

Deformation Review

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Topics

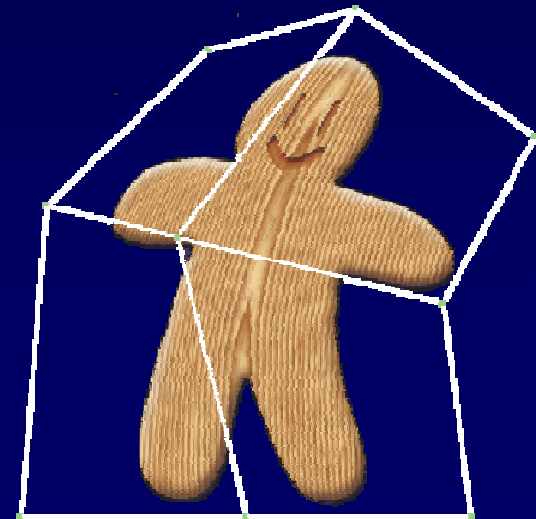
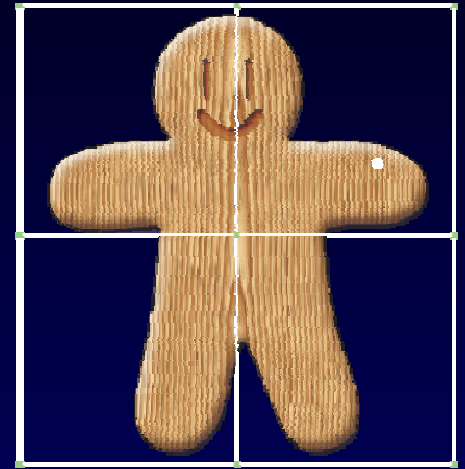
- Volumetric Space deformations
 - ◆ Defined throughout all of space and not specific to the surface being deformed
- Intrinsic Surface deformations
 - ◆ Only defined on the surface being deformed
- Misc. deformation tools

Volumetric Deformation

- Free-Form Deformations
- Mean-value Coordinates
- Vector Field Based Shape Deformation
- Meshless Deformation Based on Shape Matching

Free-Form Deformations

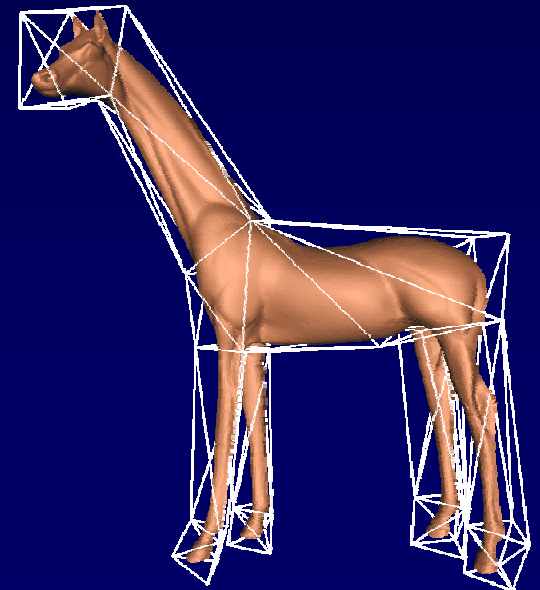
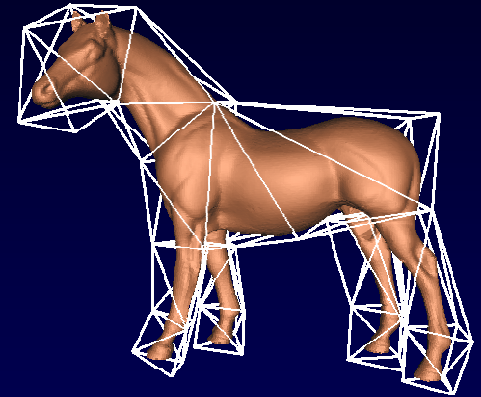
- Smooth, polynomial deformations
- Easy to compute
- Restricted to uniform grids
- Volume preservation is possible, but restrictive



3D Mean Value Coordinates

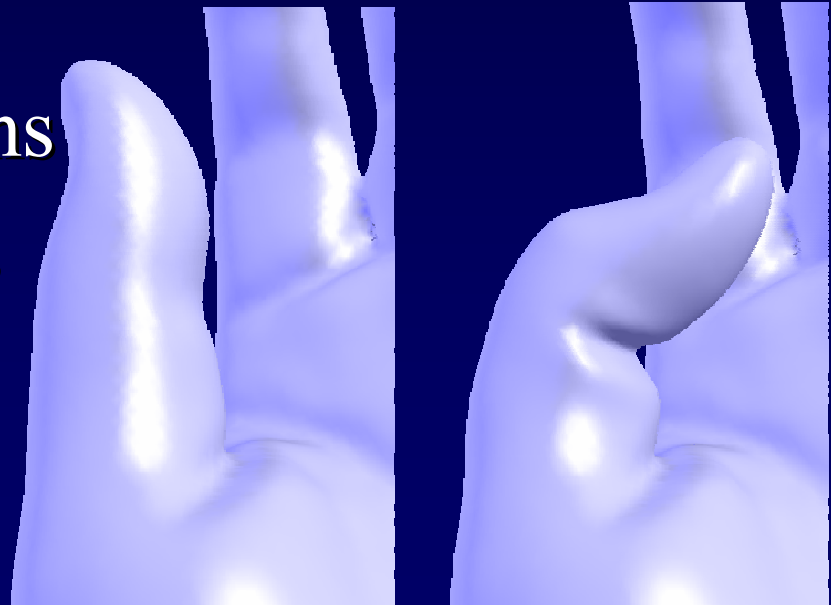
- Use any closed-triangle mesh
- Infinity smooth deformations
- Easy to compute

- Doesn't preserve volume,
stop self-intersections,
etc...



Vector Field Based Shape Deformation

- Preserves volume!
- No self-intersections!
- Not easy to control
- Questionable deformations
in extreme circumstances



Meshless Deformation Based on Shape Matching

- Used for physical simulation
- Finds a transformation fit to a set of points
- Fast (just point simulation)

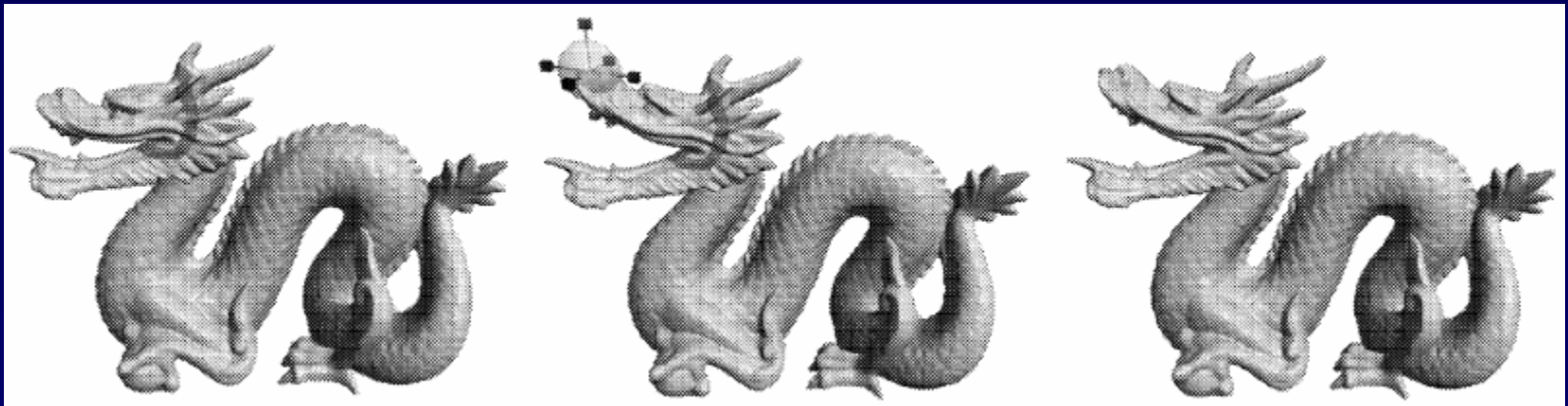


Intrinsic Surface Deformation

- Laplacian Framework for Interactive Mesh Editing
- Large Mesh Deformation using the Volumetric Graph Laplacian
- Mesh Editing with Poisson-Based Gradient Field Manipulation
- Harmonic Guidance for Surface Deformation
- An Intuitive Framework for Real-Time Freeform Modeling
- A Fast Multigrid Algorithm for Mesh Deformation
- Subspace Gradient Domain Mesh Deformation
- PriMo: Coupled Prisms for Intuitive Surface Modeling

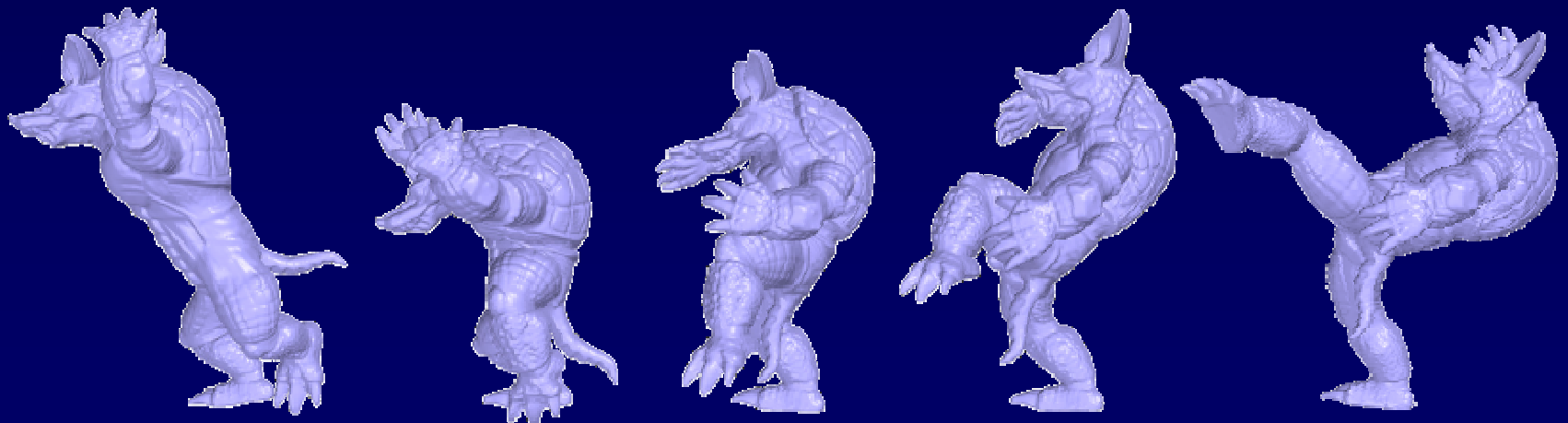
Laplacian Framework for Interactive Mesh Editing

- Made popular these intrinsic deformations
- Not rotationally invariant
- Requires large, sparse matrix solution



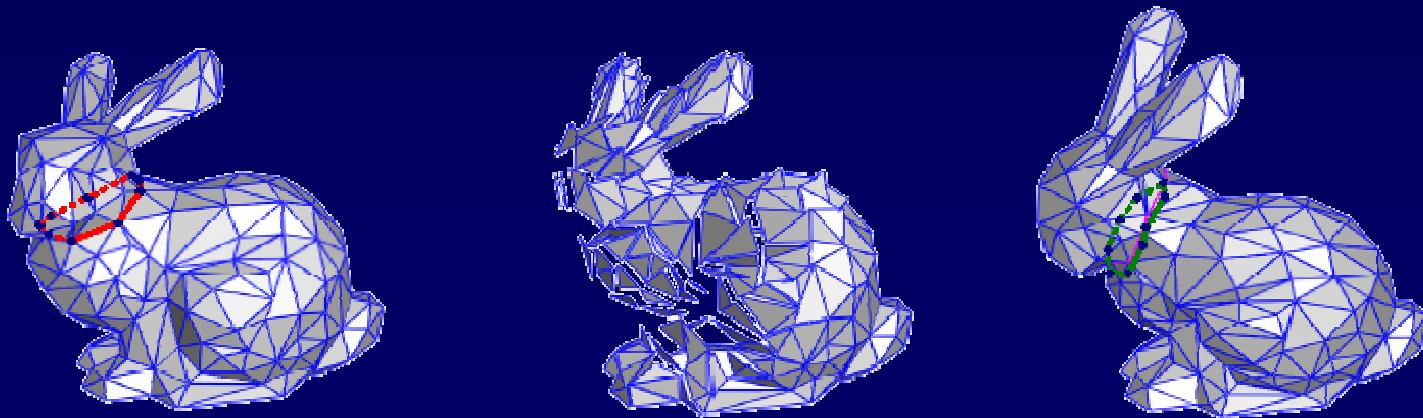
Large Mesh Deformation using the Volumetric Graph Laplacian

- Similar to Laplacian deformation
- Preserves volume (sort of)
- Must build offset mesh and volumetric graph



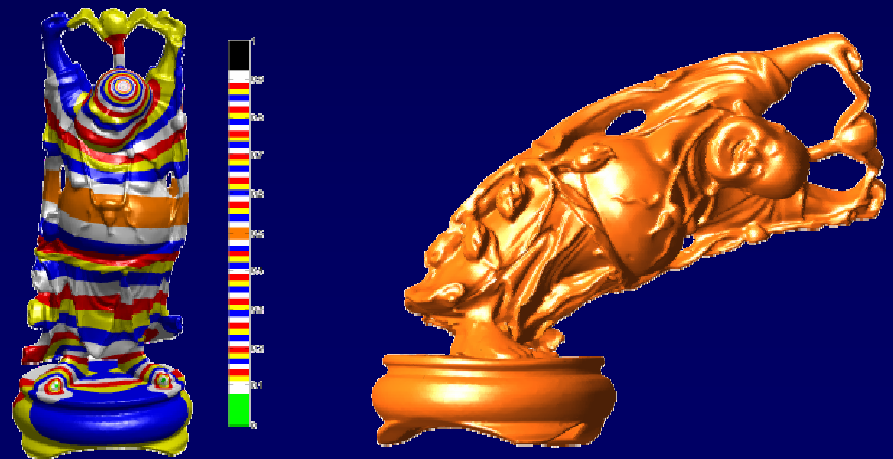
Mesh Editing with Poisson-Based Gradient Field Manipulation

- Rotationally invariant
- Introduced transformation propagation
- Transformation interpolation not optimal



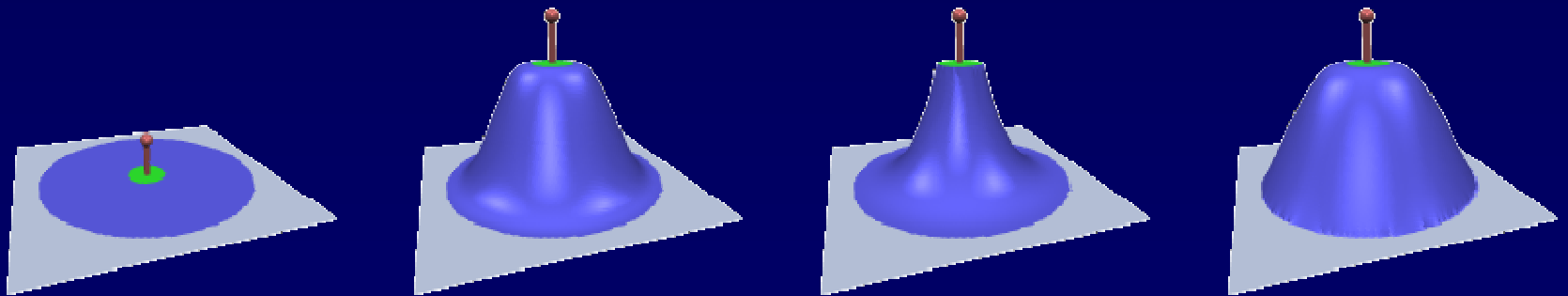
Harmonic Guidance for Surface Deformation

- Used discrete Laplacian for transformation interpolation
- Laplacian also used for surface correspondence in deformation transfer



An Intuitive Framework for Real-Time Freeform Modeling

- General method for constructing Laplacian (and higher order) basis functions
- Controllable smoothness
- Rotations problematic



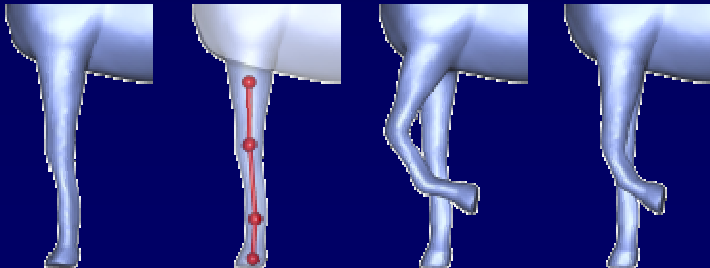
A Fast Multigrid Algorithm for Mesh Deformation

- Multi-grid method to solve for deformation
- Fast, stable computation
- Can operate on massive meshes



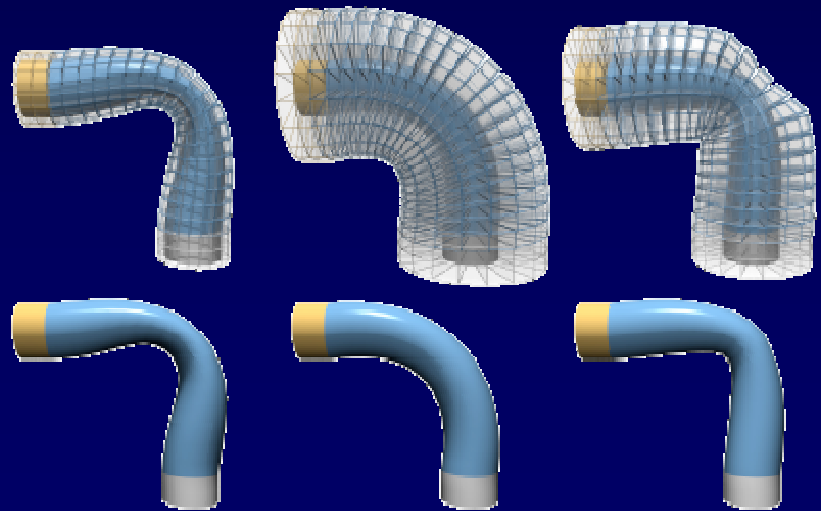
Subspace Gradient Domain Mesh Deformation

- Non-linear deformation
- Skeletal, volumetric, projection constraints
- MV Coordinates for multi-grid-like solve



PriMo: Coupled Prisms for Intuitive Surface Modeling

- Non-linear deformation
- Somewhat physically based
- Better quality than many other methods
- Multi-grid method for faster deformation

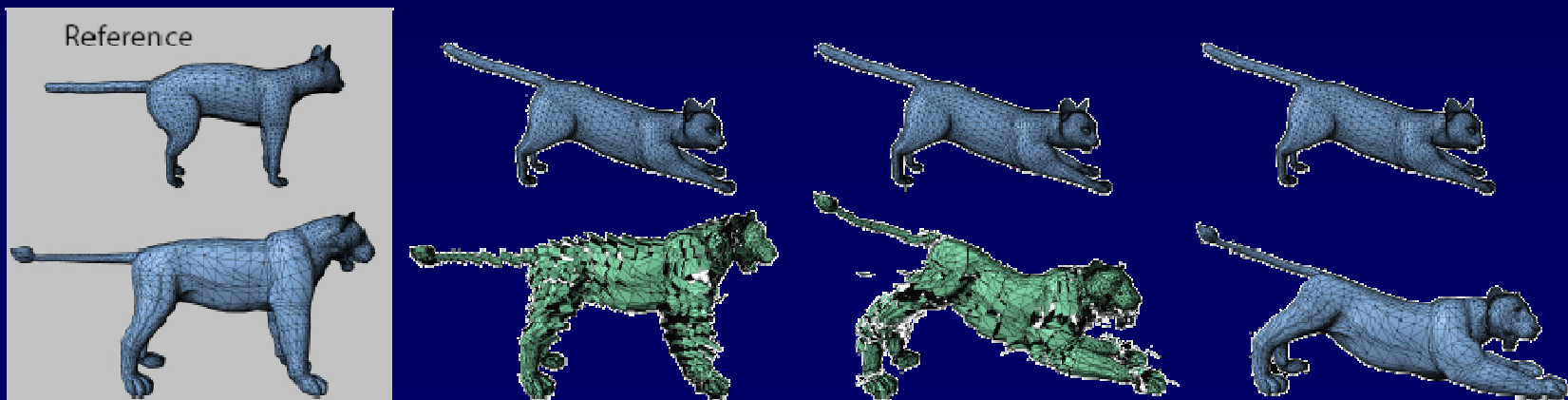


Deformation Tools

- Deformation Transfer for Triangle Meshes
- Pose space Deformation: A Unified Approach to Shape Interpolation and Skeleton-driven Deformation
- Skinning Mesh Animations

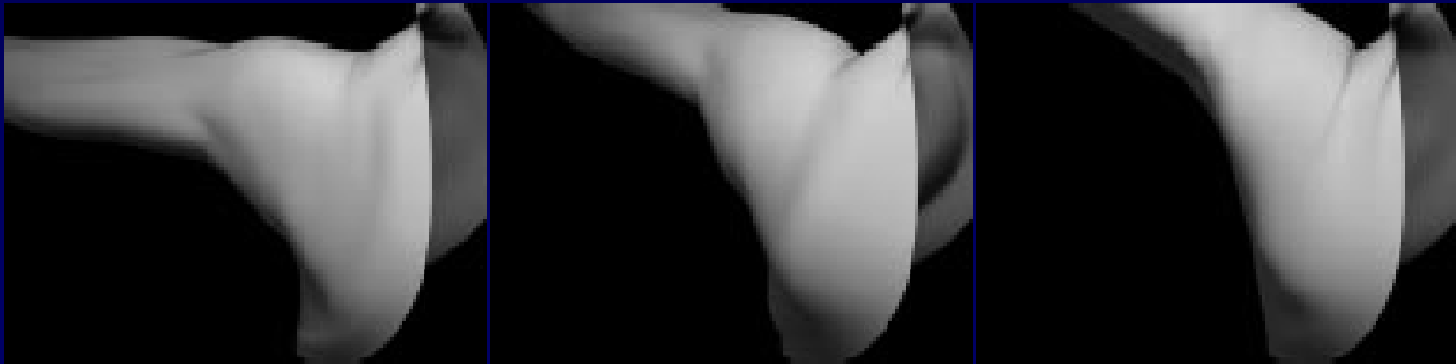
Deformation Transfer for Triangle Meshes

- Transfer deformation from one surface to another
- Correspondence map must be good



Pose space Deformation

- Allows the user to correct deformations at specified poses
- Requires good formulation of pose vector
- Correction vectors *must* be kept in local frame

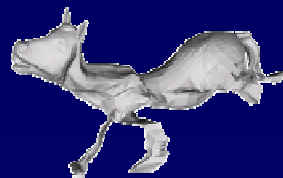


Skinning Mesh Animations

- Data compression for mesh animation
- Reduces band-width to graphics card
- Very fast play-back of animation
- Cannot create new deformations



Weights



Rank 0 NNLS



Rank 5 NNLS



Exact