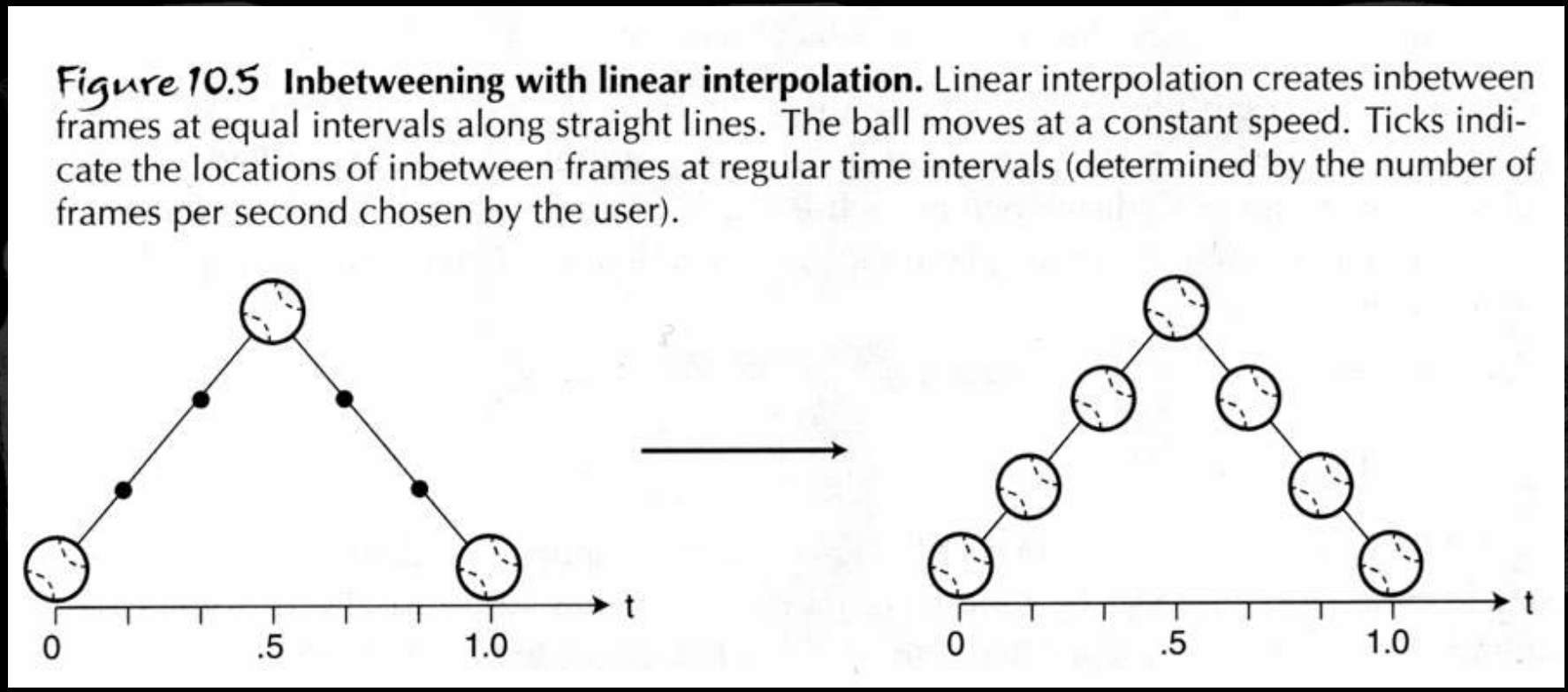


Figure 10.4 **Three keyframes.** Three keyframes representing a ball on the ground, at its highest point, and back on the ground.

From “The computer in the visual arts”, Spalter, 1999

Linear Interpolation



Simple, but discontinuous velocity

Nonlinear Interpolation

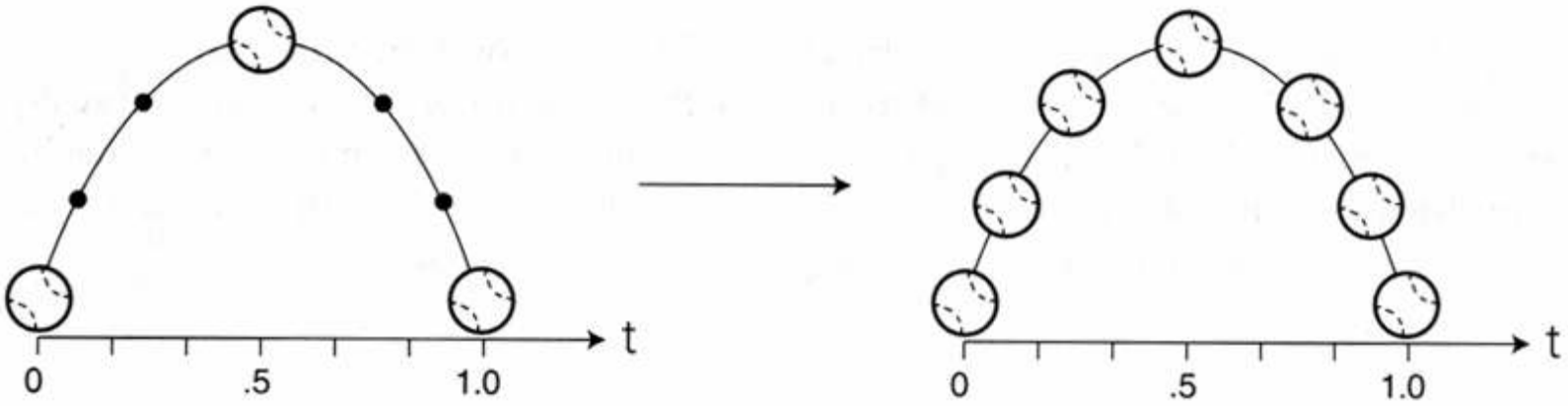


Figure 10.9 Inbetweening with nonlinear interpolation. Nonlinear interpolation can create equally spaced inbetween frames along curved paths. The ball still moves at a constant speed. (Note that the three keyframes used here and in Fig. 10.10 are the same as in Fig. 10.4.)

Smooth ball trajectory and continuous velocity, but loss of timing

Easing

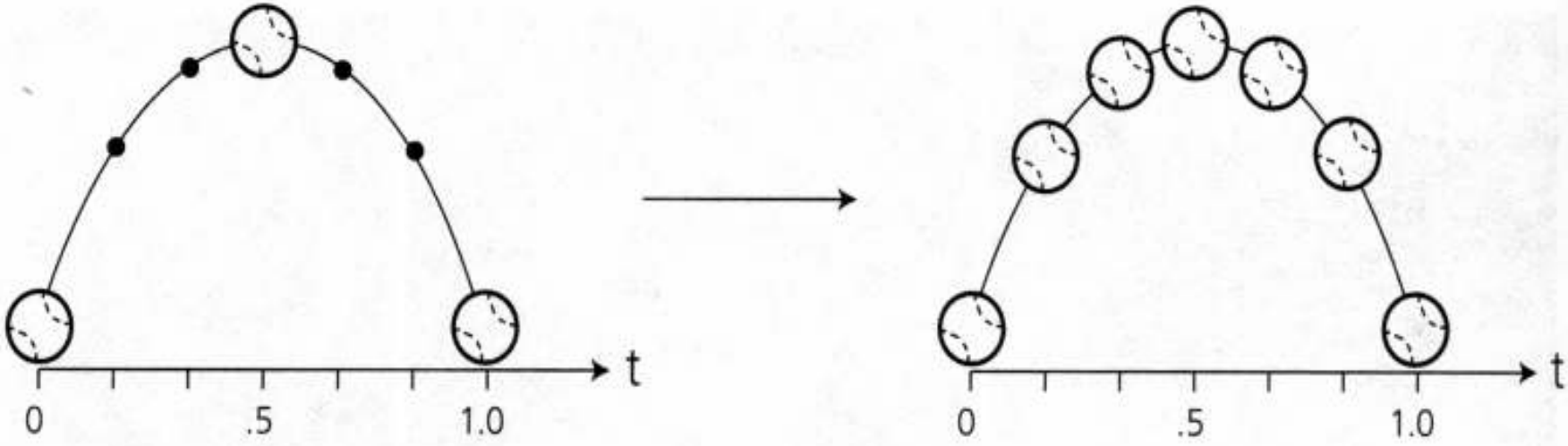


Figure 10.10 Inbetweening with nonlinear interpolation and easing. The ball changes speed as it approaches and leaves keyframes, so the dots indicating calculations made at equal time intervals are no longer equidistant along the path.

Adjust the timing of the inbetween frames. Can be automated by adjusting the stepsize of parameter, t.

Keyframing

- *Strengths*
  - Animator has exacting control
- *Weaknesses*
  - Interpolation hooks must be simple and direct
    - Remember the problems with Euler angle interp?
  - Time consuming and skill intensive
  - Difficult to reuse and adjust

Animation Techniques

Motion Capture

Microsoft Motion Capture Group

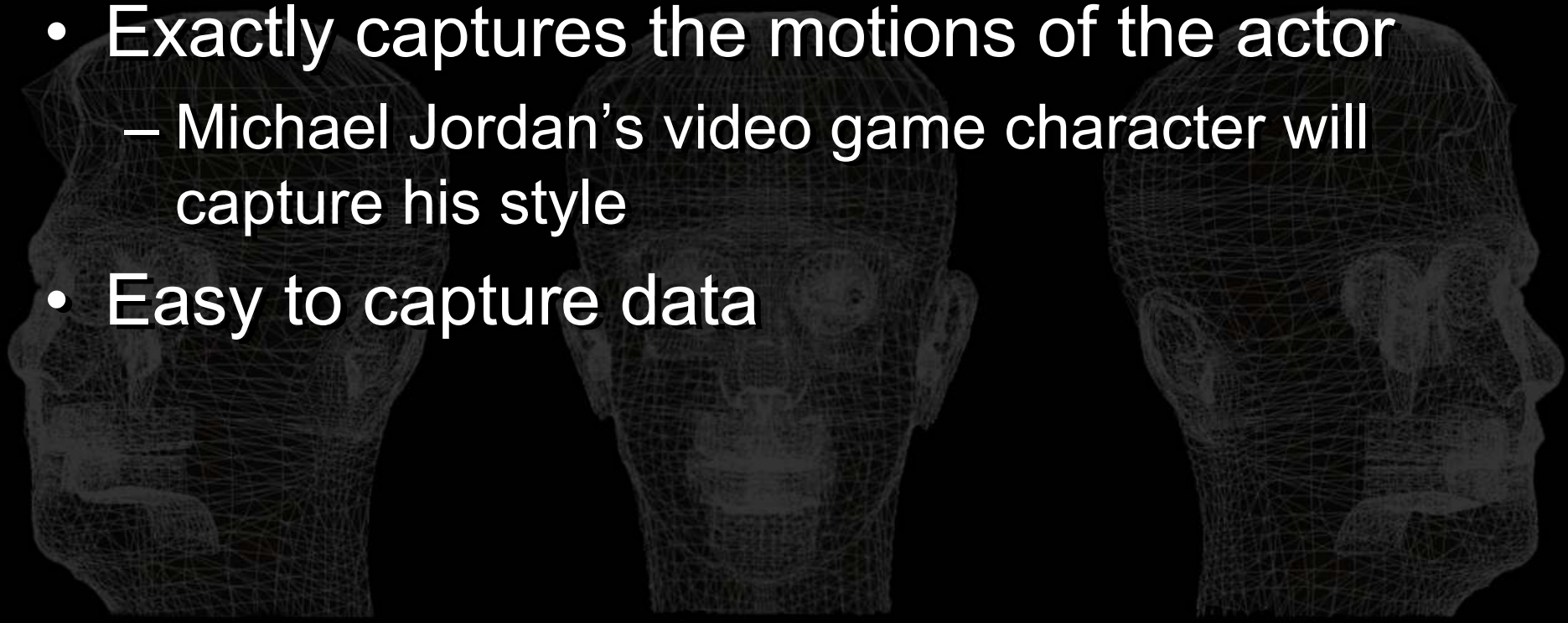
Motion Analysis

Examples

- Sports video games
  - Madden Football
- Many movie characters
  - Phantom Menace
- Cartoons

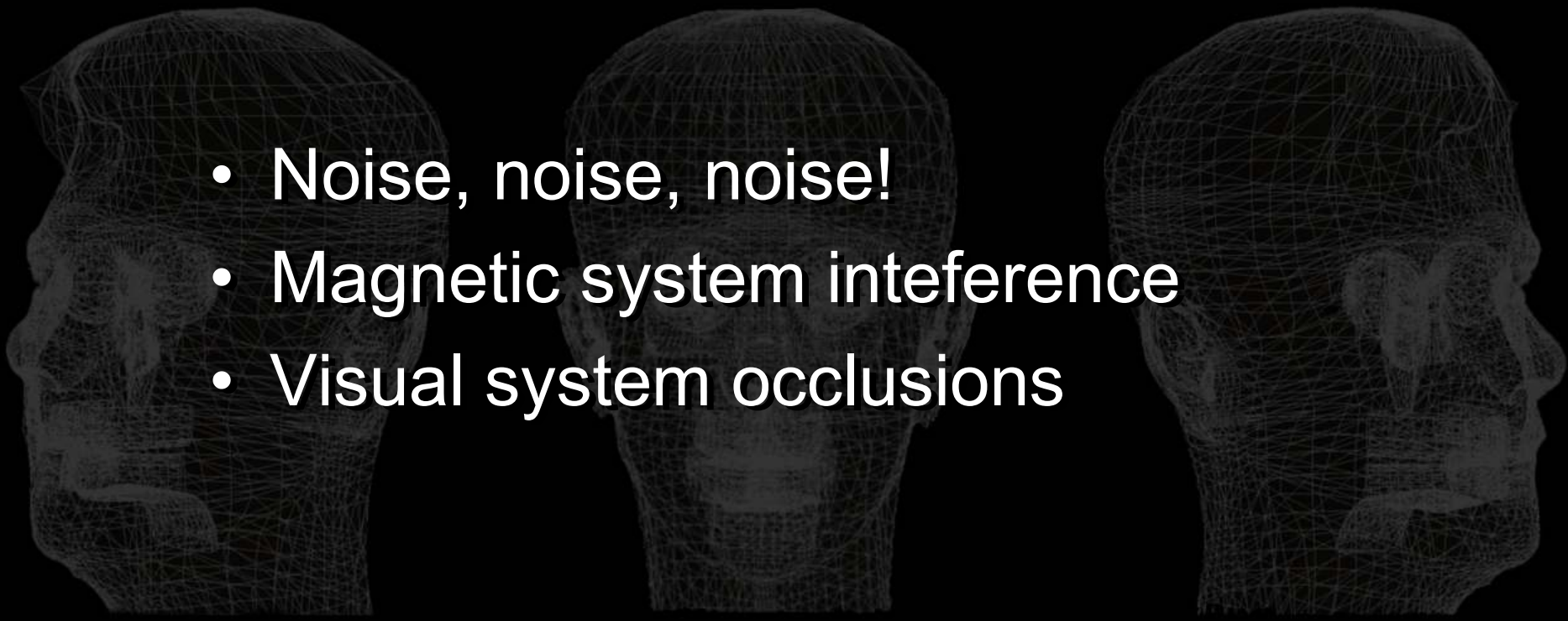

Bobby Leach Image Courtesy of Film East.

Motion Capture Strengths



- Exactly captures the motions of the actor
  - Michael Jordan's video game character will capture his style
- Easy to capture data

Motion Capture Weaknesses

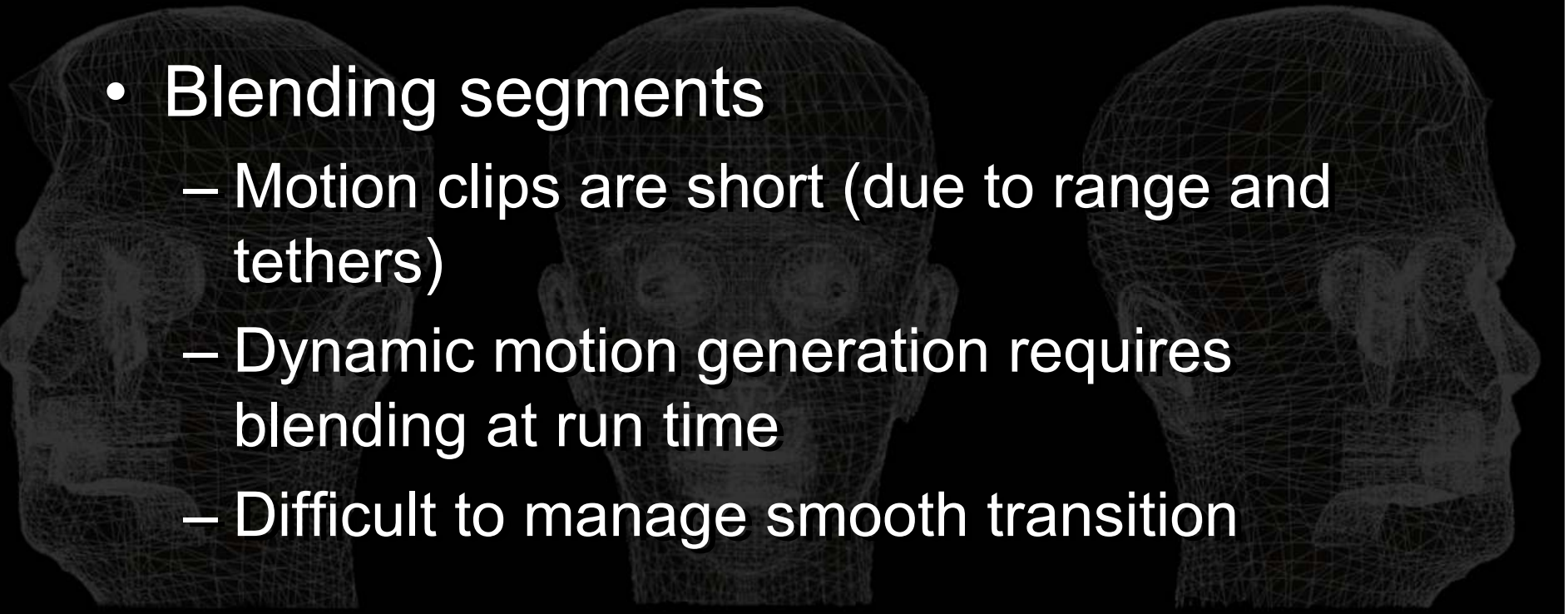


- Noise, noise, noise!
- Magnetic system inteference
- Visual system occlusions

Motion Capture Weaknesses

- Aligning motion data with CG character
  - Limb lengths
  - Idealized perfect joints
  - Foot sliding
- Reusing motion data
  - Difficult to scale in size (must also scale in time)
  - Changing one part of motion

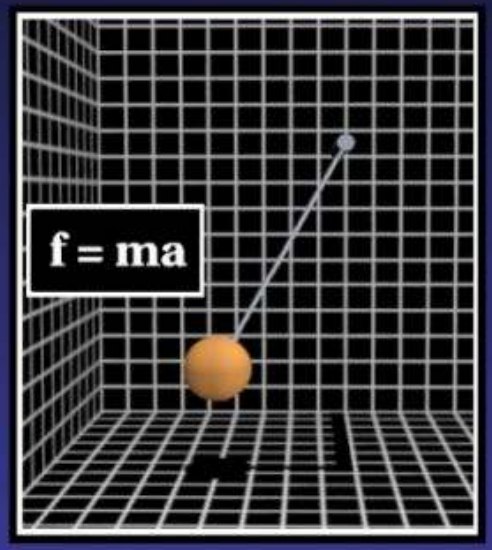
Motion Capture Weaknesses



- Blending segments
  - Motion clips are short (due to range and tethers)
  - Dynamic motion generation requires blending at run time
  - Difficult to manage smooth transition

Animation Techniques

Procedural Techniques



Procedural Animation

- Very general term for a technique that puts more complex algorithms behind the scenes
- Technique attempts to consolidate artistic efforts in algorithms and heuristics
- Allows for optimization and physical simulation

Procedural Animation Strengths

- Animation can be generated ‘on the fly’
- Dynamic response to user
- Write-once, use-often
- Algorithms provide accuracy and exhaustive search that animators cannot

Procedural Animation Weaknesses

- We're not great at boiling human skill down to algorithms
  - How do we move when juggling?
- Difficult to generate
- Expensive to compute
- Difficult to force system to generate a particular solution
  - Bicycles will fall down