Animation

Eri Prasetyo W

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Sources :

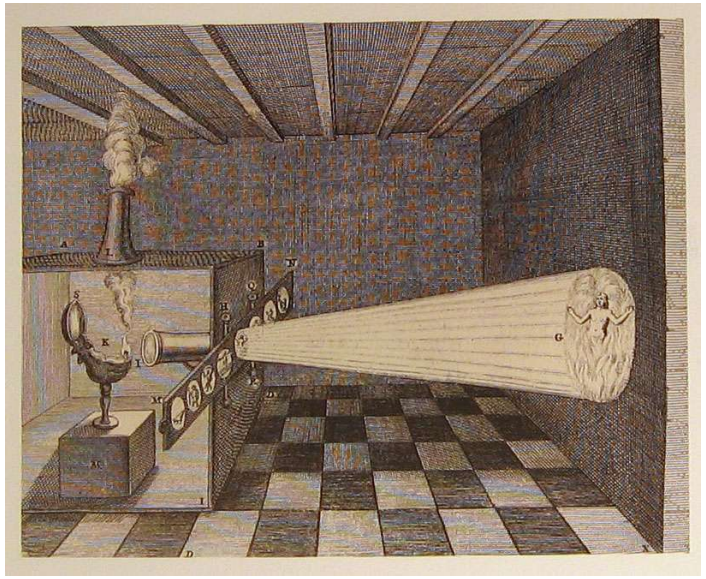
Thomas Funkhouser, Princeton University

Marie Samozino, INRIA – équipe Géometrica

Barbara Meier, Animation

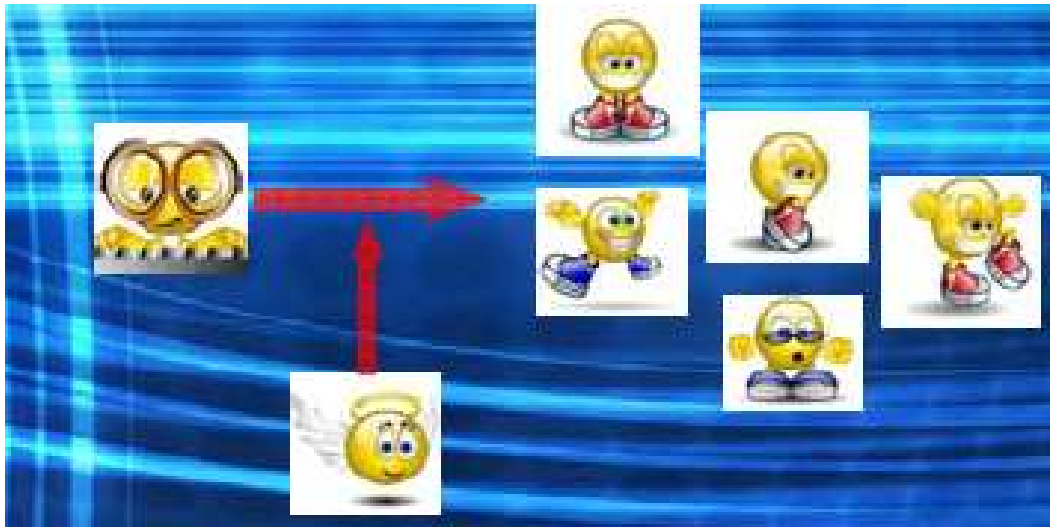
What is animation

Make objects change over time according to scripted actions



Traditional Animation

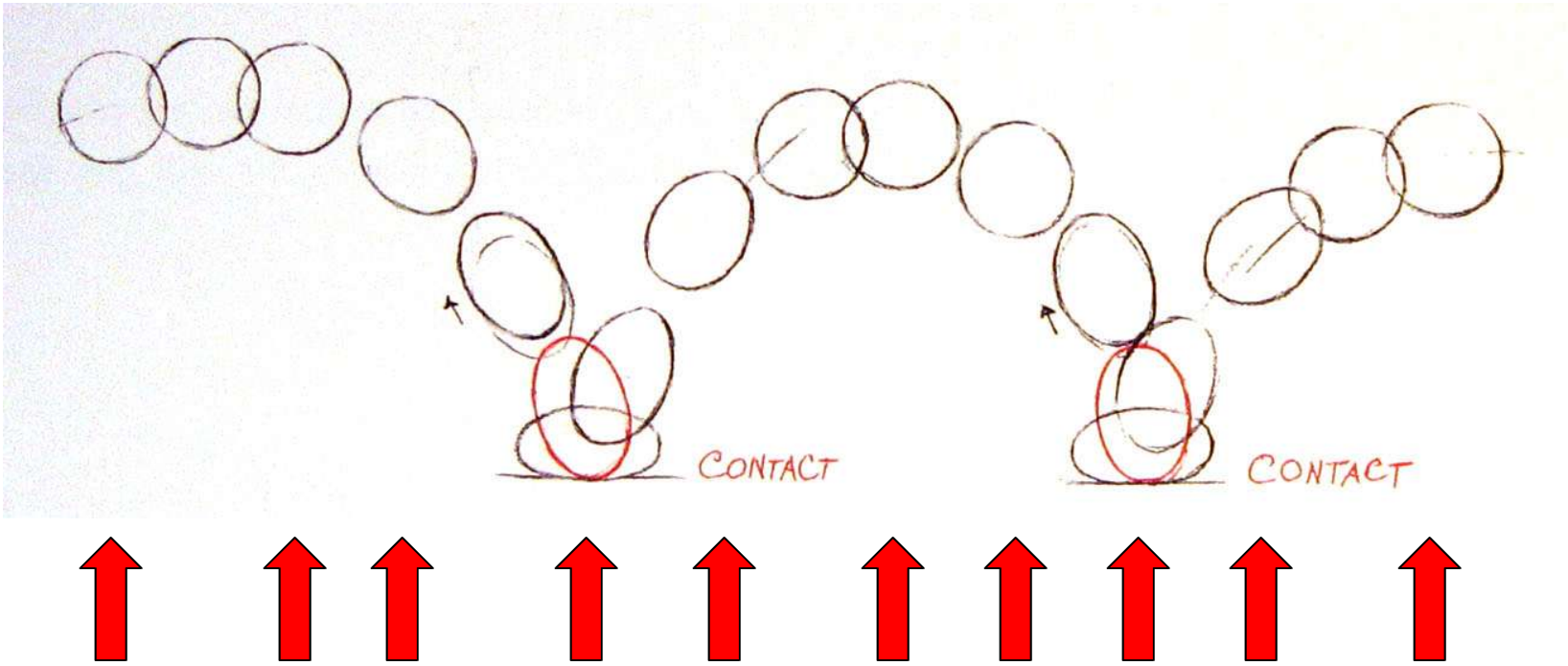
- many of the esthetic animation principles from traditional animation can and often should be applied in computer animation
- Computer animation tools enable just about anybody to make an animation
- Computer animation tools enable just about anybody to make bad animation



Principle of Traditional Animation

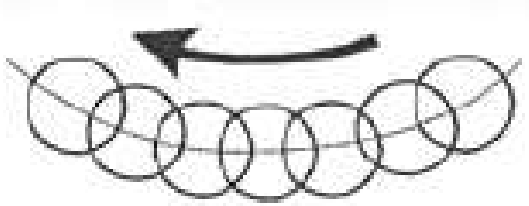
Squash : Flatten an object or character by pressure or by its own power

Stretch : Used to increase the sense of speed and emphasize the squash by contrast

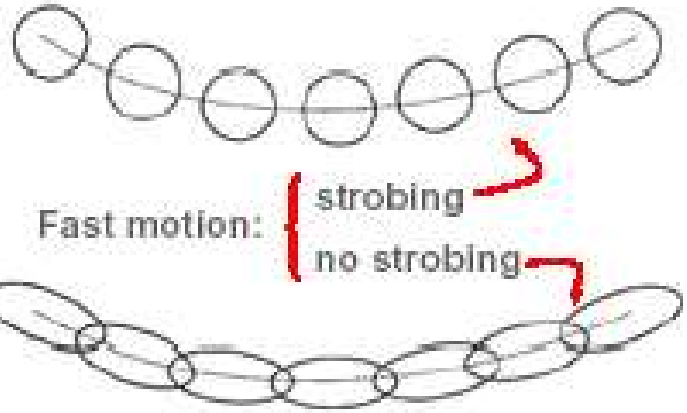


Principle of Traditional Animation

- Squash and stretch helps avoid strobing effects
- (But adding motion blur is better)

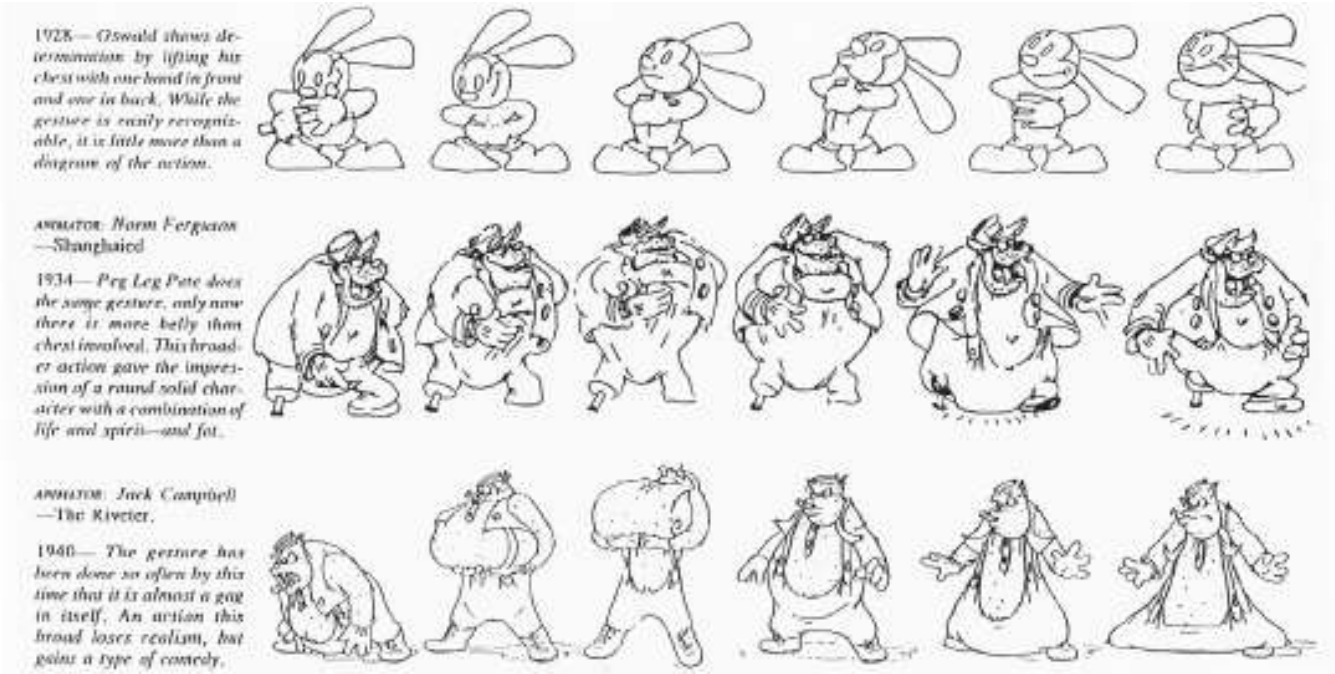


Slow motion: no strobing



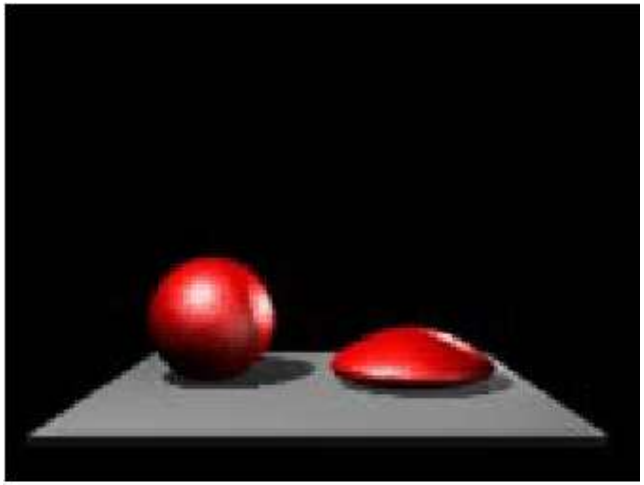
Principle of Traditional Animation

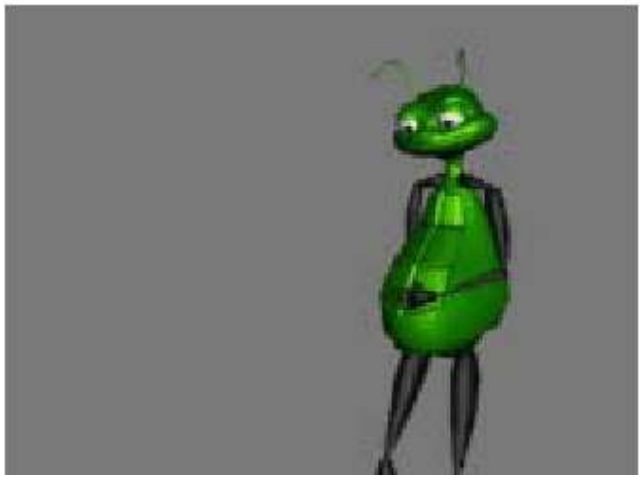
Squash & Stretch



Principle of Traditional Animation

Squash & Stretch

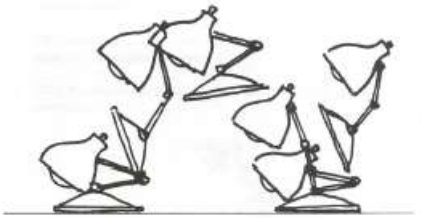




Principle of Traditional Animation

Anticipation (Squash and stretch)

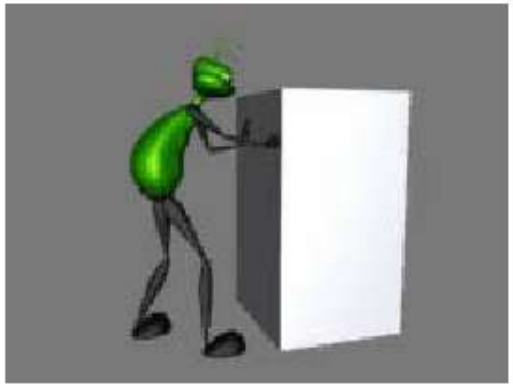
- An action breaks down into:
  - Anticipation
  - Action
  - Reaction
- Anatomical motivation: a muscle must extend before it can contract
- Prepares audience for action so they know what to expect
- Directs audience's attention
- Amount of anticipation can affect perception of speed and weight



Principle of Traditional Animation

Anticipation (Squash and stretch)

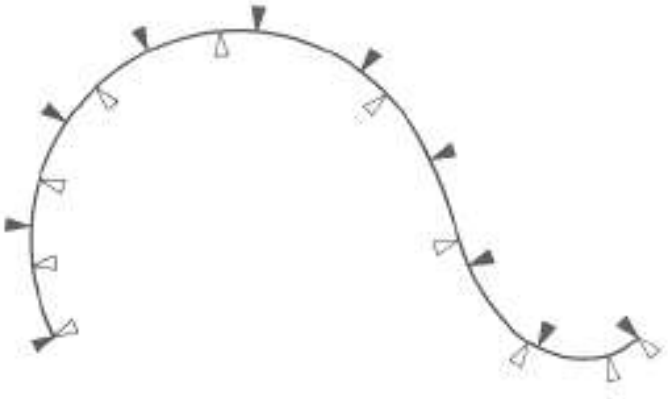
Amount of anticipation (combined with timing) can affect perception of speed or weight.



Principle of Traditional Animation

Slow in and out

- An extreme pose can be emphasized by slowing down as you get to it



Equation :

Space curve X(u), s adalah path yang terukur pada unit busur, maka kita bisa menuliskan $s = A(u)$

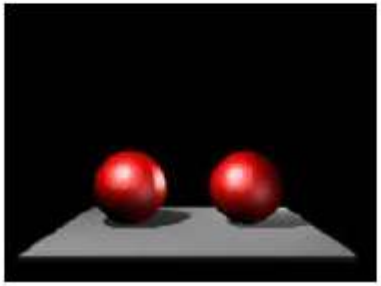
Jika busur adalah sebuah fungsi u. Reparametrize X(u) :

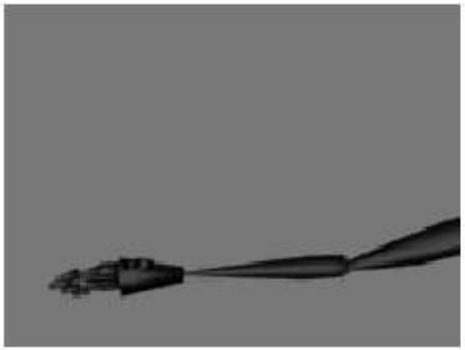
$X(u) \dashrightarrow X(s) = X(A^{-1}(s))$

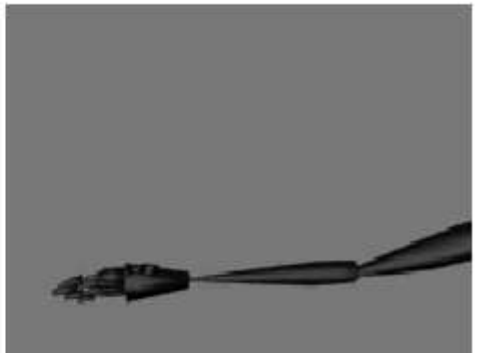
Principle of Traditional Animation

Slow in and out

In practice, many things do not move abruptly but start and stop gradually.



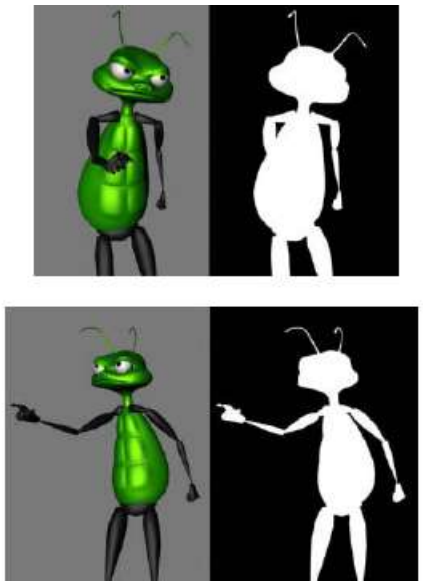




Principle of Traditional Animation

Staging

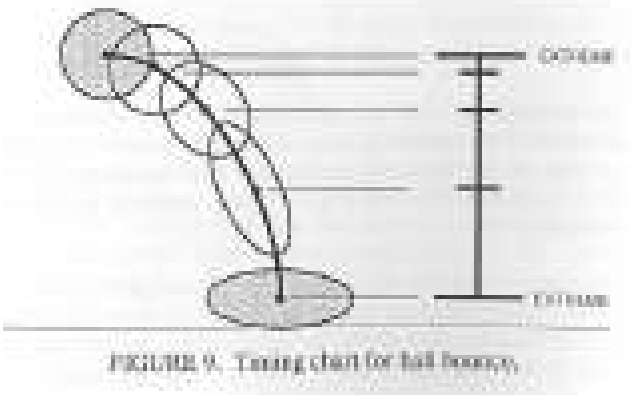
- Present the idea so it is unmistakably clear
- Audience can only see one thing at a time
- Useful guide : stage actions in silhouette
- In dialogue, character faces ¾ towards the camera, not right at each other



Principle of Traditional Animation

Timing

- Timing affects weight :
  - ✓ light object move quickly
  - ✓ heavier objects move more slowly
- timing can completely change the meaning of an action



Principle of Traditional Animation

Overlapping action

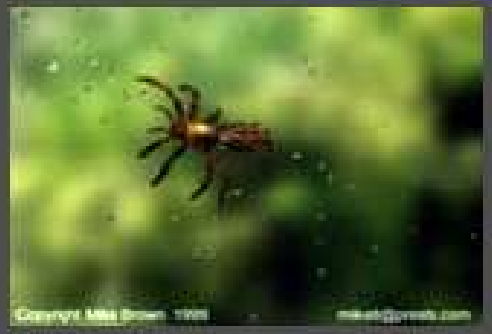
- one part initiates (leads) the move. Others follow in turn
  - ✓ Hip leads legs, but eyes often lead head
  - ✓ loose parts move slower and drag behind
- Overlaps apply to intentions. Example : setling into the house at night
  - ✓ close the door
  - ✓ lock the door
  - ✓ tace off the coat
- each action doesn’t come to a complete finish before the next strats

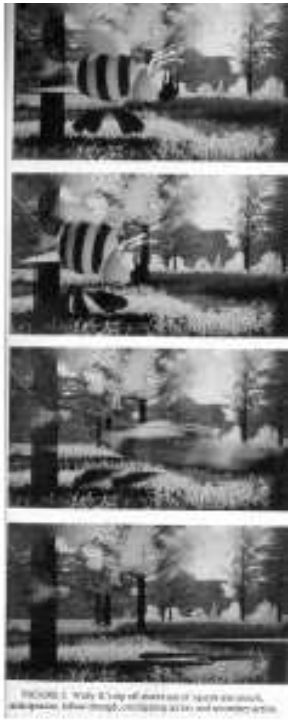
Principle of Traditional Animation

Secondary action

- an action that emphasizes the main point, but is secondary to it

- Actions have consequences.
  These should be part of the animation to enhance a realistic complexity
- Should in general be kept subordinate to the main action, to avoid detracting attention.





Principle of Traditional Animation

Exaggeration

- get to the heart of the idea and emphasize it so the audiance can see it

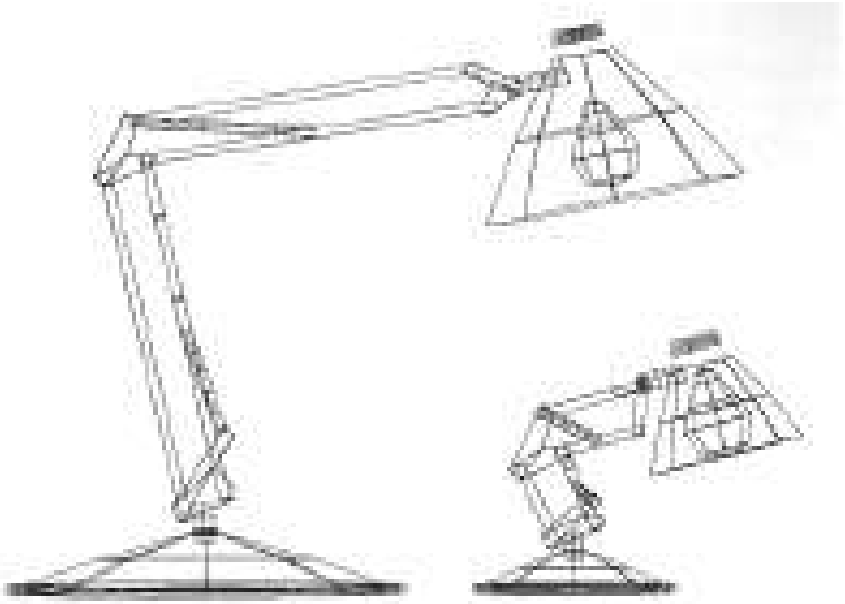
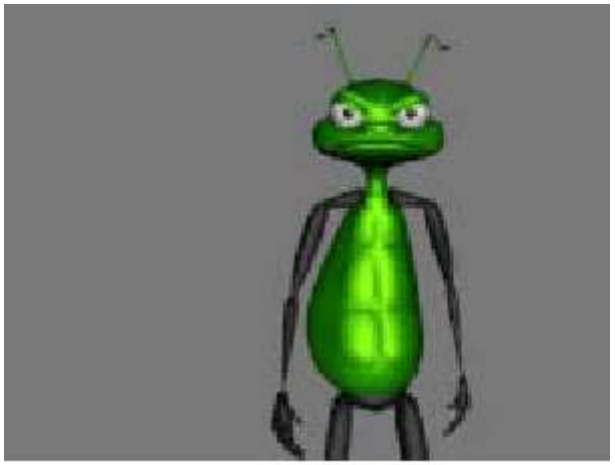


FIGURE 11. Varying the scale of different parts of Dad created the child-like proportions of Luxo Jr.

Principle of Traditional Animation

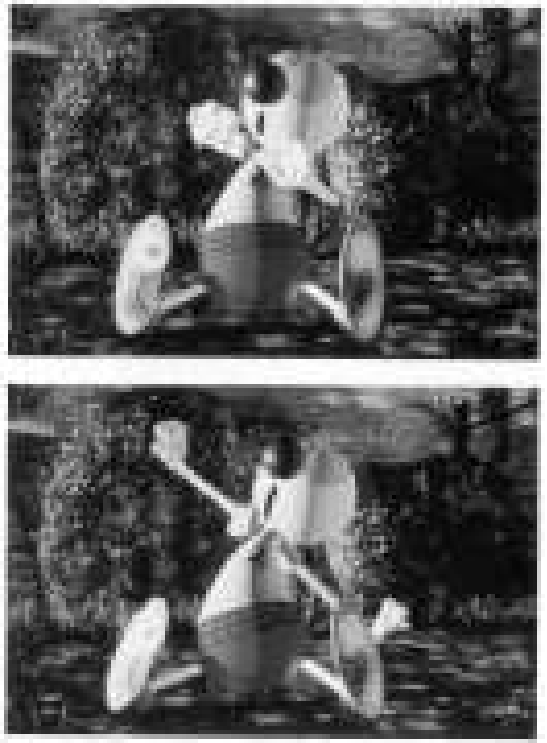
Exaggeration



Principle of Traditional Animation

Appeal

- The character must interest the viewer
- It doesn't have to be cute and cuddly
- Design , simplicity, behavior all affect appeal
- Note : avoid perfect symetries
- example : luxo jr. Is made to childlike



Principle of Traditional Animation

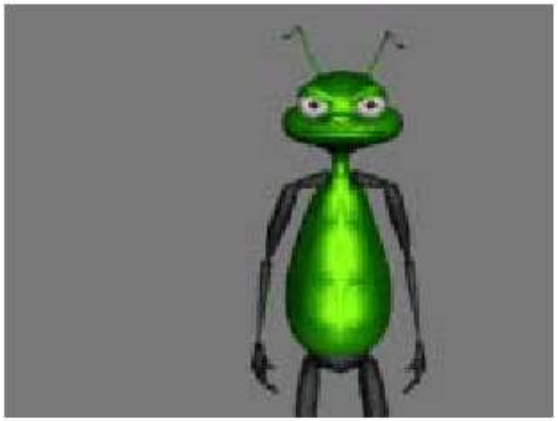
Appeal

Note: avoid perfect symmetries.

Principle of Traditional Animation

Appeal

Note: avoid perfect symmetries.

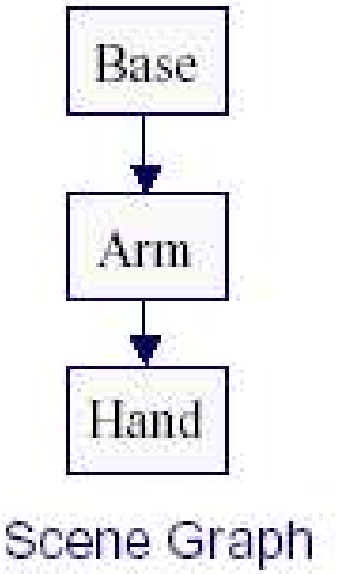


- Animation pipeline
  - 3D modeling
  - Motion specification
  - Motion simulation
  - Shading, lighting, & rendering
  - Postprocessing

Pixar

Articulated figures

Character poses described by set of rigid bodies connected by joints

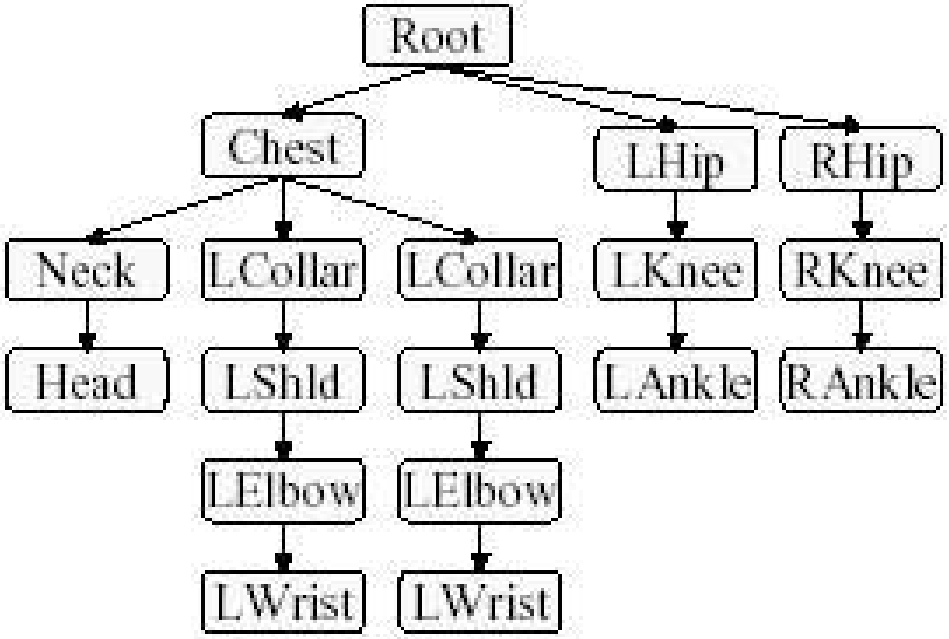


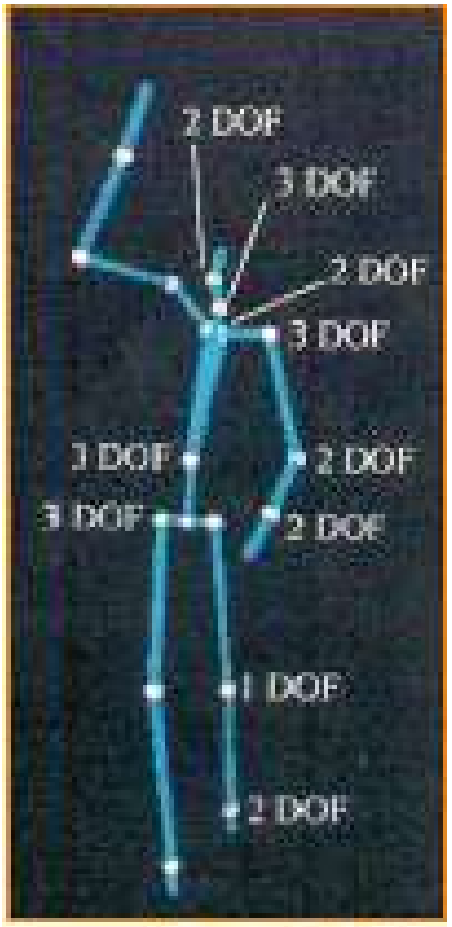
Scene Graph

Angel Figures 8.8 & 8.9

Articulated figures

Well-suited for humanoid characters



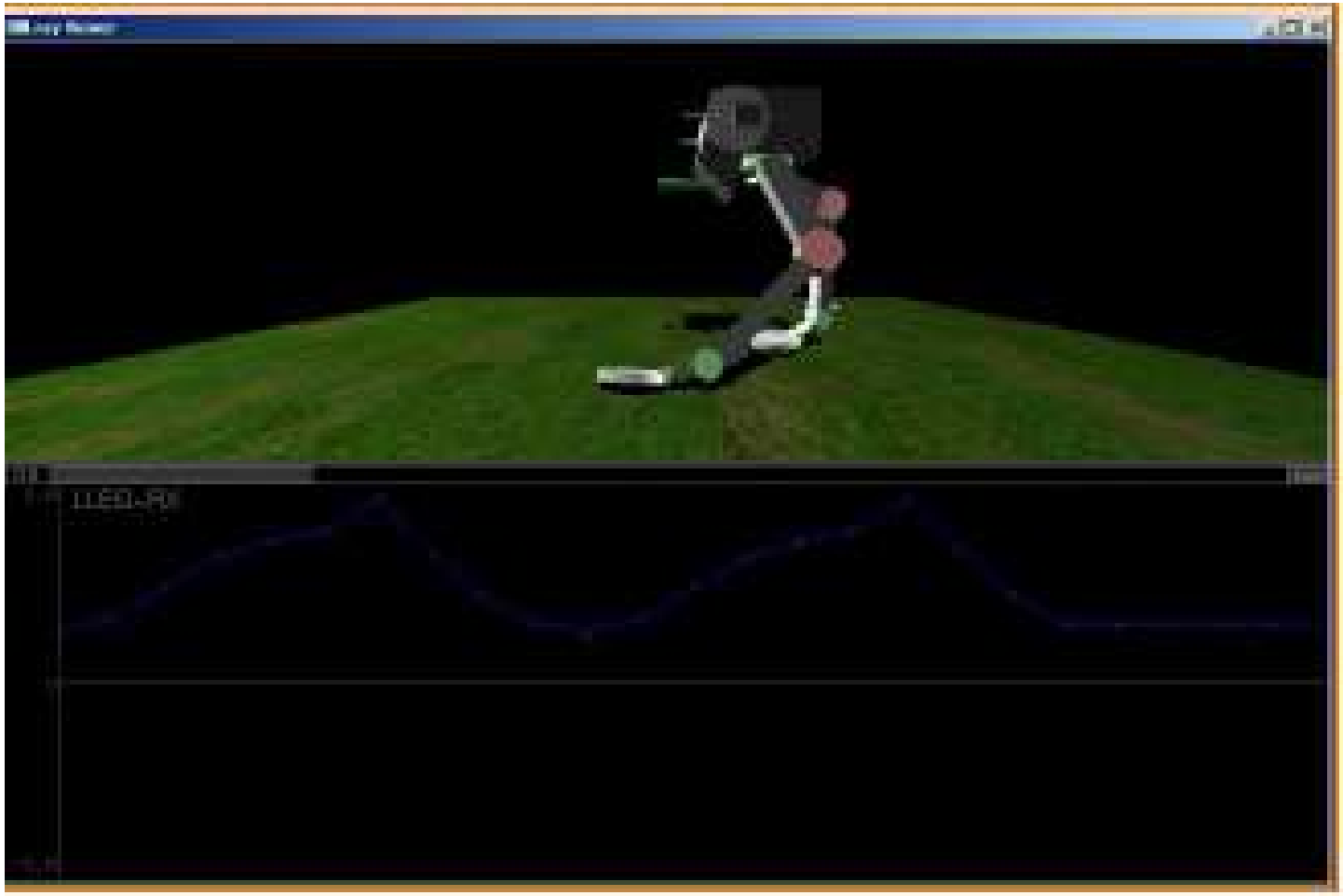


Articulated figures

Joints provide handles for moving articulated figure

Mike Marr, COS 426, Princeton University, 1995

Example : Robot

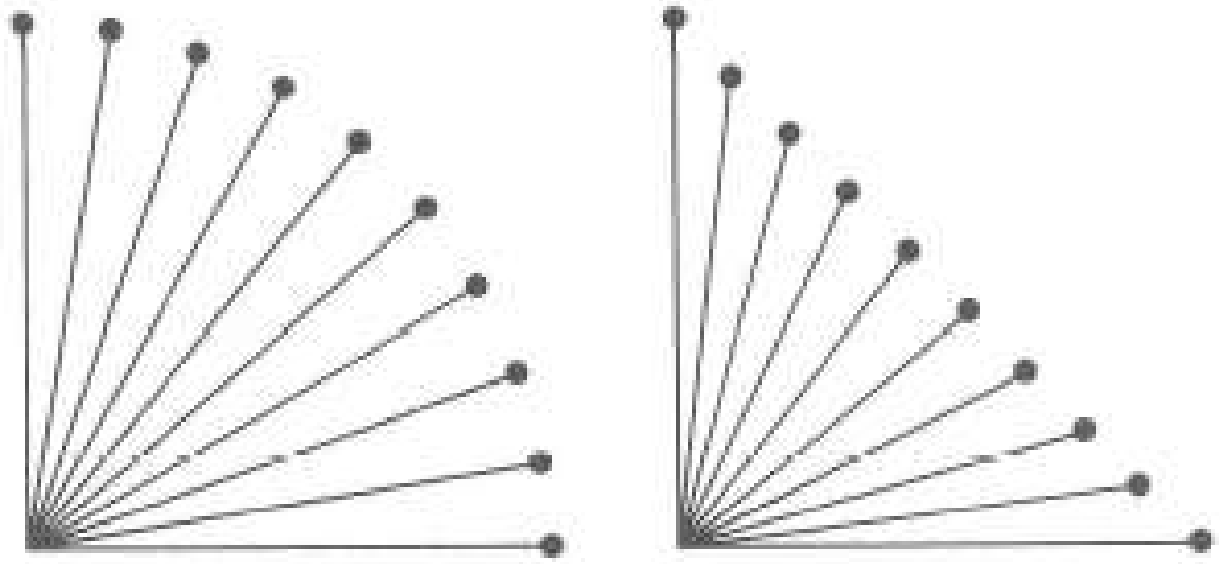


Mihai Parparita, COS 426, Princeton University, 2003

Articulated figures

Inbetweening

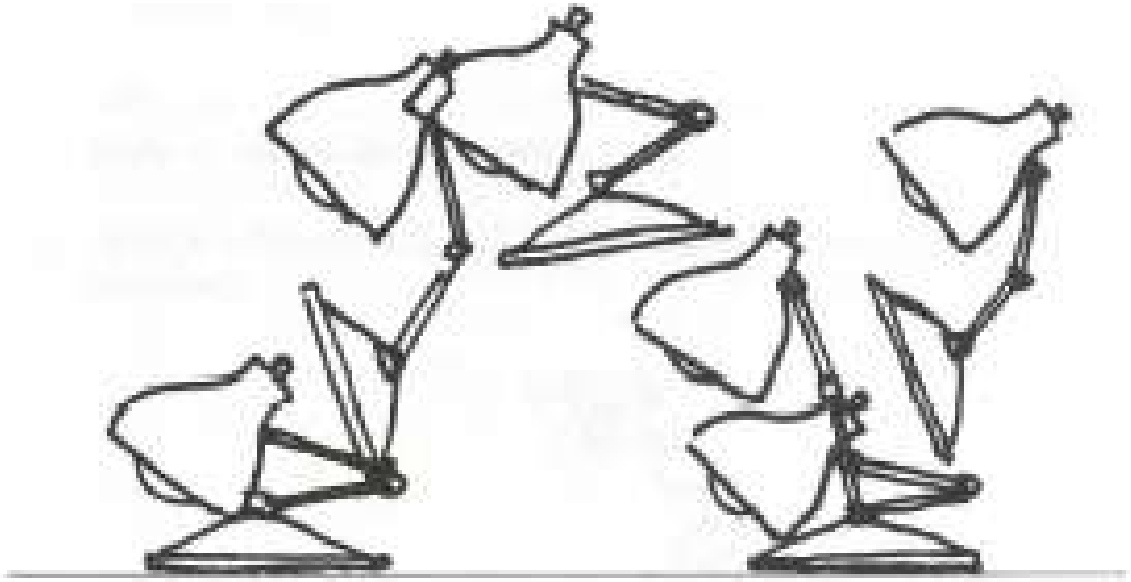
Compute joint angles between keyframes



Watt & Watt

Keyframe Animation

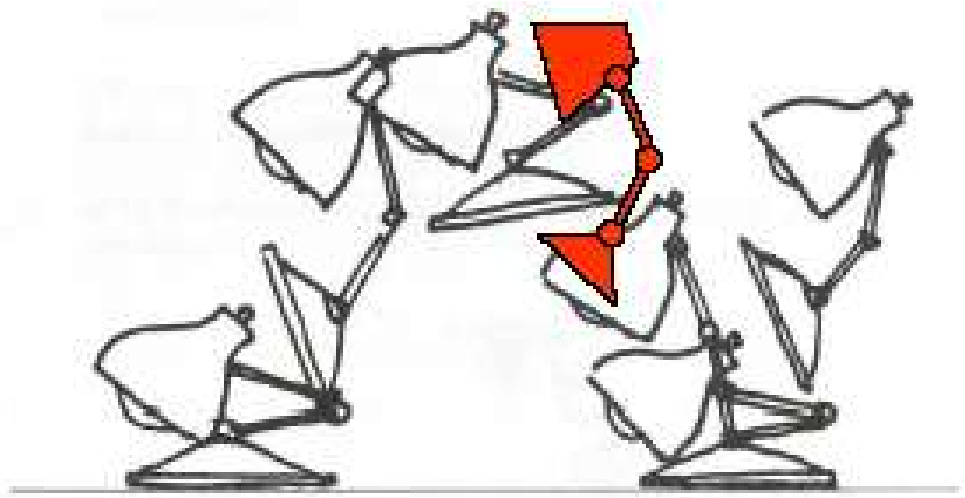
Define character poses at specific time steps called ‘keyframes’



Lasseter '87

Keyframe Animation

Interpolation variables describing keyframes to determine poses for character in between

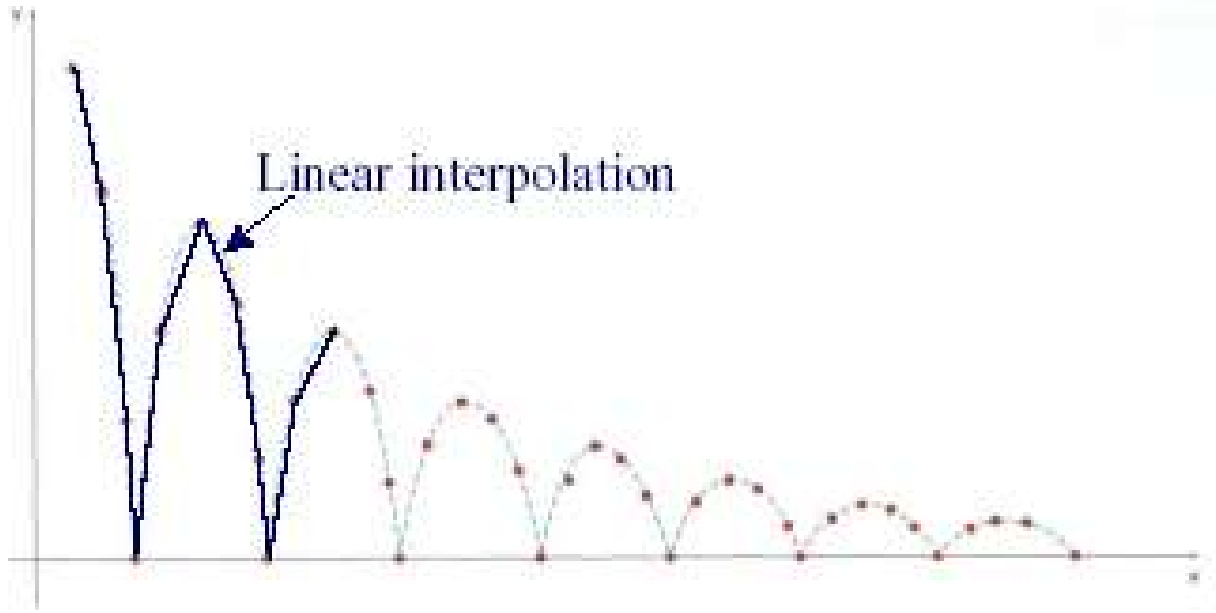


Lasseter `87

Keyframe Animation

Inbetweening :

Linear interpolation – usually not enough continuity

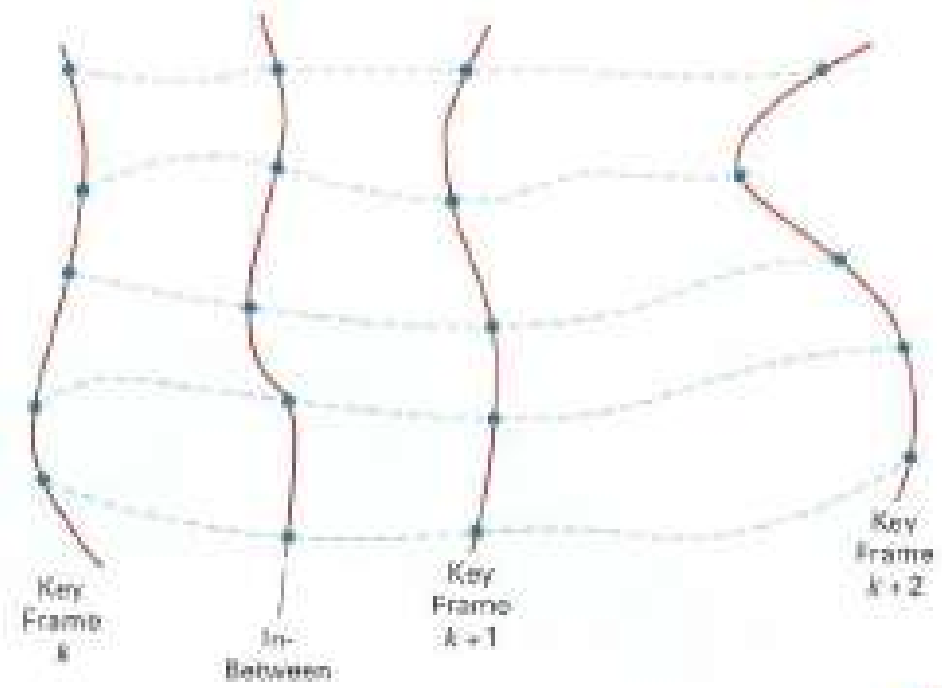


H&B Figure 16.16

Keyframe Animation

Inbetweening :

Spline interpolation – maybe good enough



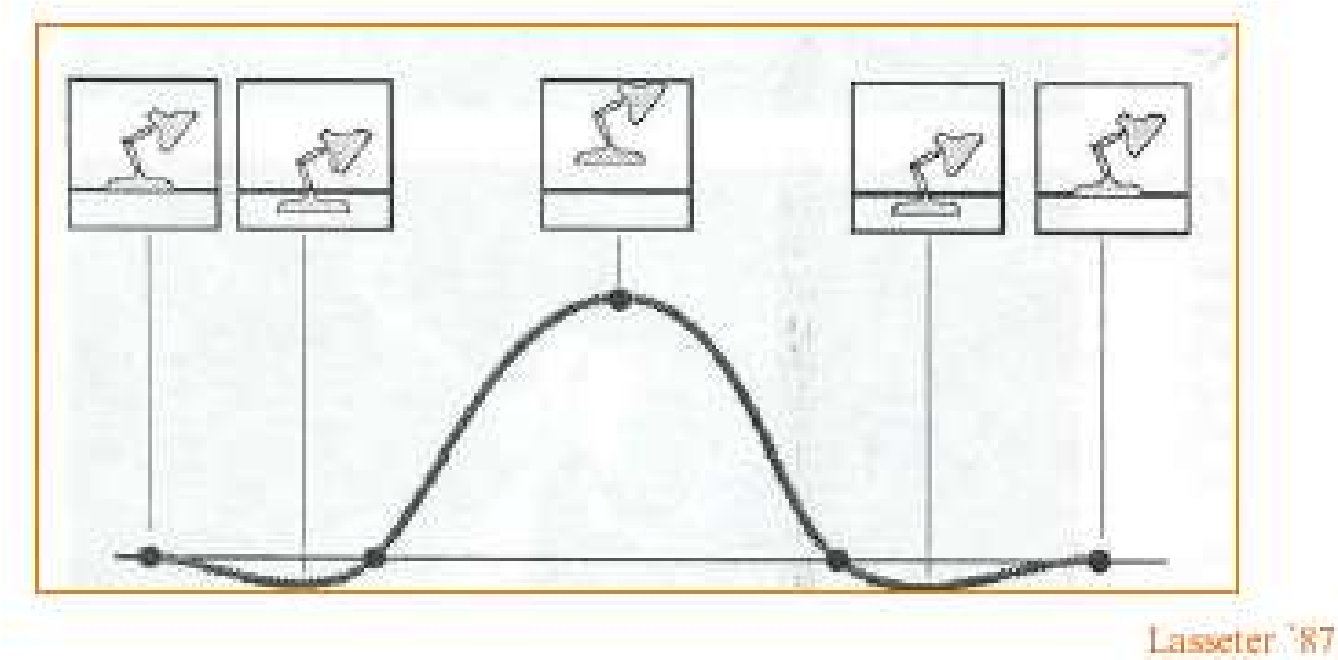
H&B Figure 16.11

Keyframe Animation

Inbetweening :

Cubic spline interpolation – maybe good enough

May not follow physical laws



Keyframe Animation

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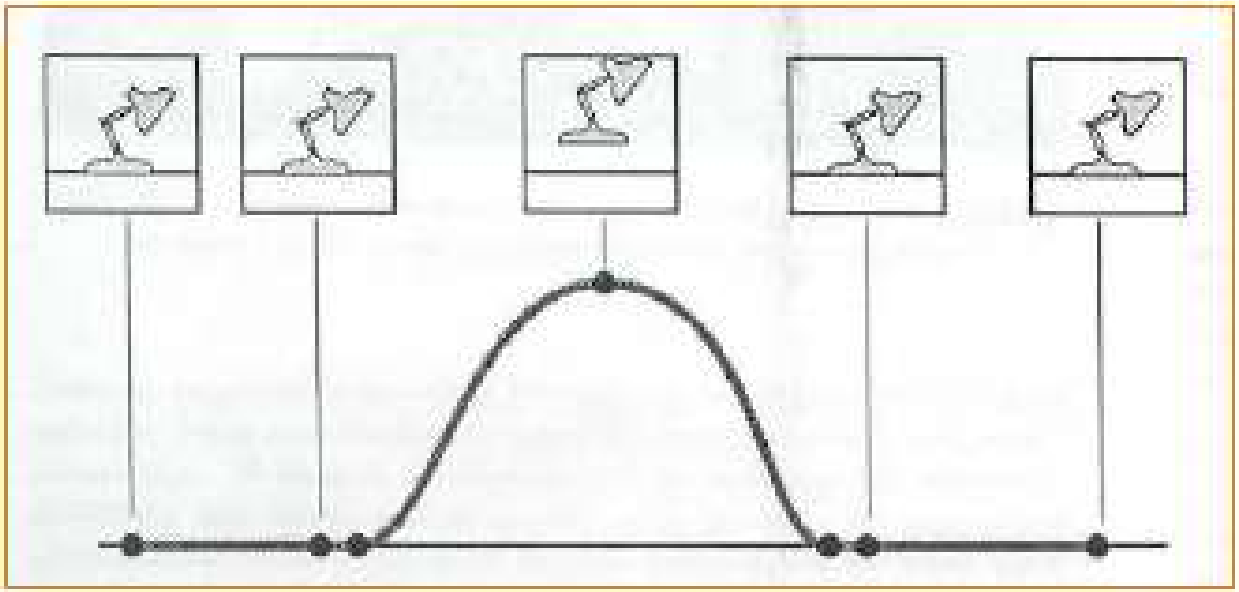
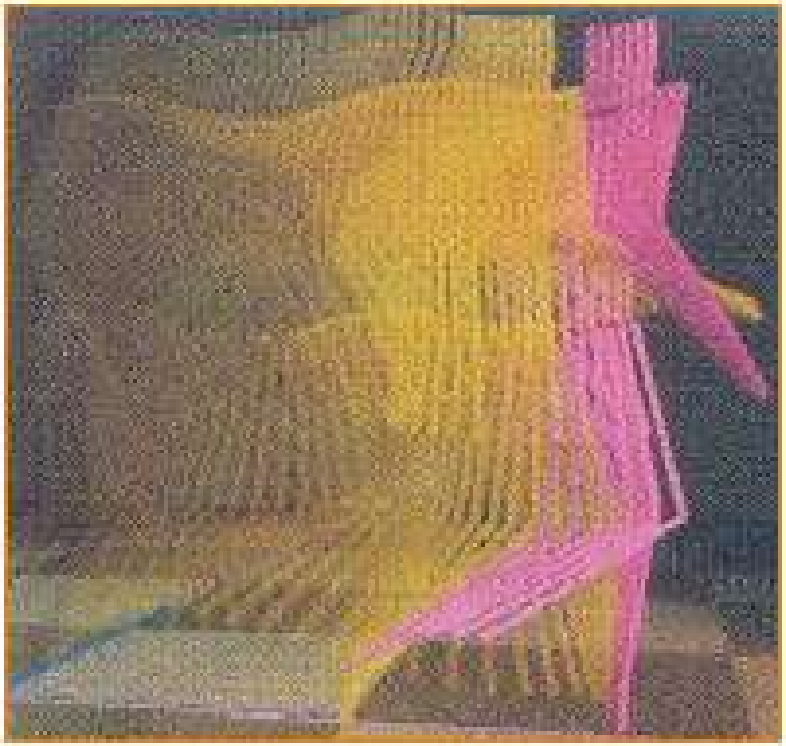


Lasseter '87

Keyframe Animation

Inbetweening :

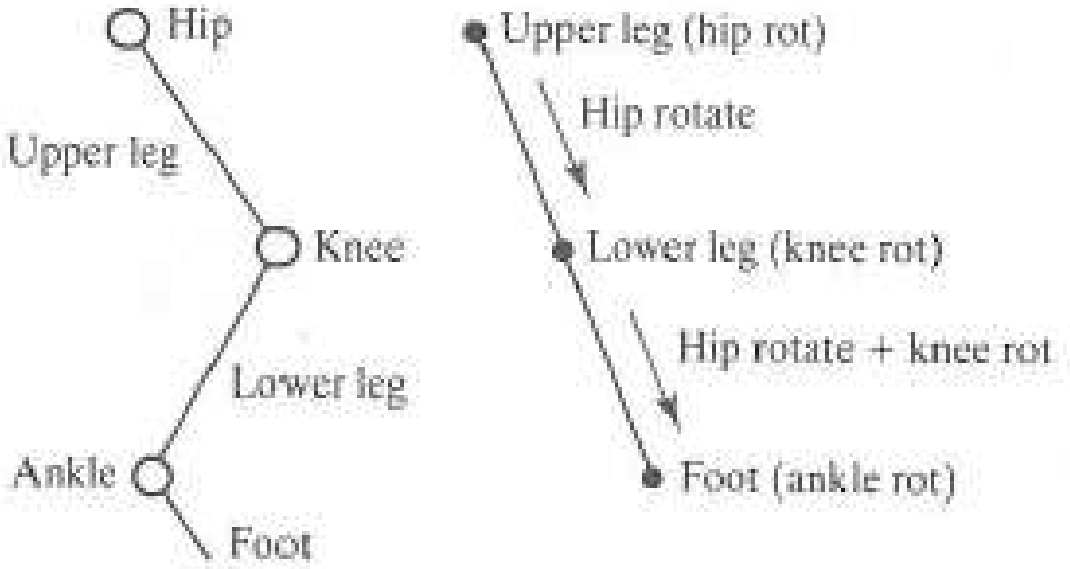
Inverse kinematics or dynamics



Rose et al. '96

Example : walk cycle

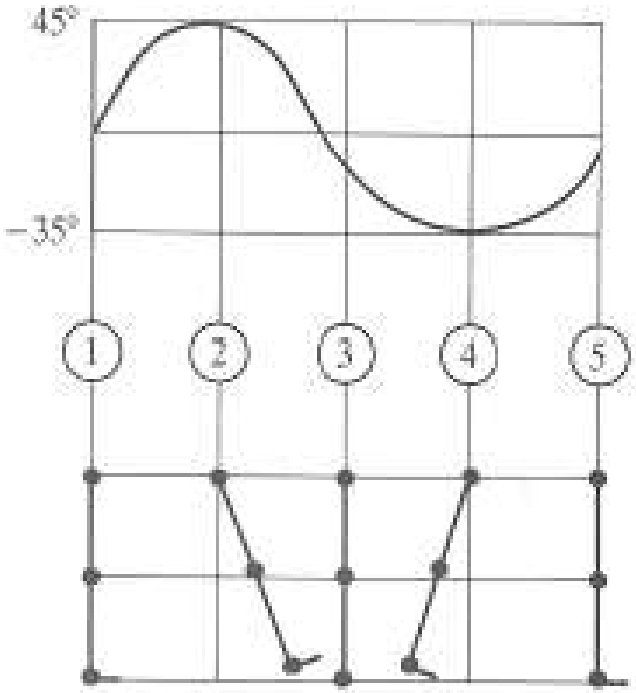
Articulated figure :



Watt & Watt

Example : walk cycle

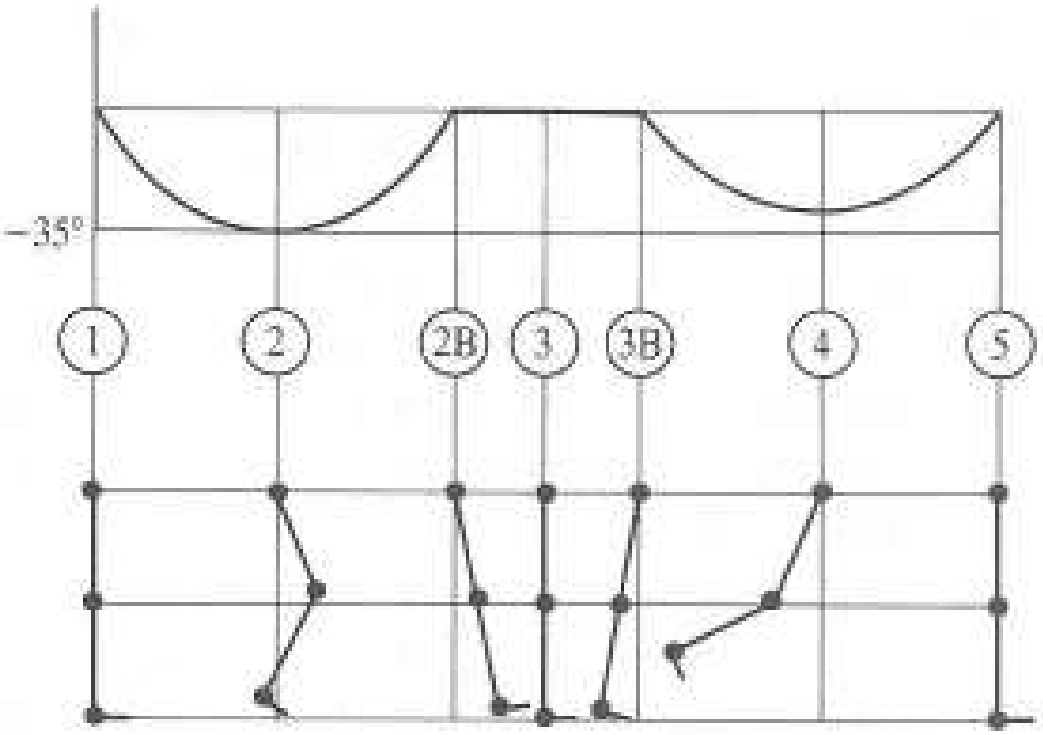
Hip joint orientation :



Watt & Watt

Example : walk cycle

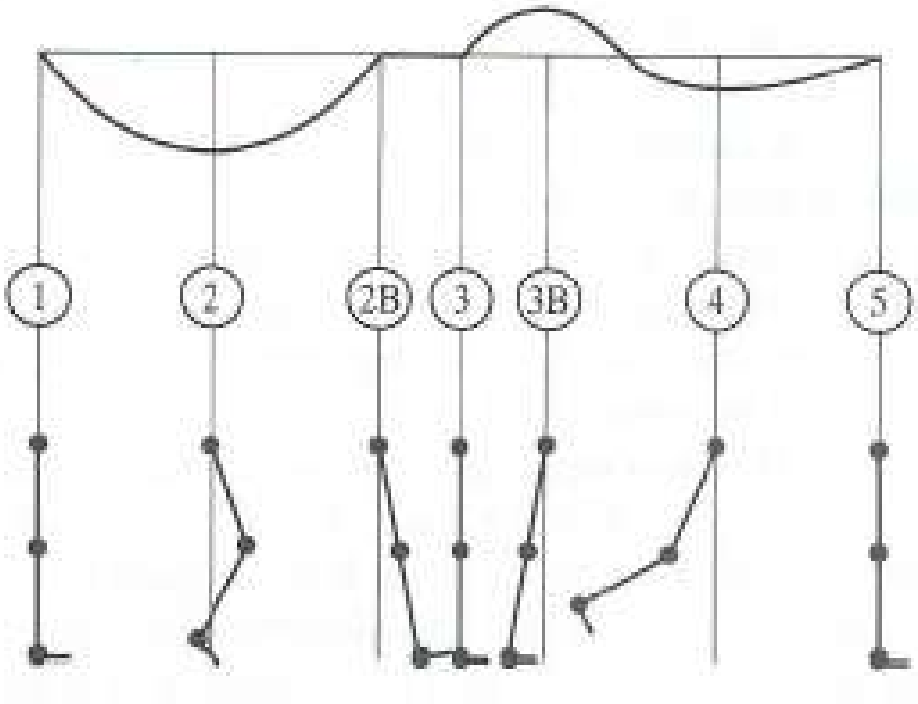
Knee joint orientation :



Watt & Watt

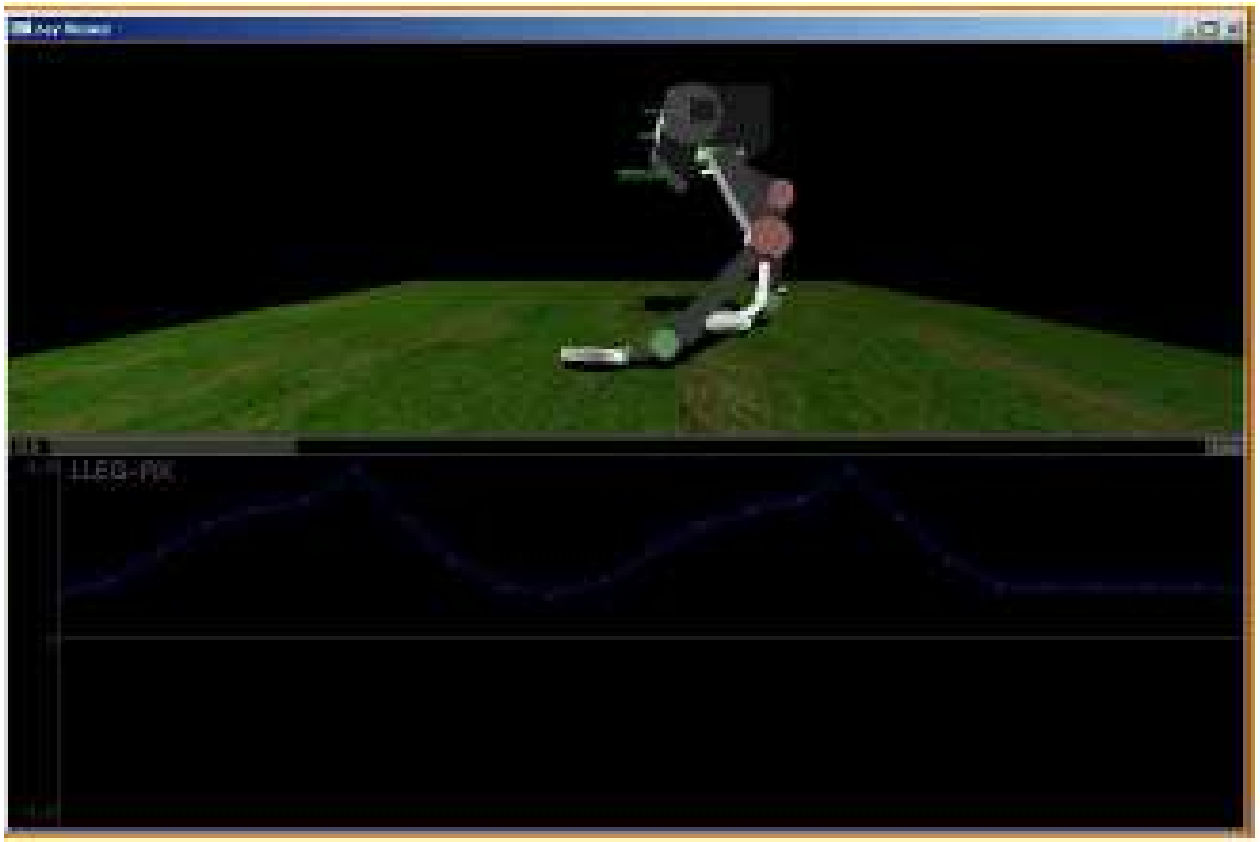
Example : walk cycle

Ankle joint orientation :



Watt & Watt

Example : Robot



Mihai Parparita, COS 426, Princeton University, 2003

Example : Ice Skating

(Mao Chen, Zaijin Guan, Zhiyan Liu, Xiaobu Qie,
CS426, Fall98, Princeton University)

Example : Red’s dream

(Pixar)

Challenges of animation

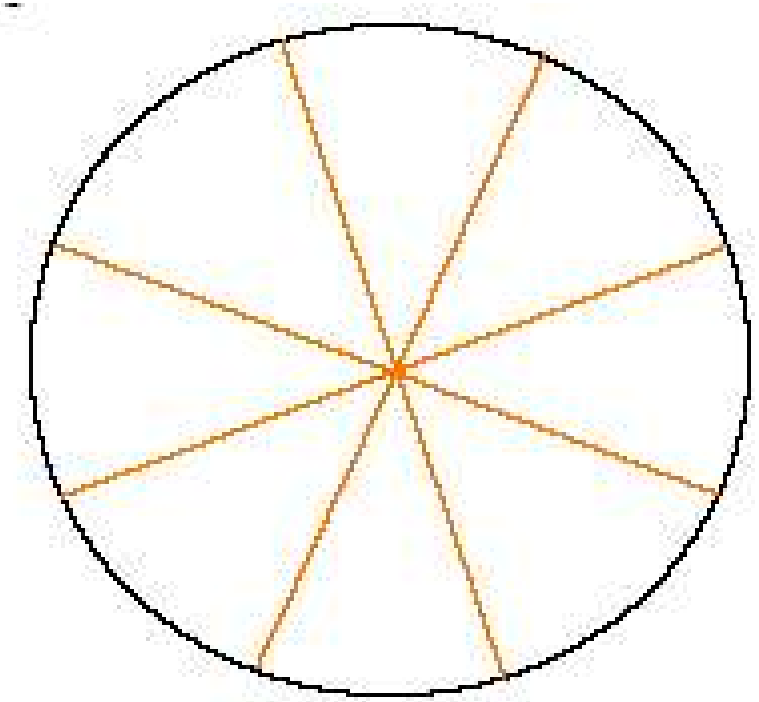
Temporal aliasing

- motion blur

Temporal aliasing

Artifacts due to limited temporal resolution

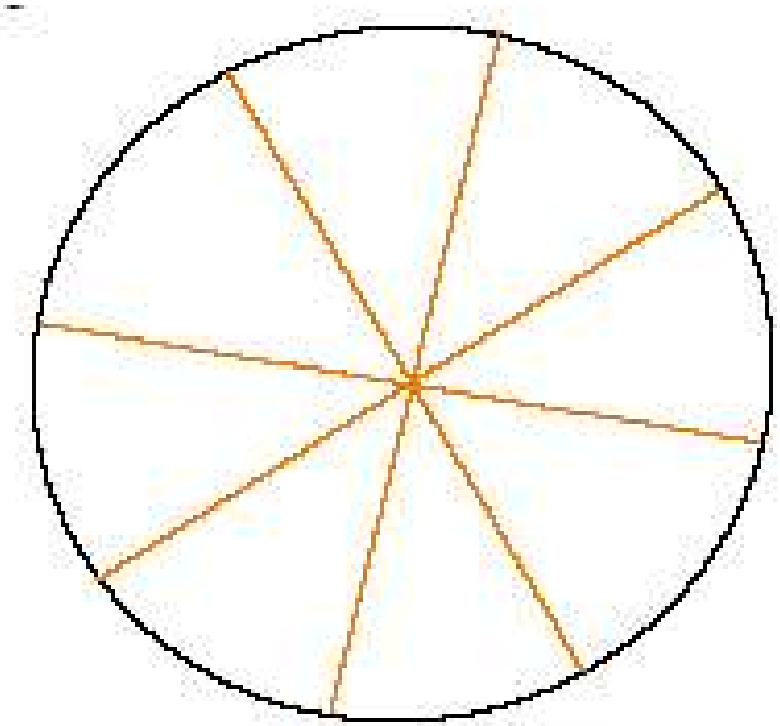
- strobing
- flickering



Temporal aliasing

Artifacts due to limited temporal resolution

- strobing
- flickering



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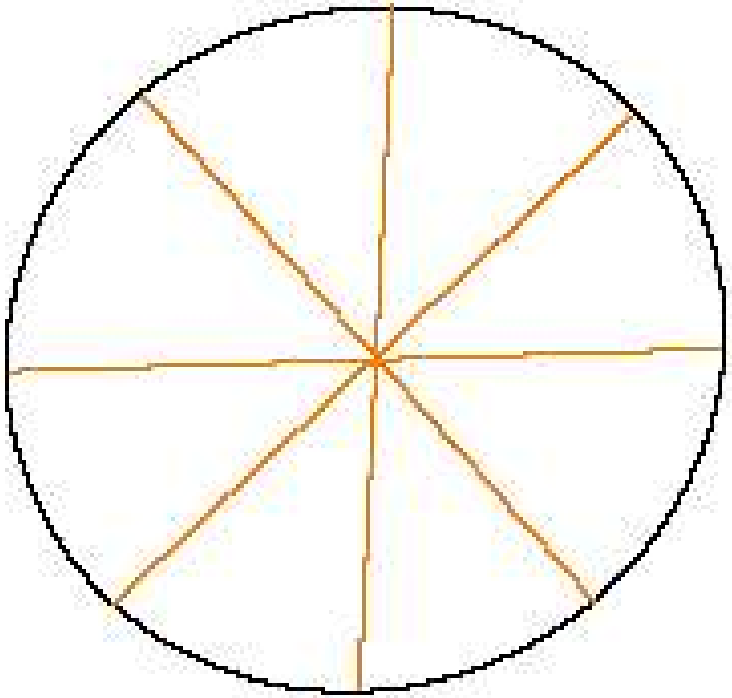

Temporal aliasing

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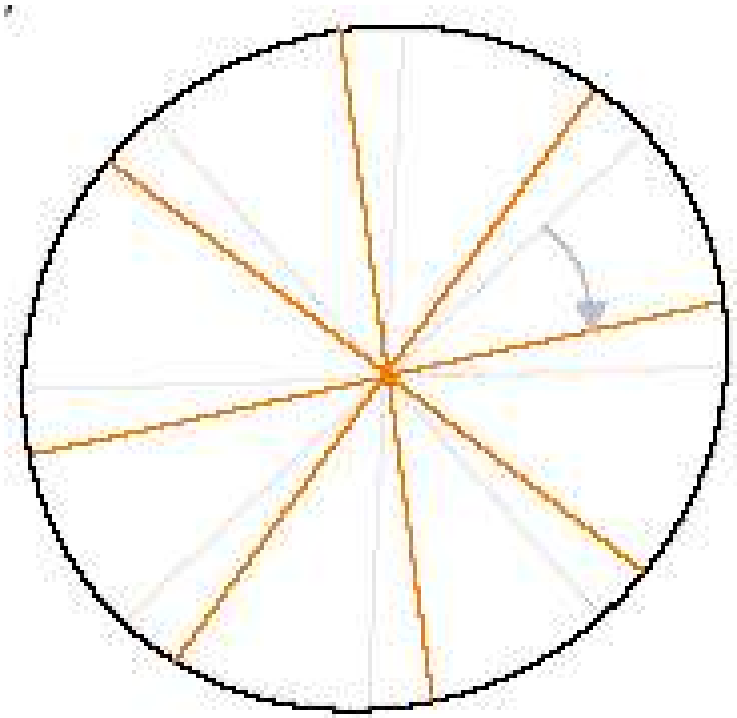
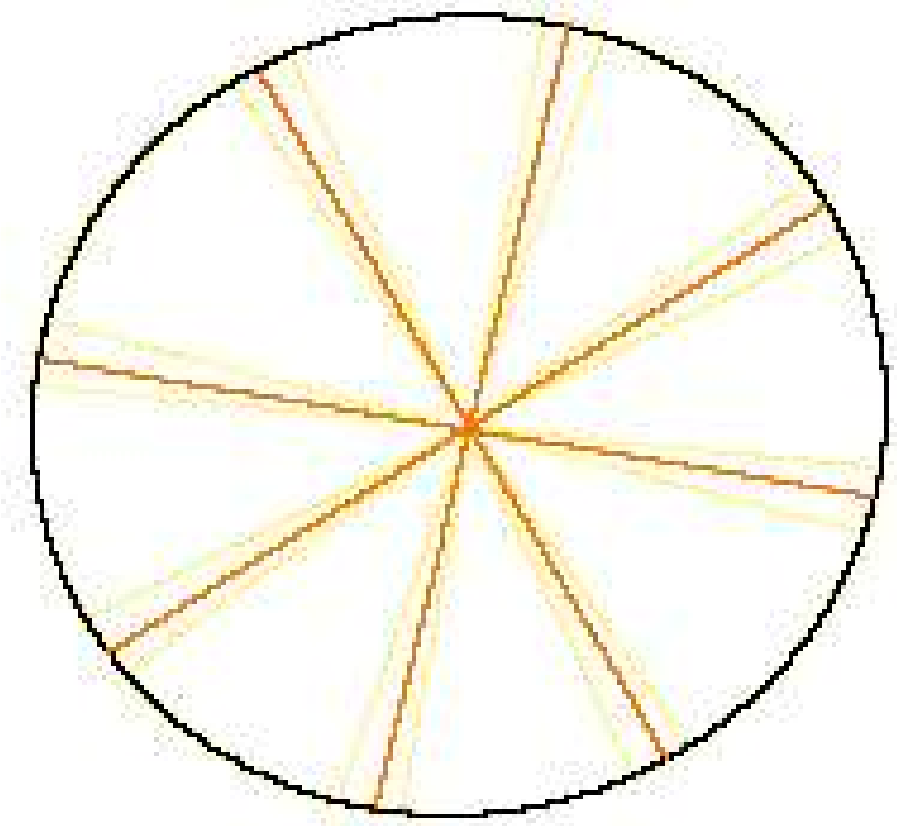


Motion Blur

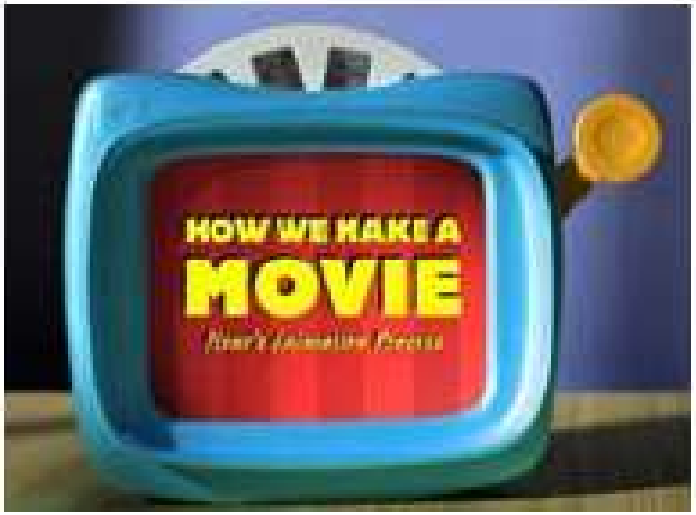
Composite weighted images of adjacent frames

- remove parts of signal under sample in time

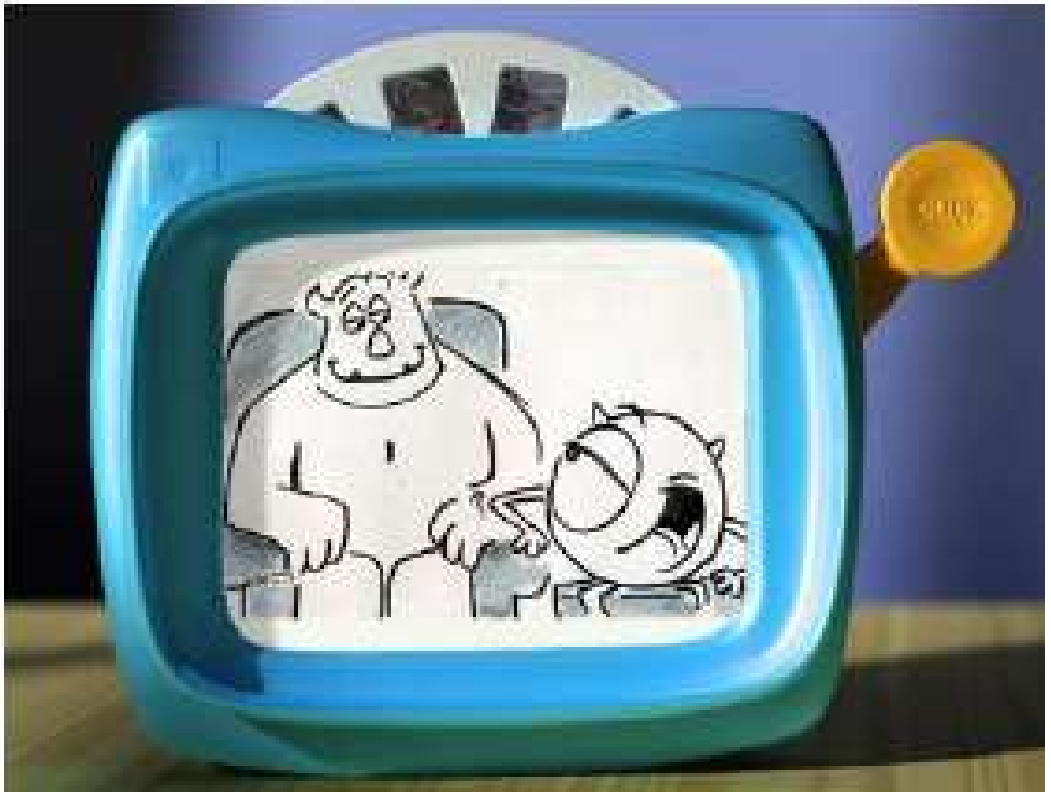


Computer animated movies

- Example: production process at Pixar



1. Write the main story



2. Write the text treatment

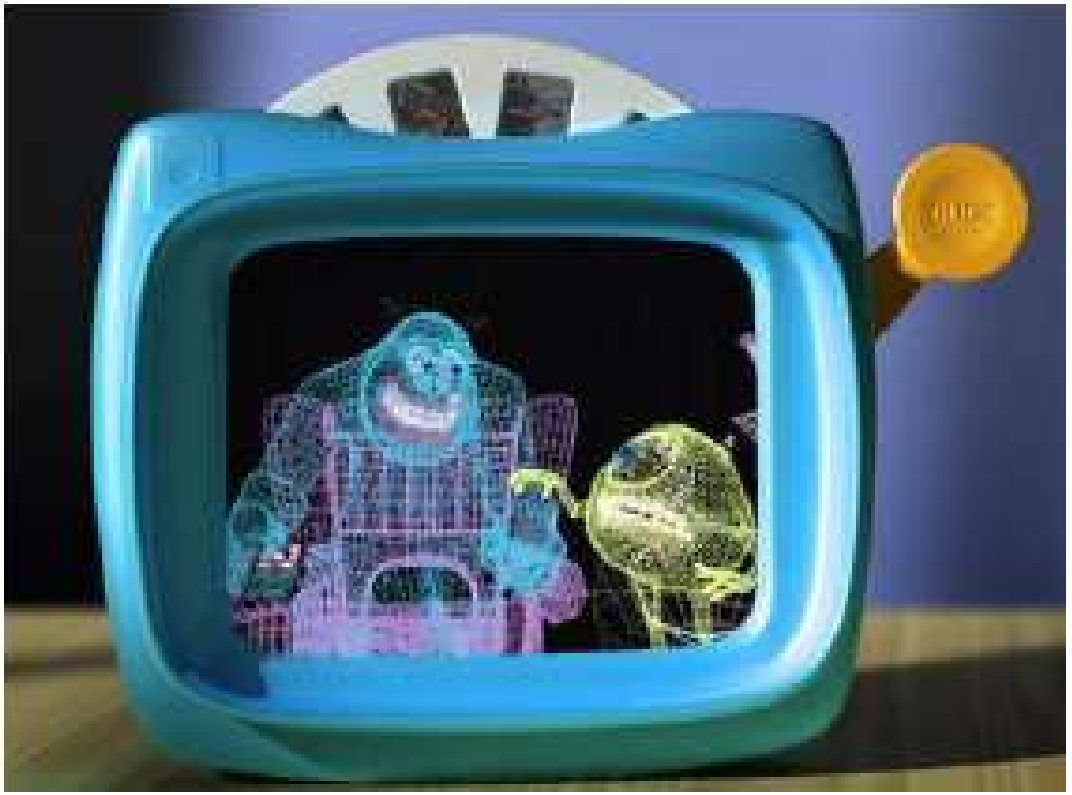
3. Draw the storyboards

4. Record ‘scratch’ voices

5. Make reels

6. Artists create look and feel

7. Models are created and articulated



8. Sets are built and dressed

9. The scenes are laid out

10. Scenes are animated

11. Shading is added

12. Lighting is added

13. Rendering

14. Add music and sound effects

summary

- Animation requires
  - Modeling
  - Scripting
  - Inbetweening
  - Lighting, shading
  - Rendering
  - Image processing

Pixar