Character Skinning

- Vertex deformation algorithm (linear blend skinning)
  - old, easy, well-known since 80’s, hardware acceleration
  - but
    - weights hard to choose, can look awful
    - weights typically sum to one, so not all configurations are available

\[ \mathbf{\bar{v}} = \sum_{i=1}^{n} w_i M_i \mathbf{D}_i^{-1} \mathbf{v}_d \]

where \( w_i \) are the influence weights, \( \mathbf{v}_d \) is the dress-pose location of a particular vertex \( \mathbf{v} \), \( M_i \) is the transformation matrix associated with the \( i \)th influence, and \( \mathbf{D}_i^{-1} \) is the inverse of the dress-pose matrix associated with the \( i \)th influence. Taken together, \( \mathbf{D}_i^{-1} \mathbf{v}_d \) represents the location of \( \mathbf{v}_d \) in the local coordinate frame of the \( i \)th influence.

From Mohr, Tokheim, Gleicher, “Direct Manipulation of interactive character skins”
**Figure 6.** At-rest and articulated contours, unweighted

**Figure 7.** Left: weight based on $1/d^2$, where $d$ is distance from $q$ to limb; right: weight based on the convolution of a limb, measured at $q$

Figures from Bloomenthal, “Medial based vertex deformation”
Figure 2: The ‘collapsing elbow’ in action, c.f. Figure 1.

Figure 3: The forearm in the ‘twist’ pose, as in turning a door handle, computed by SSD. As the twist approaches 180° the arm collapses.

Figures from Lewis, Cordner and Fong, *Pose Space Deformation: A Unified Approach to Shape Interpolation and Skeleton-Driven Deformation*
How to choose weights?

- Paint weights, influences on skin in dress pose
  - fiddle, look, fiddle, look
  - this cycle is mysterious, and hated
- Use direct interface to edit skin positions, determine weights
  - Mohr et al
  - Choice of weights typically massively overconstrained
    - M: edit skin at some pose; solve for weights; look at other poses
  - Desired skin point can lie only in convex hull of influence points
    - M: display in interface, project
Regression

• Applications
  • skinning
  • motion scoring

• Ideas
  • linear regression
  • non-linear regression
  • correlation and regularization
  • fitting
  • scattered data interpolation and radial basis functions

• Dimension, and the curse of dimension
  • Principal components
Pushing People Around

Movie by Okan Arikan
Q1: Economics of online games

- People trade artifacts for money
  - Economist estimates this as 100M$ market (?)
  - Questions:
    - how can I, as a player, be confident that expenditure is worthwhile?
      - technology (can this be done for non-networked games?)
      - company, etc.
    - As a game manufacturer, should I support this or not?
      - how can I prevent it?
      - how can I design game so that this is not attractive to players?
Q2: Command hierarchies in networked war games

• Networked strategy/tactics games are common
• But lack command hierarchies
  • and there’s not much specialization
  • why?
  • can this be fixed?
Q3: The girls’ games movement

• Big movement some 6-7 years ago, several books, companies (Purple moon, Mattell)
  • contention: girls need different types of games than boys
  • success --- Barbie fashion designer
  • nice games, but failed --- Rocket, etc.
• disappeared
• Q: did it fail, or was it just incorporated into the mainstream?
• Q: if it failed, what went wrong?
Q4: Animation standards in computer games

- Q: What is the best current human animation in a game?
  - should handle interactions, collisions, contacts
- Q: What matters for the game experience?
- Q: Will the future bring more realism?
  - if so, how does one control the interactions?
Further ideas in skinning

- The skin might be obtained from range data of a person in various configurations
  - procedure:
    - scan
    - hole fill
    - obtain parametric surface model by least squares