Cloth and Hair 2008

A summary of cloth and hair animation papers from SIGGRAPH, SCA, and CASA 2008.

CSE 888 with Dr. Rick Parent presented by Michael Andereck at The Ohio State University
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Categories we'll look at today

- Hair Rendering
- Hair Animation
- Gross Cloth Animation
- Fibrous Cloth Animation
Hair Rendering


Hair Photobooth

- Hair model acquired by photo-scanning method, capturing fiber position and orientation to improve on visual hulls model.
- Detailed geometric model created from scan with hole filling from scalp to surface.
- Rendering can then be performed under arbitrary lighting and camera angles.
- Modeling takes ~10 hours and rendering takes 90-140s on a standard PC.
Efficient Multiple Scattering

- Light scattering is critical to realistic hair rendering, particularly light colored hair.
- Previous models have been too expensive, or have taken poor approximations.
- This model uses a two-pass method similar to photon mapping, storing the spherical harmonics in a 3D grid space, rather than a photon-by-photon method, for more efficiency.
- The second pass uses a ray-tracer, integrating the stored radiance against the fiber's scattering function.
- The result is visually compelling and 10x faster than photon methods.
Dual Scattering Approximation

- Unlike a photon approach, this method relies on aggressive approximations of the Bidirectional Scattering Distribution Function.
- Realistic complex scattering can be achieved at two orders of magnitude faster than unbiased Monte-Carlo path tracing.
- Realistic results can be achieved in real-time on a standard PC.
Hair Animation


Discrete Elastic Rods

- Treat rods based as how it deviates from the standard Bishop frame.
- Nice results include buckling, dynamic bending, coupling between bending and twisting, knot-tying.
- See Ben's presentation for more information.
Mass-Spring Hair

- Goal is to model every of 100,000 hairs rather than a clumping or continuum model.
- Hairs have characteristics of friction, static attraction, etc.
- Mass-spring model for individual hairs allows for realistic individual hair behavior including clumping, and self- and environment-collisions.
- Altitude-spring based model allows for torsion of hair.
- Expensive but realistic results.
Gross Cloth Animation

• “Modeling yucky stains in cloth,” NOTAPAPER 2008.
Yucky Stains
Animating Developable Surfaces Using Nonconforming Elements

- Present a discretization for physics-based animation of developable surfaces.
- Constrained not to deform in plane, but out of plane.
- This non-conforming approach allows zero in-plane deformation to be a hard constraint, but causes discontinuous meshes.
- Add a ghost mesh to get around this.
- Uses a second-order time-integration method which can yield significant speedup.
- Can run on 100x100 mesh at ~10s/frame
Multigrid Fast Cloth Simulation

- They present a multigrid method adequate for solving a heavy linear system in cloth simulation in $O(n)$ time, rather than $O(n^{1.5})$ time.
- Difficult to migrate to cloth problems due to lack of physical meaning in levels.
- Their algorithm ensures conservation of all physical properties across levels.
- Demonstrations across multiple garment types with 4x speedup in computation over preconditioned conjugate gradient method.
Fibrous Cloth Animation

• “Simulating Knitted Cloth at the Yarn Level,” Kaldor et al (Cornell), SIGGRAPH 2008.
• “Shear Buckling and Dynamic Bending in Cloth Simulation,” Zhou et al (Chinese University of Hong Kong), CASA 2008.
Simulating Knitted Cloth

- Knitted fabrics behave differently from woven material.
- This simulation focuses on yarns rather than sheets.
- Yarns simulated as inextensible, but otherwise flexible B-spline tubes.
- Friction among yarns approximated by rigid-body velocity filters.
- Key yarn-yarn interactions mediated by stiff penalties.
- Realistic results with practical off-line simulation rates.
Shear Buckling, Dynamic Bending

- Woven fabrics behave differently than other sheet materials.
- Model shear buckling by simulating the microstructure of weaving.
- Model structural bending based on the thin-shell theory.
- Wrinkles and folds appear and disappear in a more natural way than previous models.
Future Focus

• For the next presentation, I will focus on the fibrous cloth animation papers.