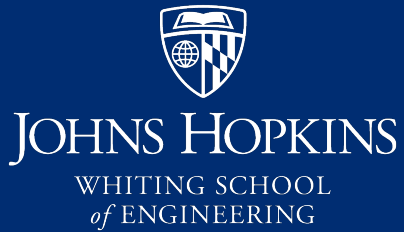


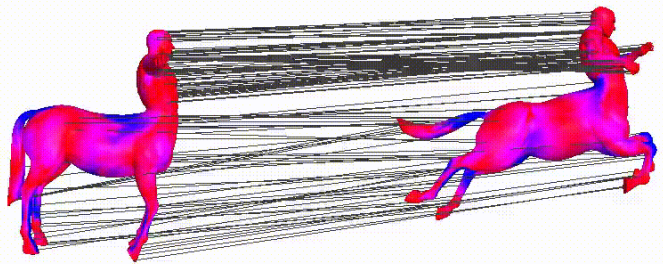
Correspondences for Genus-zero Shapes

Sing Chun Lee, Misha Kazhdan

Problem Statement

- General shape correspondence problems:
  - Given shapes $M, N \subset \mathbb{R}^3$, find a meaningful map $\Phi_{M \to N}: M \to N$
- Input:
  - Full (vs partial) genus-zero shapes
- Method:
  - Fully-automatic and deformable
- Output:
  - Pairwise dense correspondences

Dense Point-to-point Correspondences

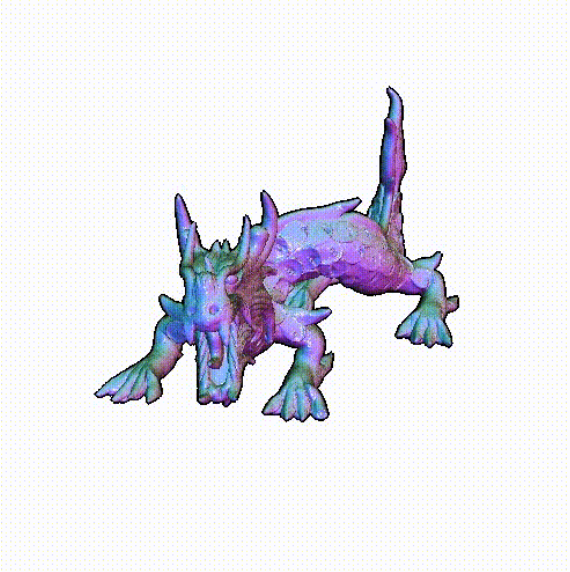


Our Approach

1. Per shape:
   a. Conformal parameterization
   b. Authalic evolution
   c. Signal generation

2. Per pair:
   a. Rotational alignment
   b. Registration refinement
   c. Composed dense maps

- **Conformalized Mean Curvature Flow (CMCF)**
  - Parameterize the input shape over S^2
  - Fast and robust
  - Converge to a conformal parameterization



CMCF Evolution

[M. Kazhdan, J. Solomon, and M. Ben-Chen. SGP 2012]

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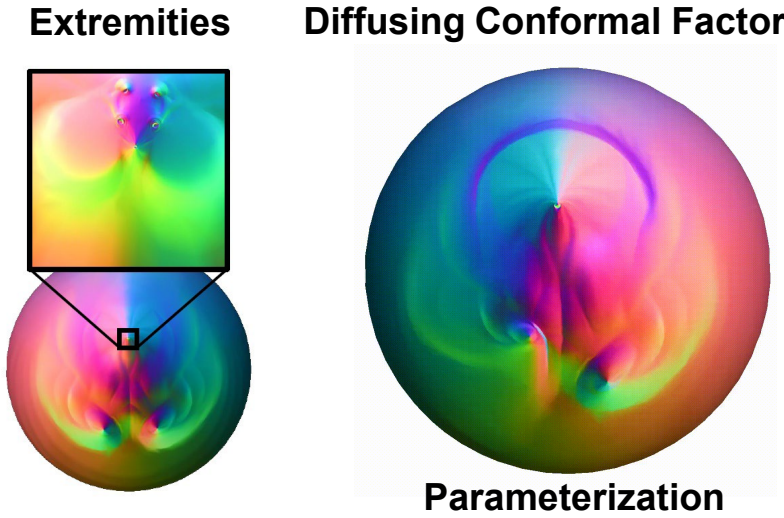
- **Diffusion of Conformal Factors**
  - Expand extremities authalically
  - Diffuse the parametrization by flowing more compressed regions towards less compressed regions.



[G. Zou, J. Hu, and X. Gu. IEEE TVCG 2011]

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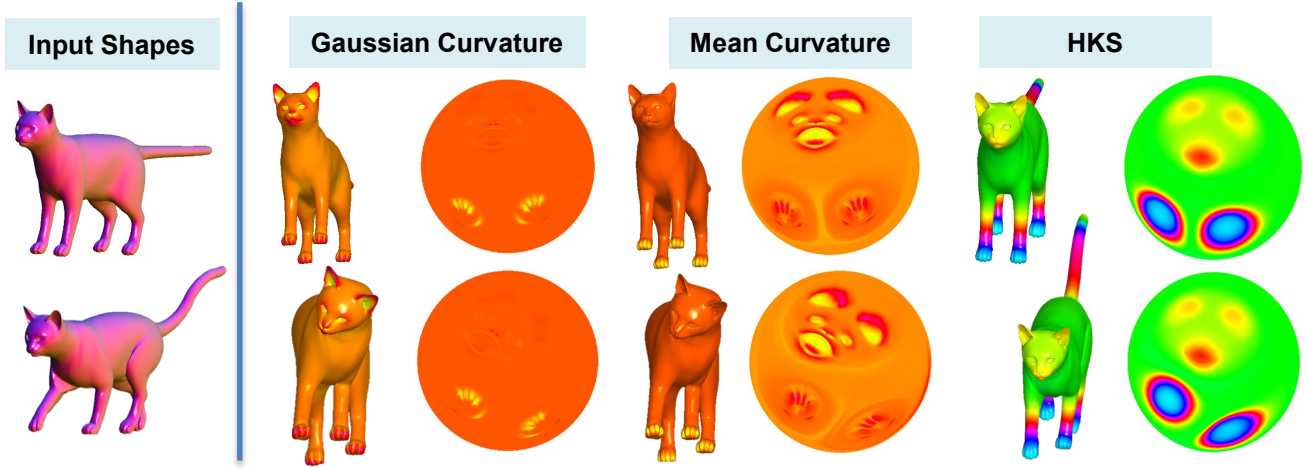
- **Correspondence Signals**
  - Intrinsic correspondence
    - Heat Kernel Signature
    - Gaussian Curvature
  - Extrinsic correspondence
    - Mean Curvature



[J. Sun, M. Ovsjanikov, and L. Guibas. SGP 2009]

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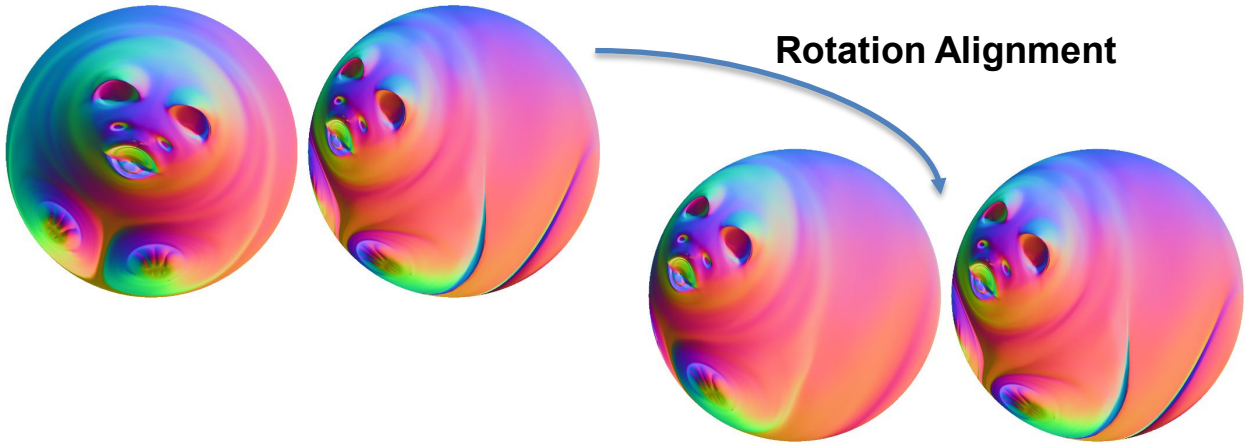
- **Rotation Registration**
  - Each shape is now represented by a d-dimensional signal on the sphere
  - Find the rotation maximizing signals' correlation (solvable by fast spherical Fourier transform)



[A. Baden, K. Crane, and M. Kazhdan. SGP 2018]

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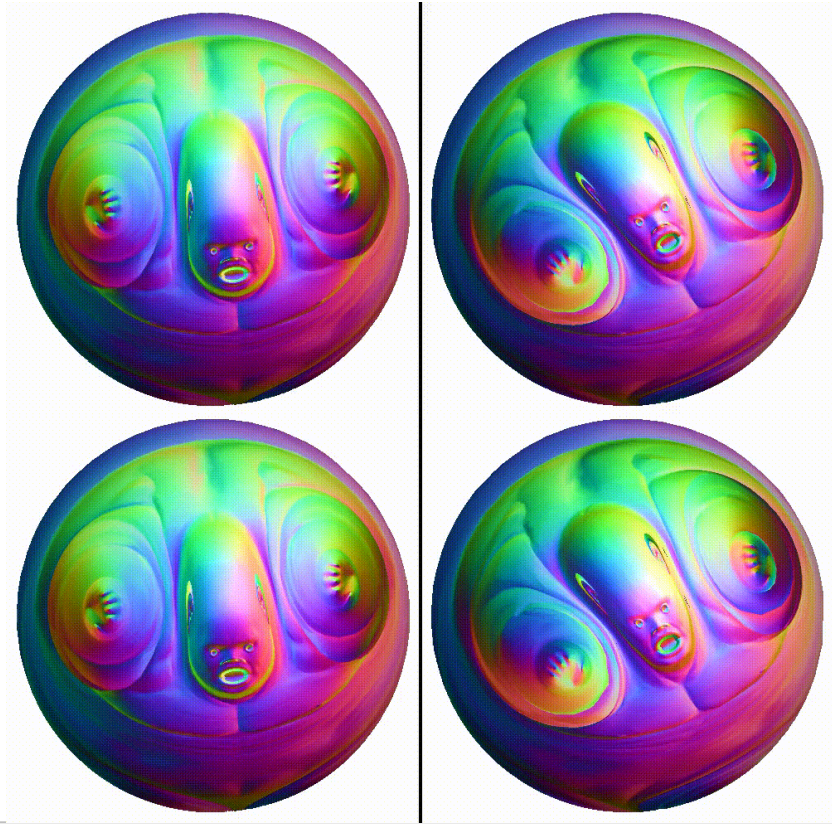
- **Surface Optical Flow:** Solve for the vector field whose flow minimizes the fitness and smoothness term



[F. Prada, M. Kazhdan, M. Chuang, A. Collet, and H . Hoppe. SIGGRAPH 2016]

Our Approach

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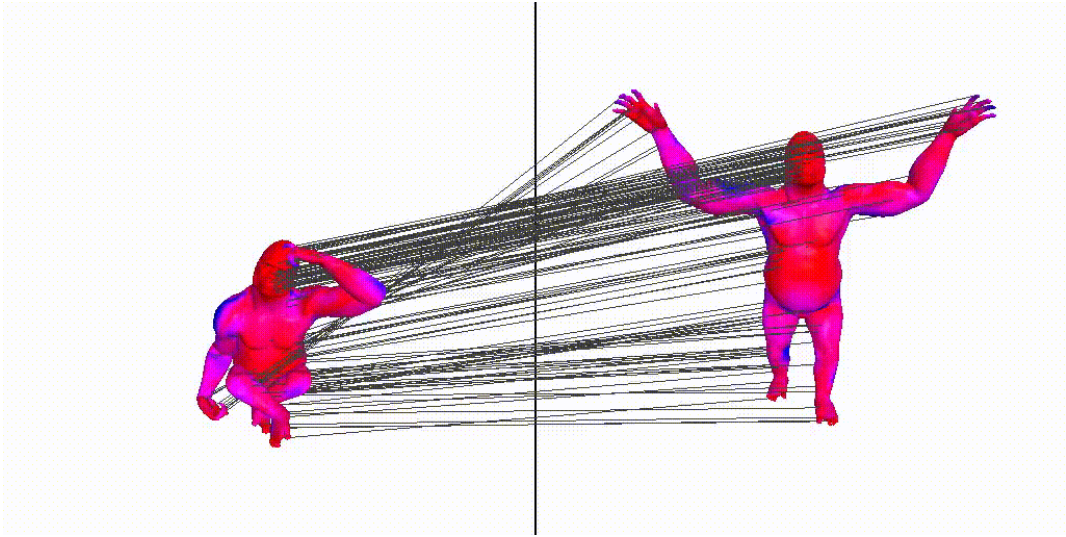
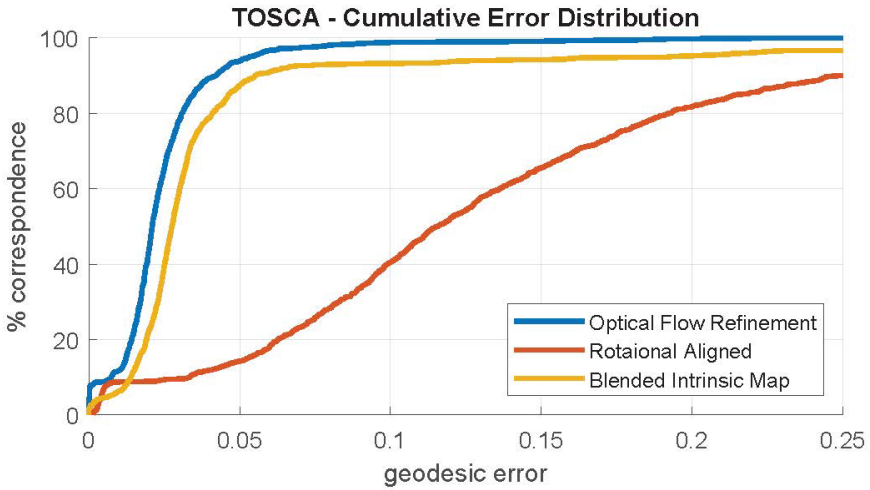
- **Dense Correspondence Maps**
  - Spherical parameterizations, $\Phi_M: M \to S^2$, $\Phi_N: N \to S^2$
  - Rotation alignment, $R: S^2 \to S^2$
  - Optical flow refinement, $\vec{V}: S^2 \to S^2$
  - Dense map, $\Phi_{M \to N} = \Phi_N^{-1} \circ \vec{V} \circ R \circ \Phi_M$



[S.C. Lee, and M. Kazhdan. In Progress]

Results & Conclusion

- Evaluated using TOSCA Dataset
- Compared with Blended Intrinsic Map,
- Average biharmonic distance
- **Comparable fully automatic dense point-to-point correspondence solution**



[A. Bronstein, M. Bronstein, and R. Kimmel. Springer Publishing Cmpany 2008]
[V. G. Kim, Y. Lipman, T. Funkhouser. ACM ToG 2011]

Thank you