Inter-Surface Mapping

John Schreiner
Arul Asirvatham
Emil Praun

University of Utah

Hugues Hoppe

Microsoft Research

Authors

John Schreiner

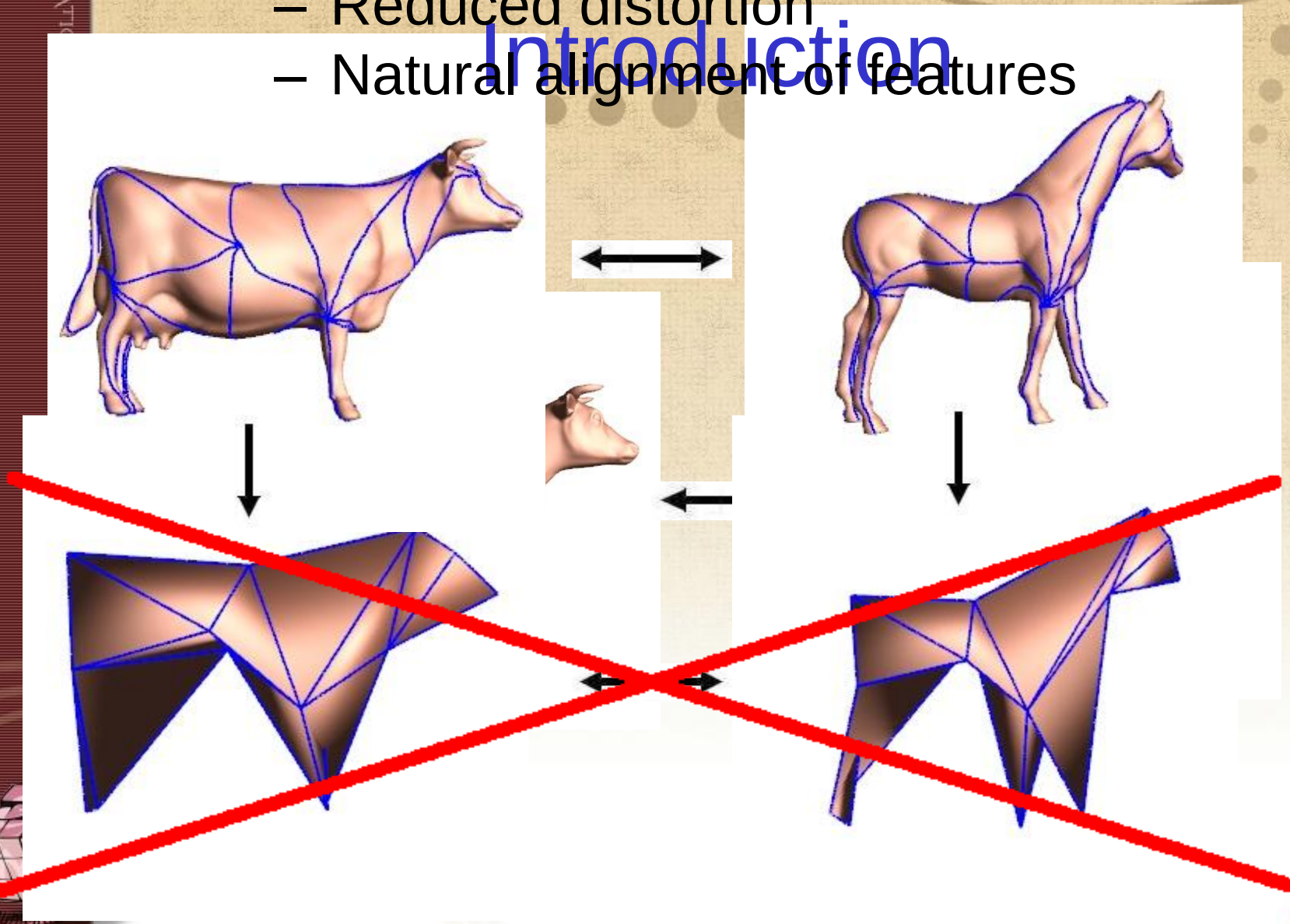
Arul Asirvatham

Emil Praun

Hugues Hoppe

No intermediate domain

- Reduced distortion
- Natural alignment of features



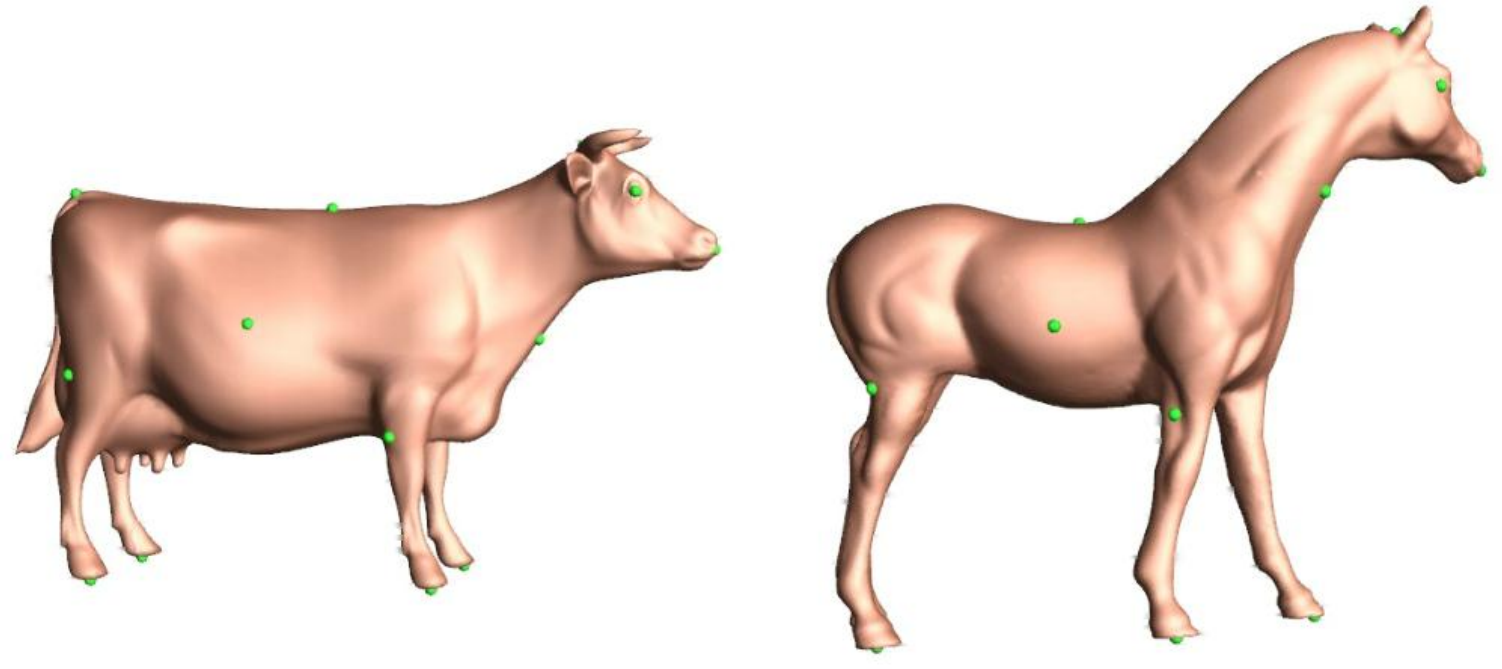
How Is Our Method Different?

- Directly create inter-surface map
  - Symmetric coarse-to-fine optimization
  - Symmetric stretch metric

→ Automatic geometric feature alignment

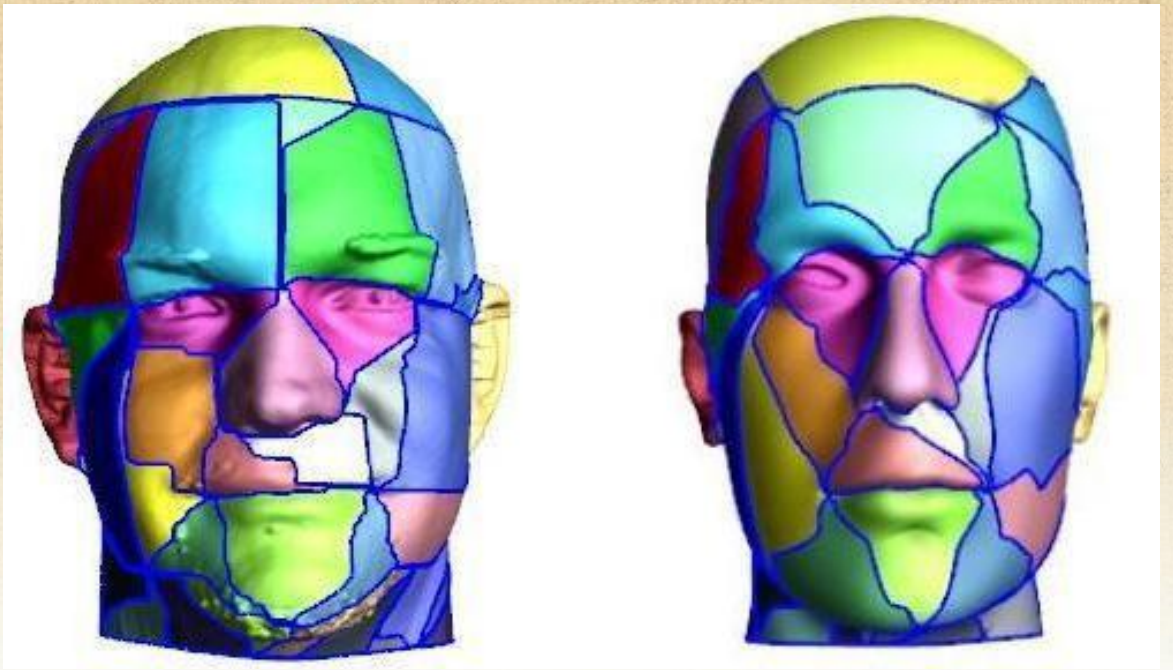
- Robust
  - Very little user input
  - Arbitrary genus
  - Hard constraints

Algorithm Overview



1. Consistent mesh partitioning
2. Constrained Simplification
3. Trivial map between base meshes
4. Coarse-to-fine optimization

Consistent Mesh Partitioning



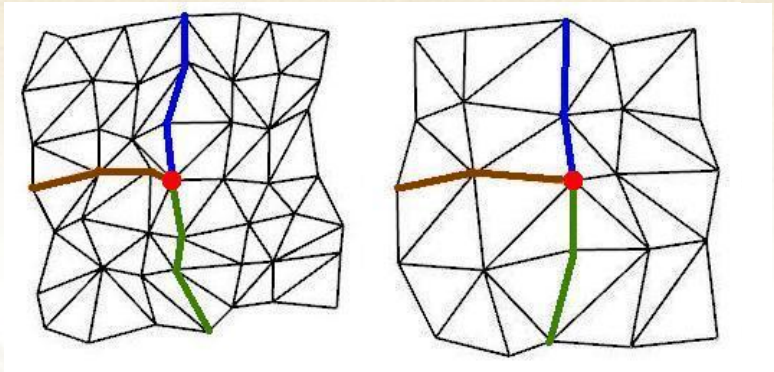
- Compute matching shortest paths
- Add paths not violating legality conditions

Partition

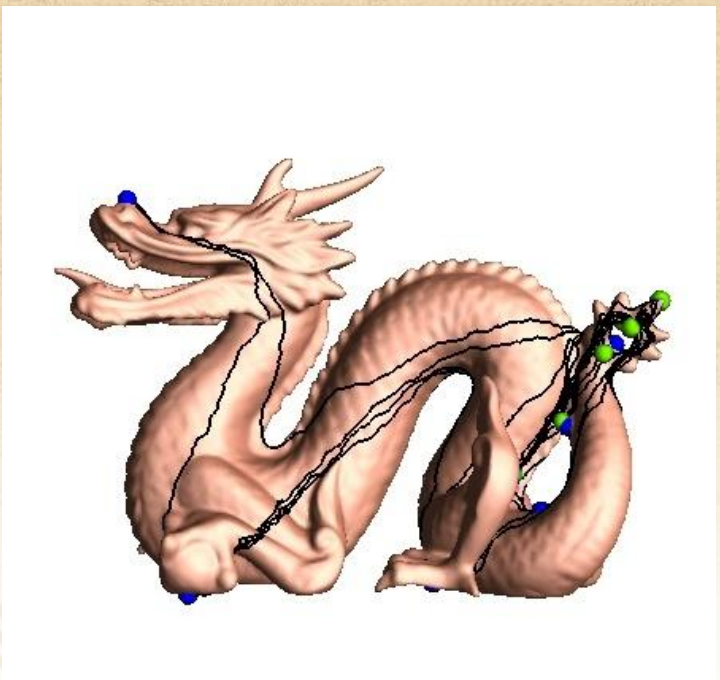
- Assign feature points on both 2 meshes.
- Find the shortest path between each pair of feature vertices. (Dijkstra search)
  - The search is constrained to not intersect with paths already in the network.
  - Solution : perform Dijkstra on both the ***mesh vertices*** and the ***edge midpoints***.
- Select the best pair of corresponding path and split the mesh.
  - Sort by the sum of path lengths on 2 meshes.

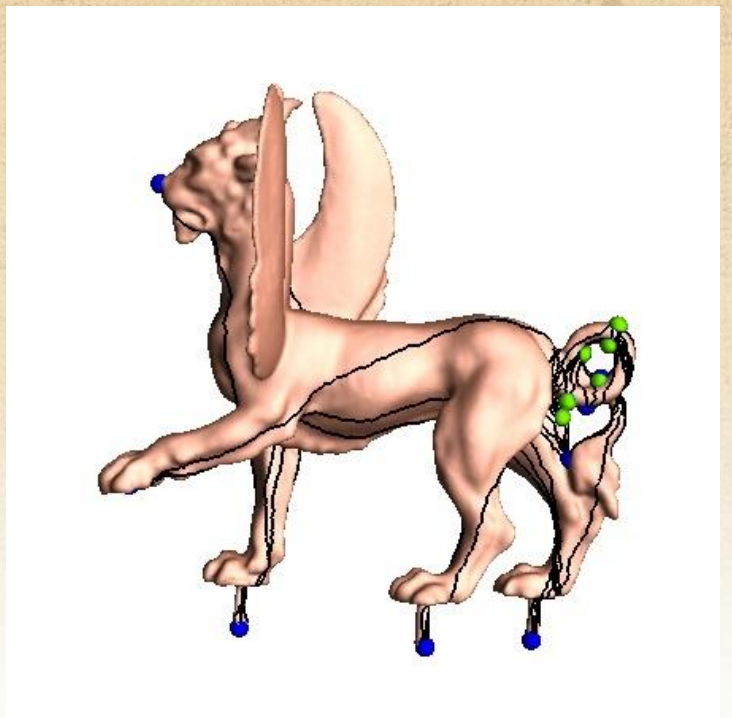
Legality Conditions

- Paths don't intersect
- Consistent neighbor ordering
- Cycles don't enclose unconnected vertices



Automatic Insertion Of Feature Points



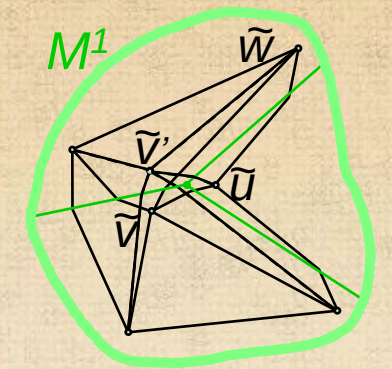


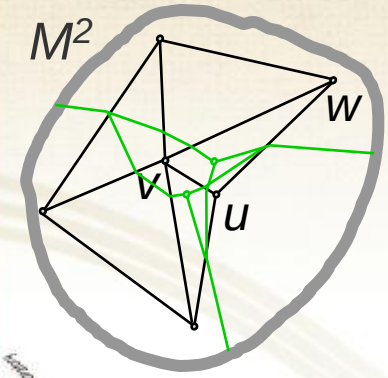
Add features if not enough to resolve genus

Coarse-to-Fine Algorithm

- Interleaved refinement
- Vertex optimization

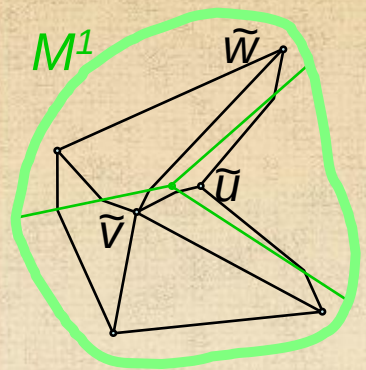
Vertex Optimization

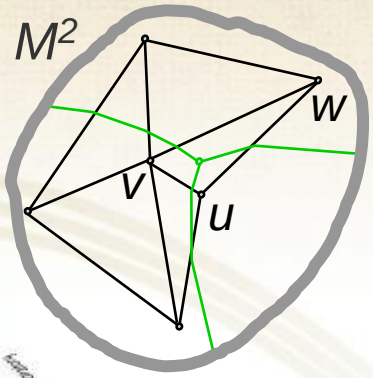


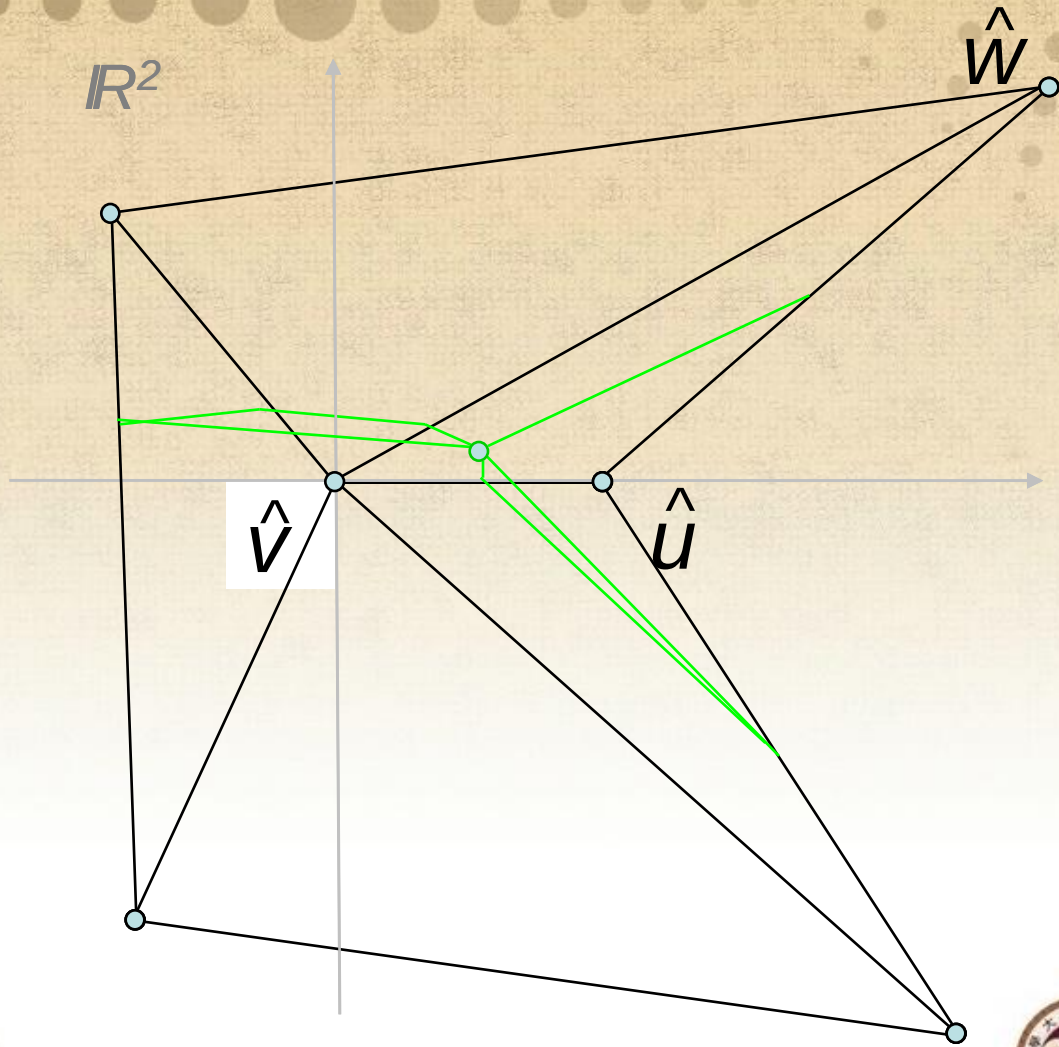


- Consider v of M^2 and optimizes v of M^1
- The optimization only modifies the map inside these corresponding neighborhoods
  - Regenerate barycentric coordinates

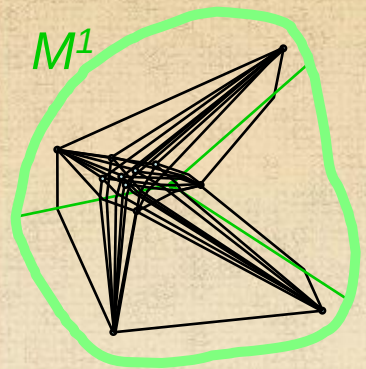
2D Layout

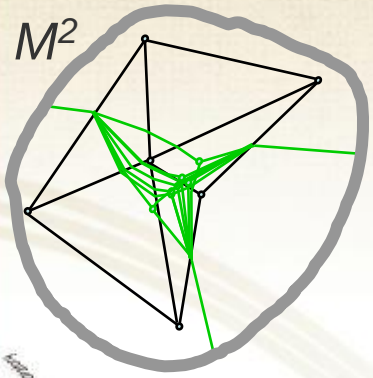


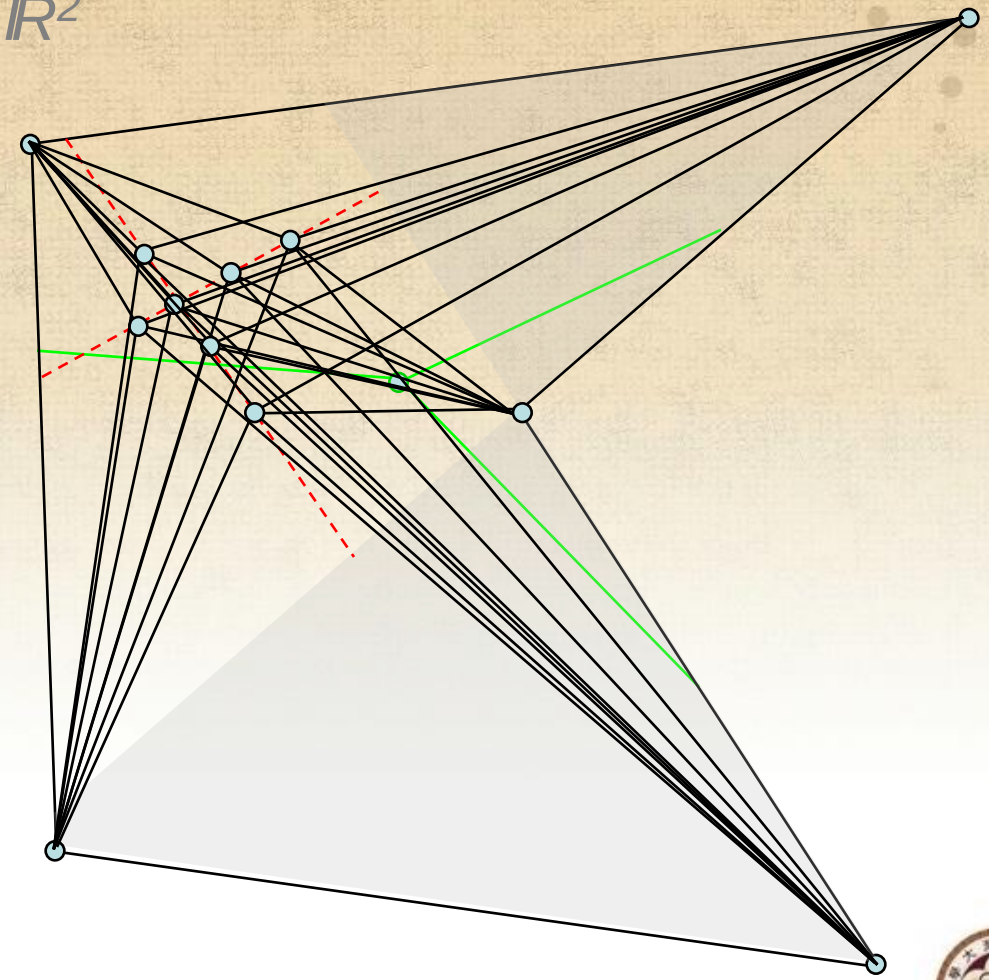




Line Searches





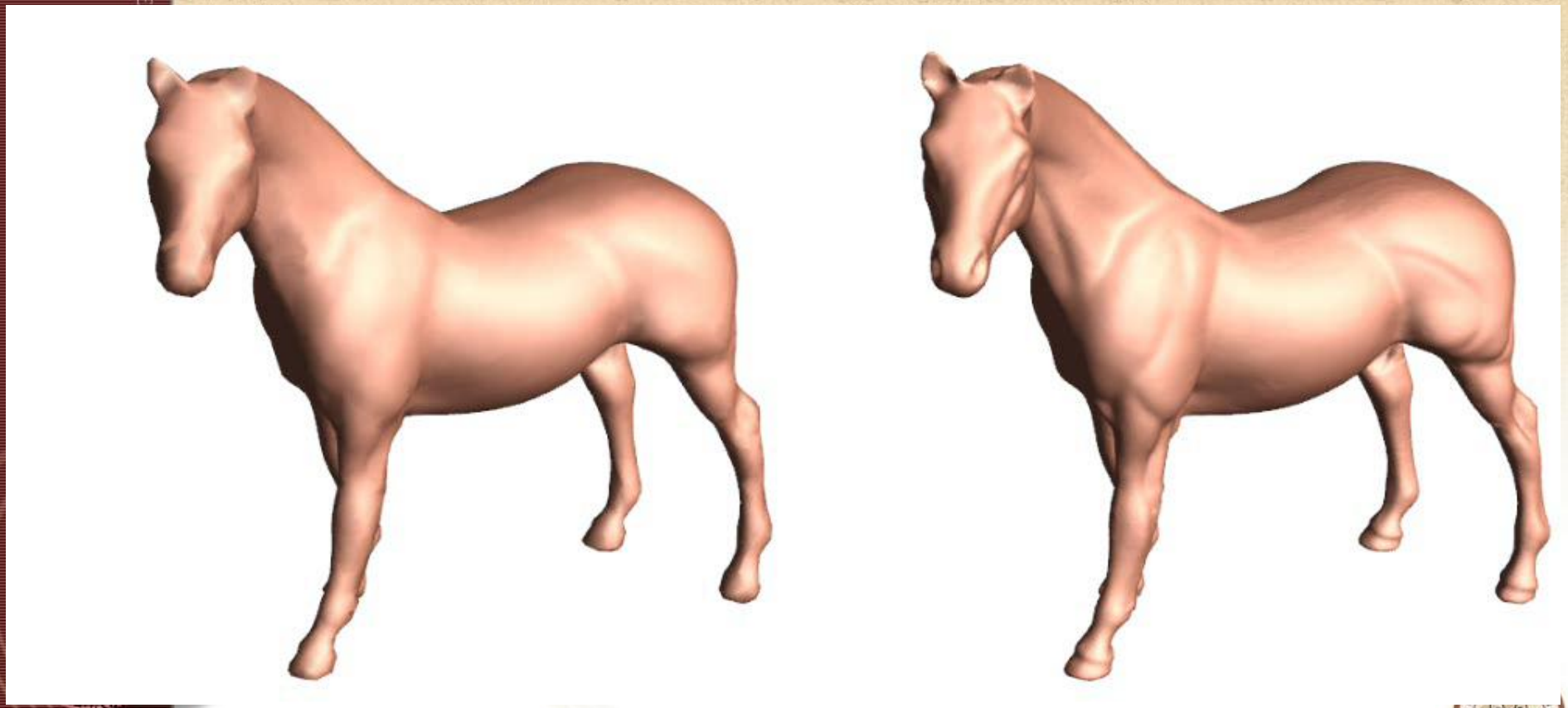


Stretch Metric

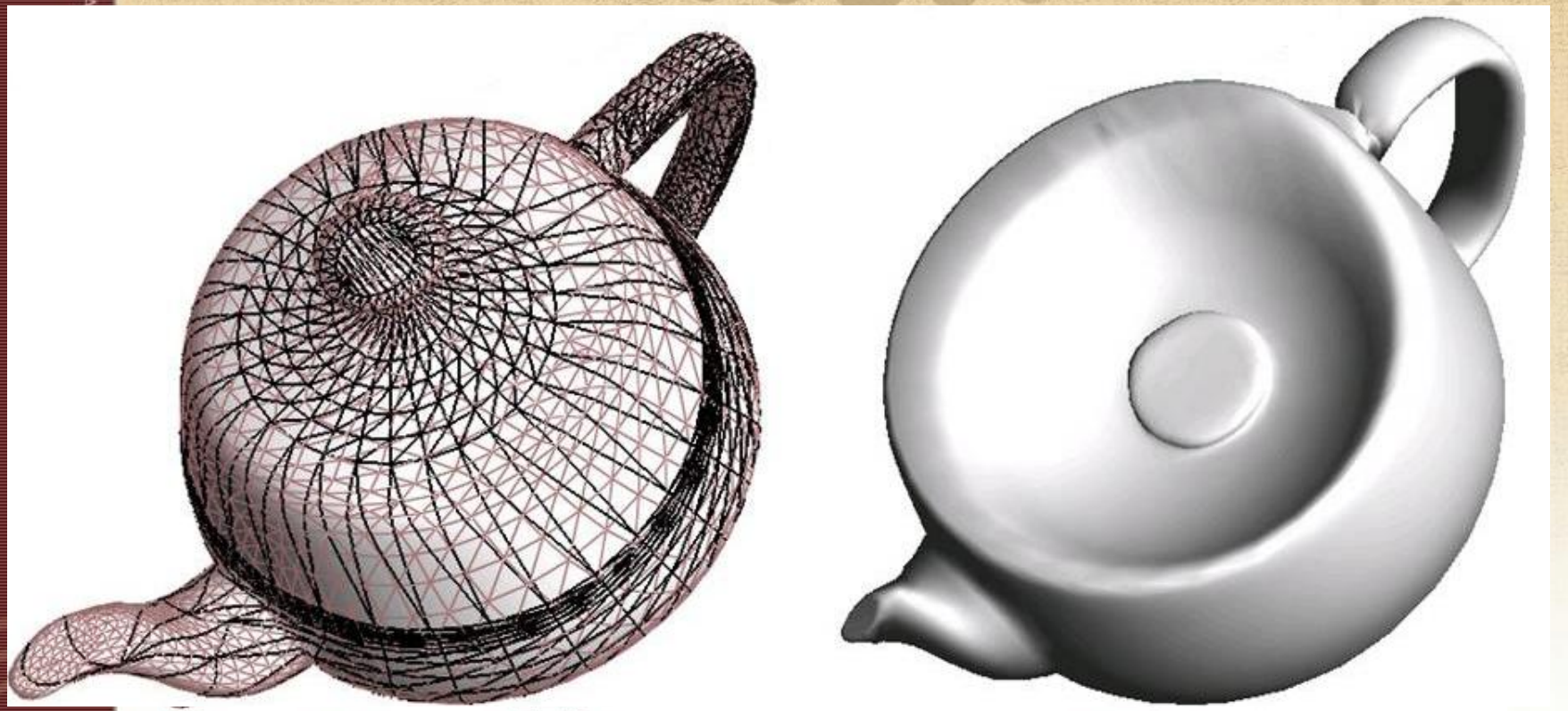
- Automatically encourages feature correspondence

Conformal

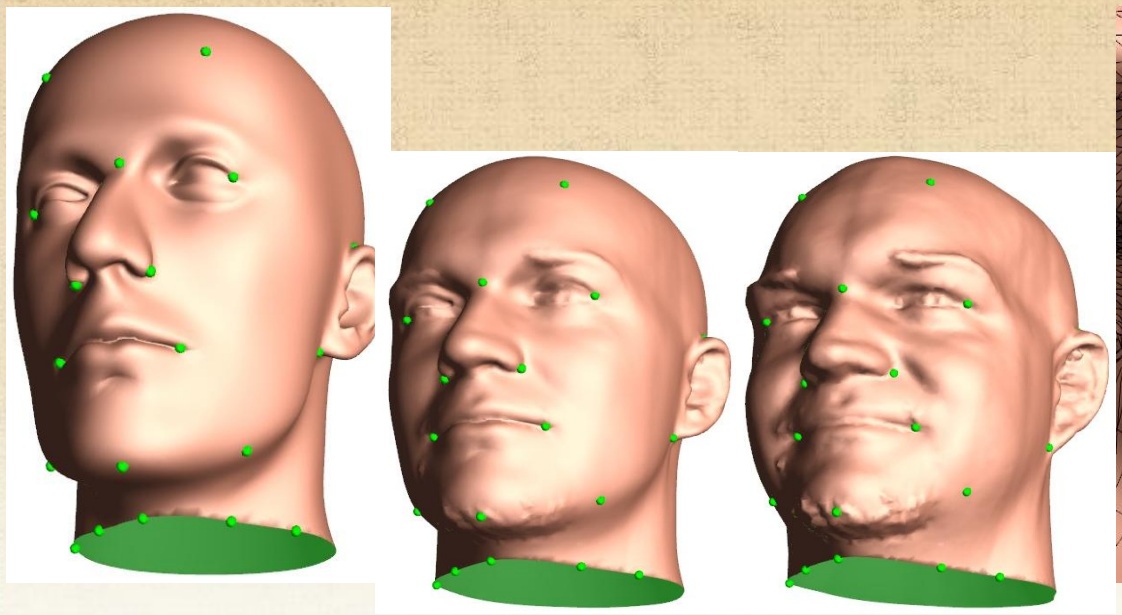
Stretch

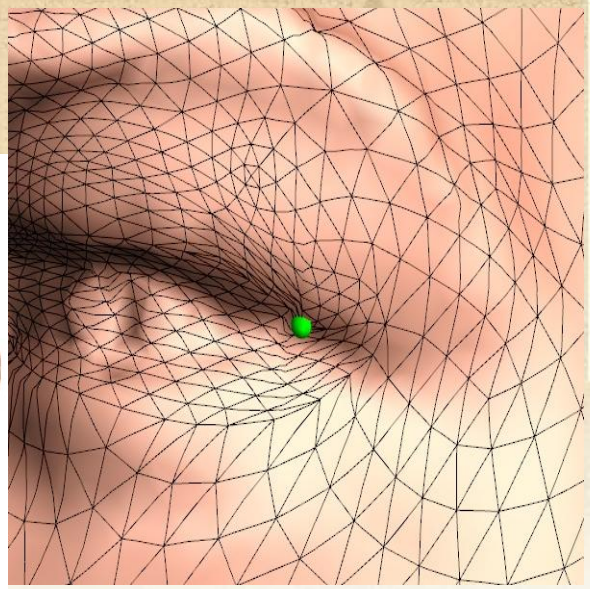


Results: Inter-Surface Mapping



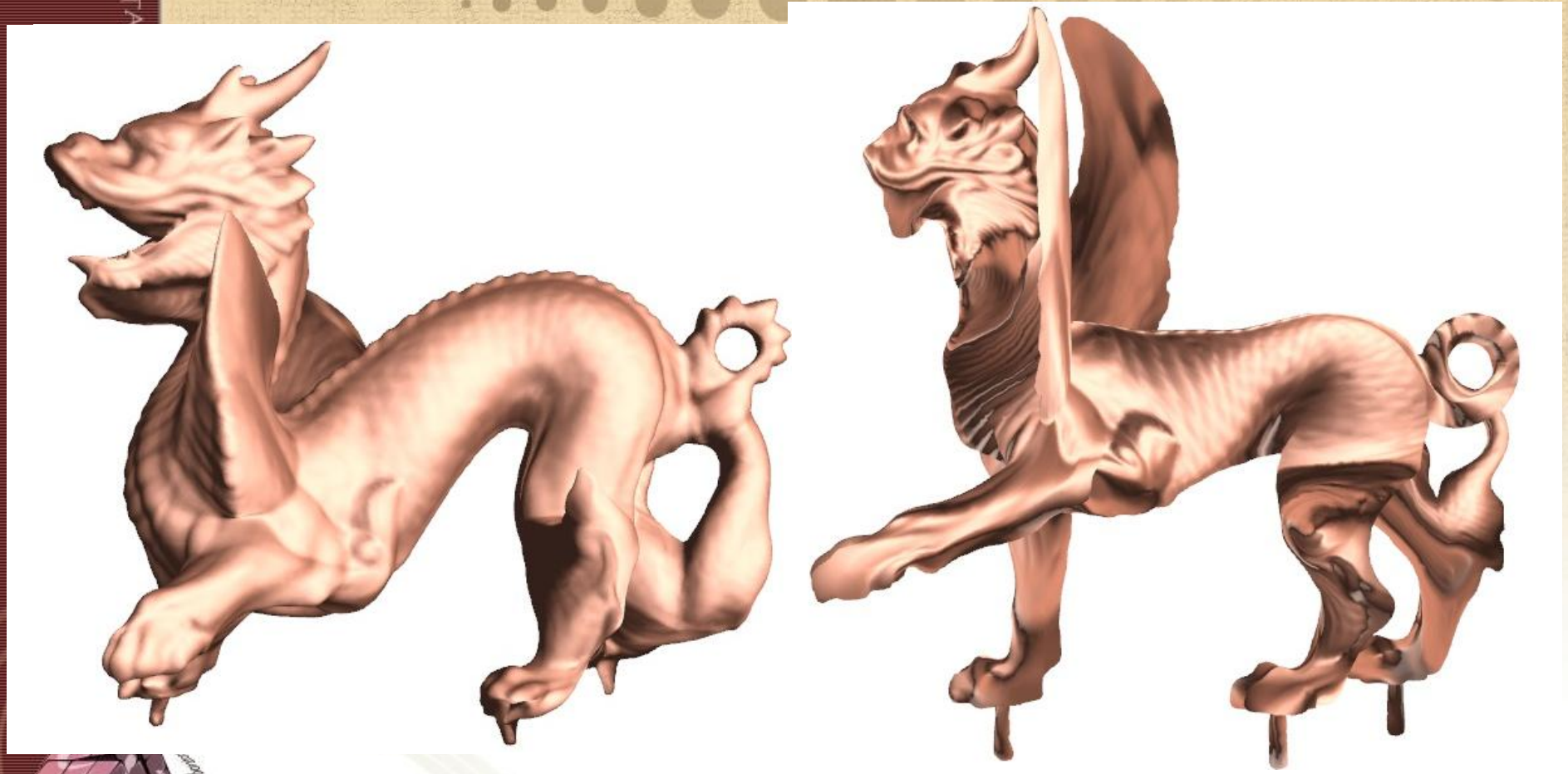
Results: Inter-Surface Mapping





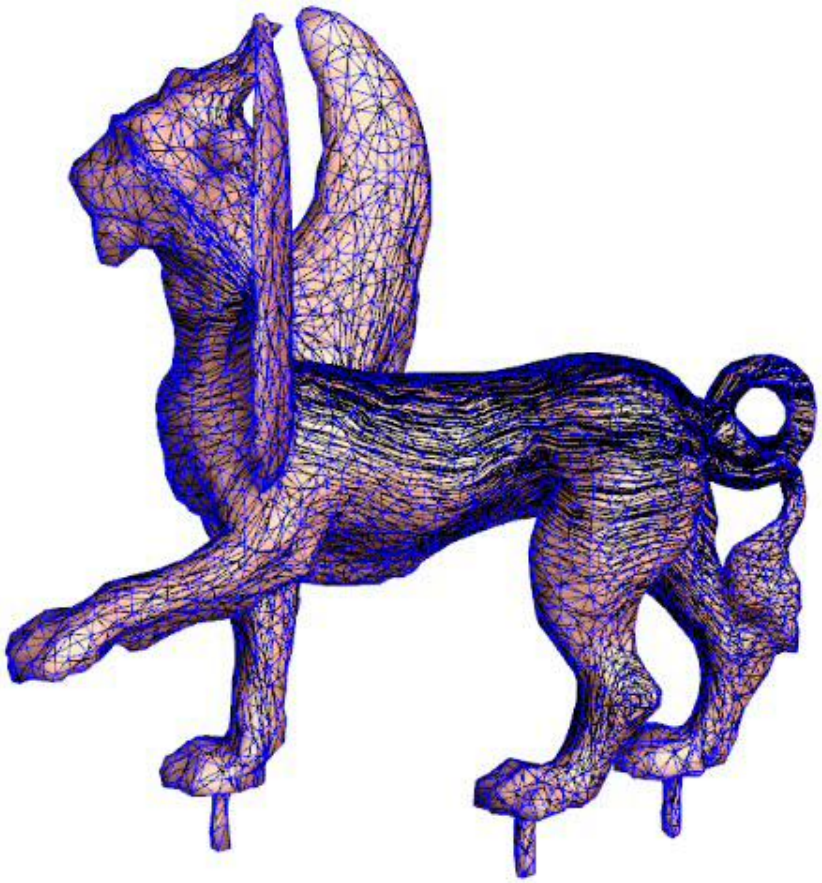
Low distortion around hard constraints

Results: Inter-Surface Mapping



Arbitrary genus(genus 2; 8 user feature points)

Robustness



Conclusion

- Directly create inter-surface map
  - Symmetric coarse-to-fine optimization
  - Symmetric stretch metric

→ Automatic geometric feature alignment

- Robust: guaranteed bijection
  - Arbitrary genus
  - Hard constraints
- General tool with many applications

Future Work

- Faster technique
  - Currently: 64K faces, 2.4GHz → 2 hours
- More than 2 models
- Surfaces with different topologies

CMLAB NATIONAL TAIWAN UNIVERSITY

~ The End~