Computer Animation 1

Lecture 8

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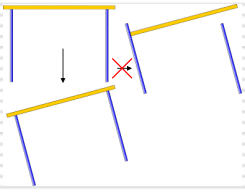
This lecture…

- Hierarchies
  - Hierarchical modelling and animation
  - Forward and Inverse Kinematics
- Graph editor
- Surfaces and Materials
  - Surface characteristics

Hierarchical Modelling

- Parenting
  - Grouping of objects
  - Parent & Children
- Null object
  - Named
  - Very useful
  - Allows independent manipulation of all parented children

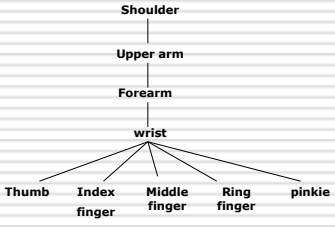


Hierarchy?

- Parents can be children of other parents

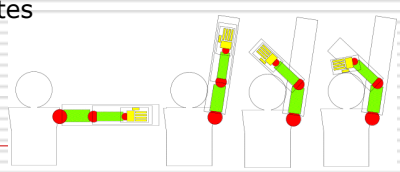
- The parents can have more than one child that is in turn a parent to more than one child that is in turn a parent to more than one…

Hierarchy of the arm



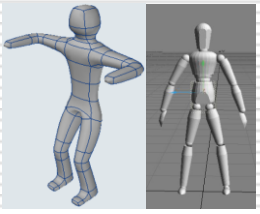
Hierarchical Animation

- Also called 'forward kinematics'
- Each node is positioned individually starting with first parent.
- Positioning is based on local co-ordinates



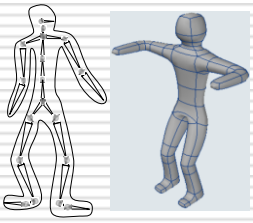
Building Models

- Models can be built from separate objects, or from a continuous mesh
- Models built from separate objects can be animated by directly animating the objects
- Models built from continuous mesh need to use specialist objects called bones

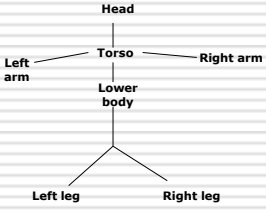


Bones, Joints & Armatures

- Bones are a specialised object used to deform mesh
- They are placed inside a mesh and when they are moved, they deform the mesh around them
  - They're used a lot in character animation

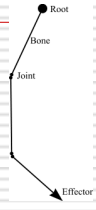


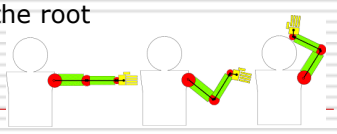
Hierarchy of a body



Inverse Kinematics

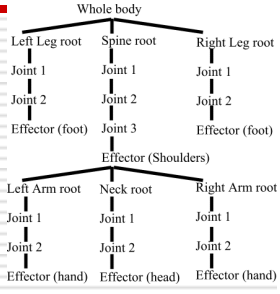
- Bones or independent objects
- Skeletons
- Effector
- Root
- Transformations work from the effector to the root





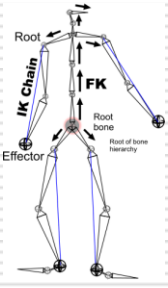
Skeletons

- Made of bones/objects
- Chains of bones/objects can be grouped together into complex structures



Bone Hierarchy for IK

- In Character animation a mix of IK and FK is used to achieve realistic motion
- In the illustration there are a number of different hierarchies for IK and FK all eventually linked to a root bone

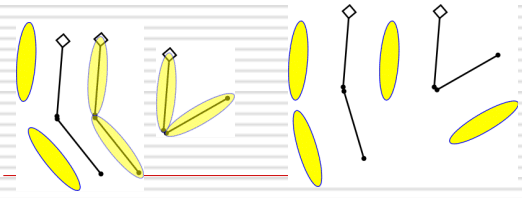


Geometry

- Adding surfaces to the skeleton
- Independent surfaces
- Envelopes

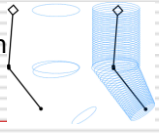
Independent surfaces

- Concatenated with the skeleton



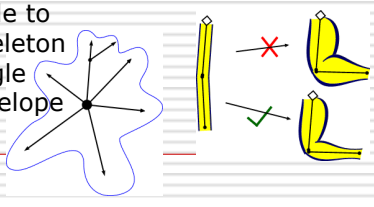
Envelopes

- Simplest involves extruding a circular cross section along the path of a skeleton
- Differs from a normal extrusion - the envelope will deform with movement of the underlying skeleton
- Require bones for animation



Envelope Deformation

- Can lead to undesirable effects at the point of the bend
- Some ability to specify the degree and direction of deformation
- It's possible to wrap a skeleton with a single global envelope

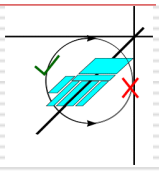


Constraints and Limits

- Some packages limit degree of movement of bones/objects
  - sometimes for mechanical/physiological reasons
  - sometimes for computational reasons

Limits and Constraints

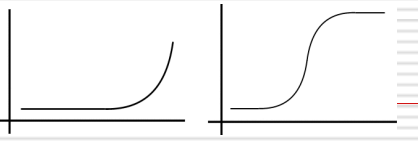
- Limits
  - Rotational limits
  - Positional limits
  - Scale limits
- Constraints
  - Associating transformations with those of a second model
  - Position, Direction, Rotation



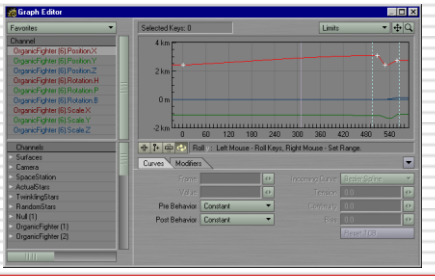
GRAPH EDITOR

Eases

- Gradual changes in starting/finishing acceleration/deceleration
- Ease-in (or slow-in)
- Ease-out (or slow-out)
- Ease-in-out

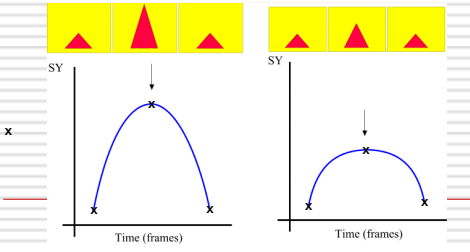


LightWave Graph Editor



Parameter-Curve Editing

- Alters the shape of the spline
- Allows fine control over animation



SURFACES & MATERIALS

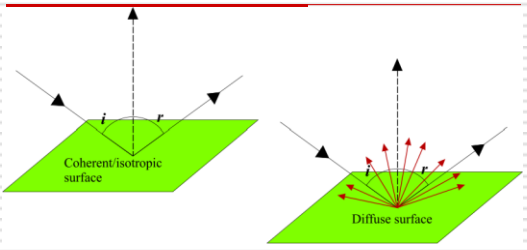
Surfaces

- In 3D
  - Made of polygons or splines
  - Rigorously numerically defined
- In the real world
  - Much more chaotic
  - Made of lots of different materials
  - Limitless characteristics
  - But can be characterised, measured, and simulated

Surface properties

- Diffuse
  - Tendency to reflect light in random directions
- Specular
  - Size and brightness of highlights
- Reflective
  - Coherent reflection of light rays from a polished surface

Diffuse surfaces reflect randomly in many directions

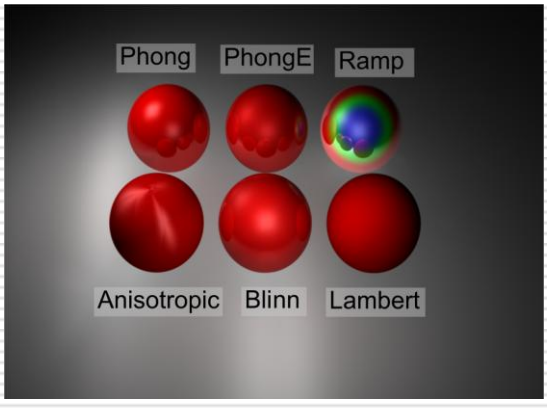


Types of diffuse surface

- Range of different models
  - Lambert
    - Common general purpose diffuse surface
  - Oren Nayar
    - Good for diffuse reflection from rough surfaces. Good for unpolished wood stone etc.
  - Minnaert
    - Good for porous or fibrous materials (astrophysical model developed from lunar observation)

Specular surfaces

- Reflective surfaces with large highlights
- Opposite of diffuseness – more coherent
  - Diffuse qualities usually have to be reduced as reflective qualities are increased
- Fresnel
  - Complex surface where ray reflection is based on the angle that the point of view has in relation to the observed surface (good for non isotropic surfaces)



Importance

- Need good mathematical models of real world light reflection for realistic portrayal in the virtual environment
- Need to understand formation and colouration of specular highlights
- Wide range of different 'Shaders' available for accurate portrayal of real world surfaces and effects on lighting

Today

- Modelling, Texturing, and Animation