Motion Modelling
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Modeling Human Motion
Articulated Motion

• Rigging
  – Attaching a skeleton to a model
  – Skeleton is key-framed to move the model
Articulated Motion

• Rigging
  – Embed the skeleton
  – Attach the bones to the model
Articulated Motion

• Rigging
  – What is a skeleton

Bones

Joints

Hierarchy
Articulated Motion

- Rigging
  - What is stored in a skeleton
    Rigid transformations
    On bones or joints
    Bones can be transformed rigidly
Articulated Motion

• Rigging
  – Bones can be transformed rigidly
Articulated Motion

- Rigging
  - Attach the bones to the model
  - Weights indicate how much a vertex is affected by a bone
Articulated Motion

• Rigging
  – Attach the bones to the model
Articulated Motion

- Rigging
  - Attach the bones to the model

\[ T(x) = \text{avg}(T_1, T_2, w_1, w_2) \]
Articulated Motion

• Rigging
  – How to blend (average) transformations

Linear Blend Skinning

Represent $T_i$ with $T_i$ in homogenous coordinates

$T(x) = w_1(x)T_1 + w_2(x)T_2$

$x' = T(x)x$

$T(x) = \text{avg}(T_1, T_2, w_1, w_2)$
Articulated Motion

• Rigging
  – How to blend (average) transformations
    Linear Blend Skinning
Articulated Motion

• Forward vs. inverse kinematics
Articulated Motion

- Forward vs. inverse kinematics

Diagram:
- Inverse
- Goal
- Move
- Inferred
Articulated Motion

- Controllers
  - Classical controllers e.g. in Autodesk Maya
Motion Capture

- Special suits with markers
- Controlled
  - Lighting
  - Cameras
- Track markers
- Real-time monitoring
Motion Capture

- Motion capture
Motion Estimation

Input depth map

Pose Estimator → Pose Parameters → Pose Deformer → Resampler Rasterizer

Collision & Physical Constraints

Shape
Motion Estimation

Pose Estimator → θ (Pose Parameters) → Pose Deformer → Resampler Rasterizer

Latent Space → Shape

Input: depth map & colour image
Facial Motion

- Face is the most delicate part of a character
- Hard not to fall into the uncanny valley
Facial Motion

• The uncanny valley: don’t fall into it
Facial Motion

- How can we control facial animation
- Blendshapes
  - Provides a linear space of facial expressions
Facial Motion

• How can we control facial animation

Blendshapes

\[ F_1 \quad w_1 \quad F_2 \quad w_2 \quad F_3 \quad w_3 \quad F_4 \quad w_4 \]

\[ \sum_{i} w_i F_i \]
Facial Motion

• How can we control facial animation

Blendshapes
Facial Motion Capture

• Fine scale details
  – Solution: Capture
Facial Motion Capture

• Fine scale details
  – Solution: Capture
  – Use as examples to define shape spaces, e.g. with blendshapes