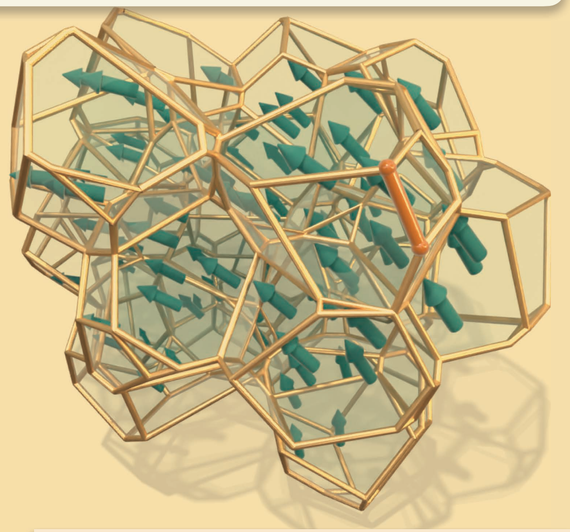
Kahlert School of Computing
New Graduate Student Orientation
Friday August 21 2026

A Brief Introduction to Geometry Processing

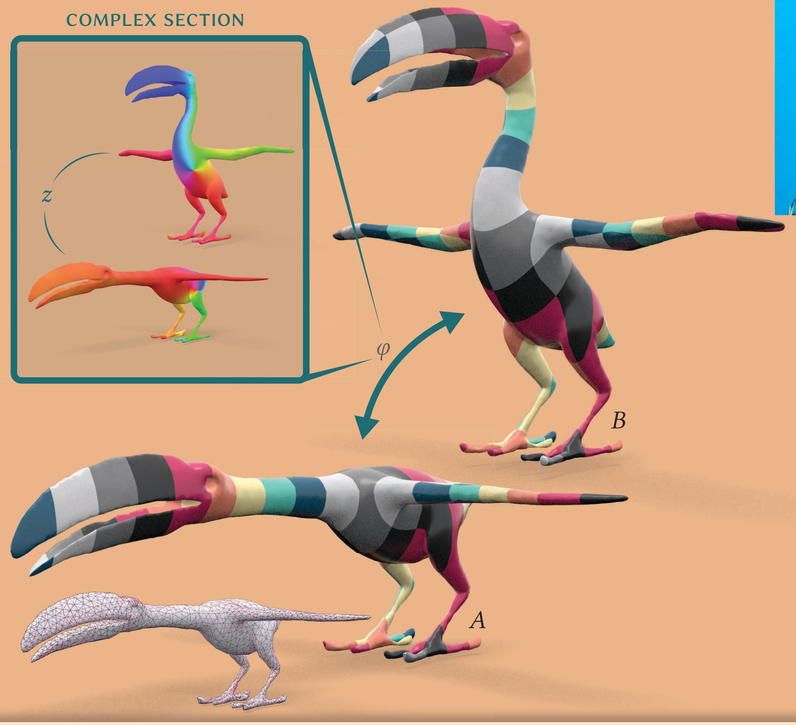
Mark Gillespie

Discrete Differential Geometry

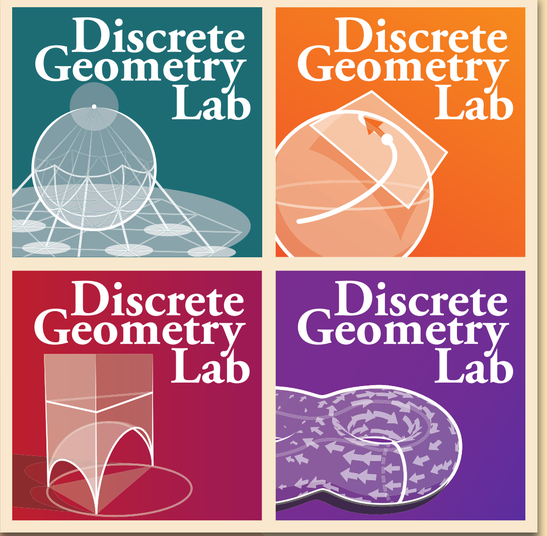


Digital Fabrication

Shape Correspondence



Surface Parameterization

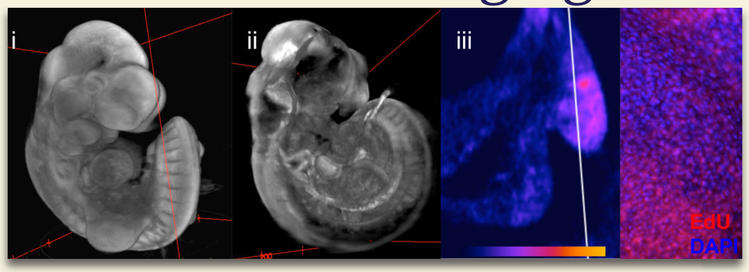


Mark Gillespie
geometry.cs.utah.edu
mark.gillespie@utah.edu

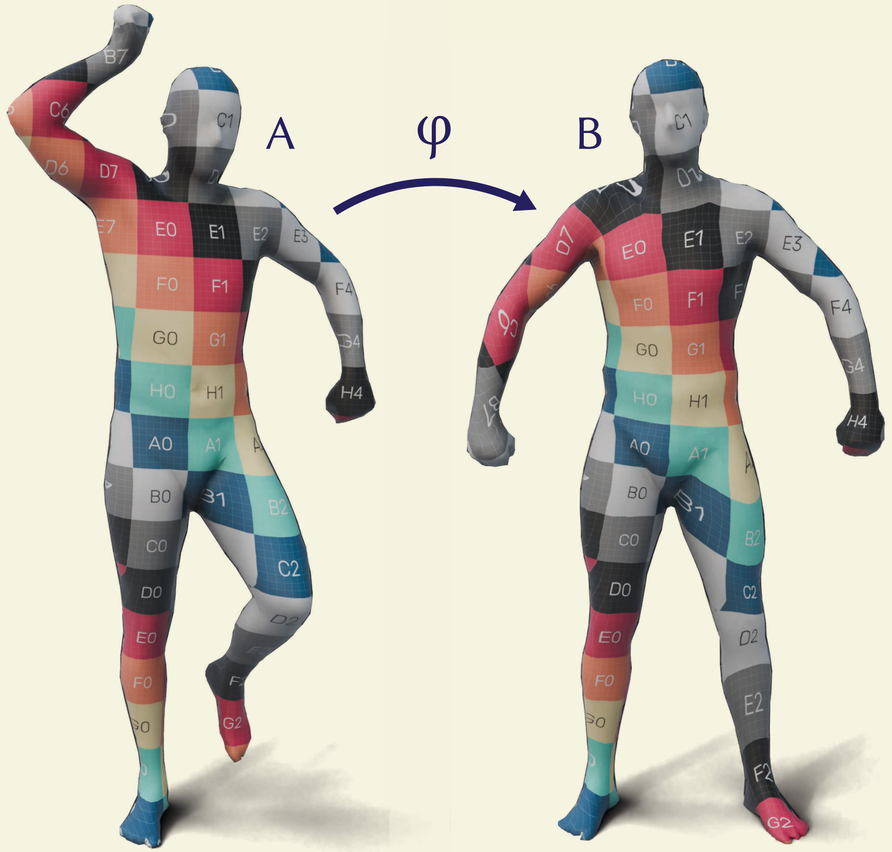
Problem:
Mapping between Surfaces

required to study data over collections of shapes

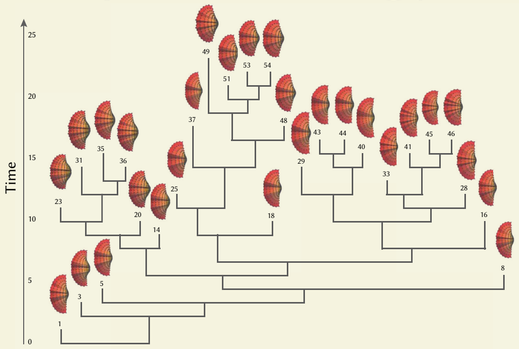
medical imaging



[Hallgrimsson et al. 2015]



paleontology

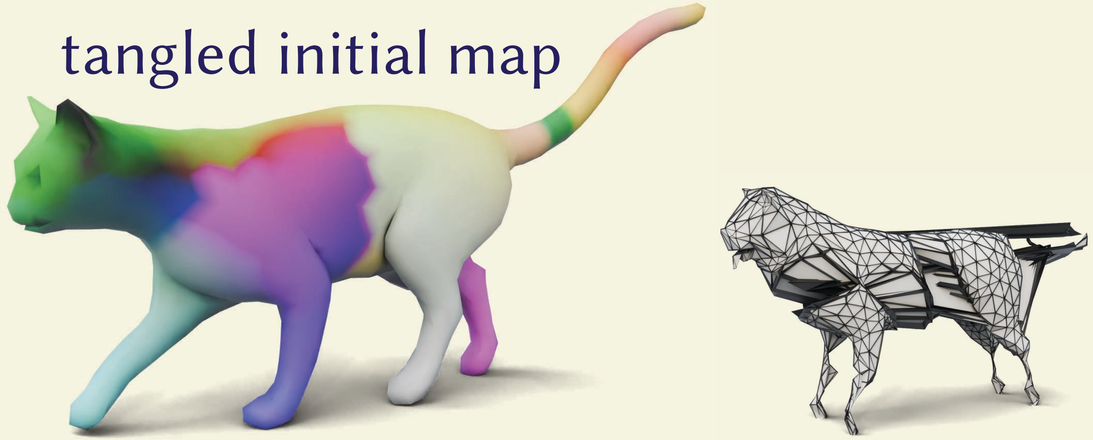


[Polly & Motz 2016]

Map Untangling

Fixing Flips

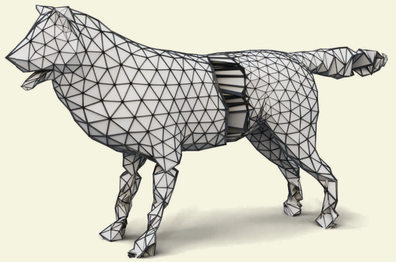
tangled initial map



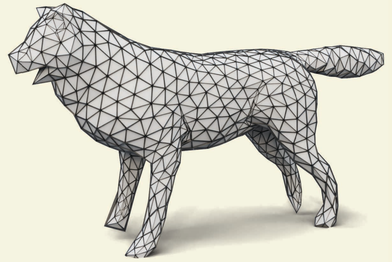
source

RHM

[Ezuz et al. 2019]



ours

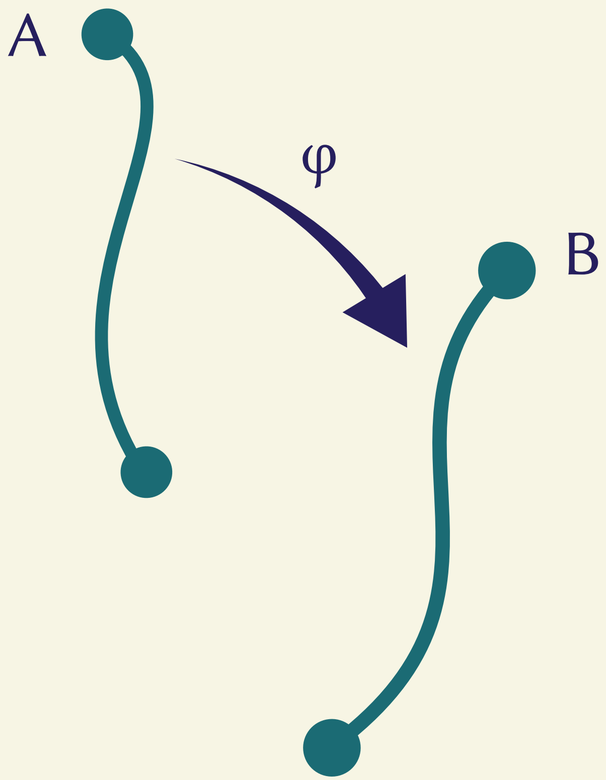


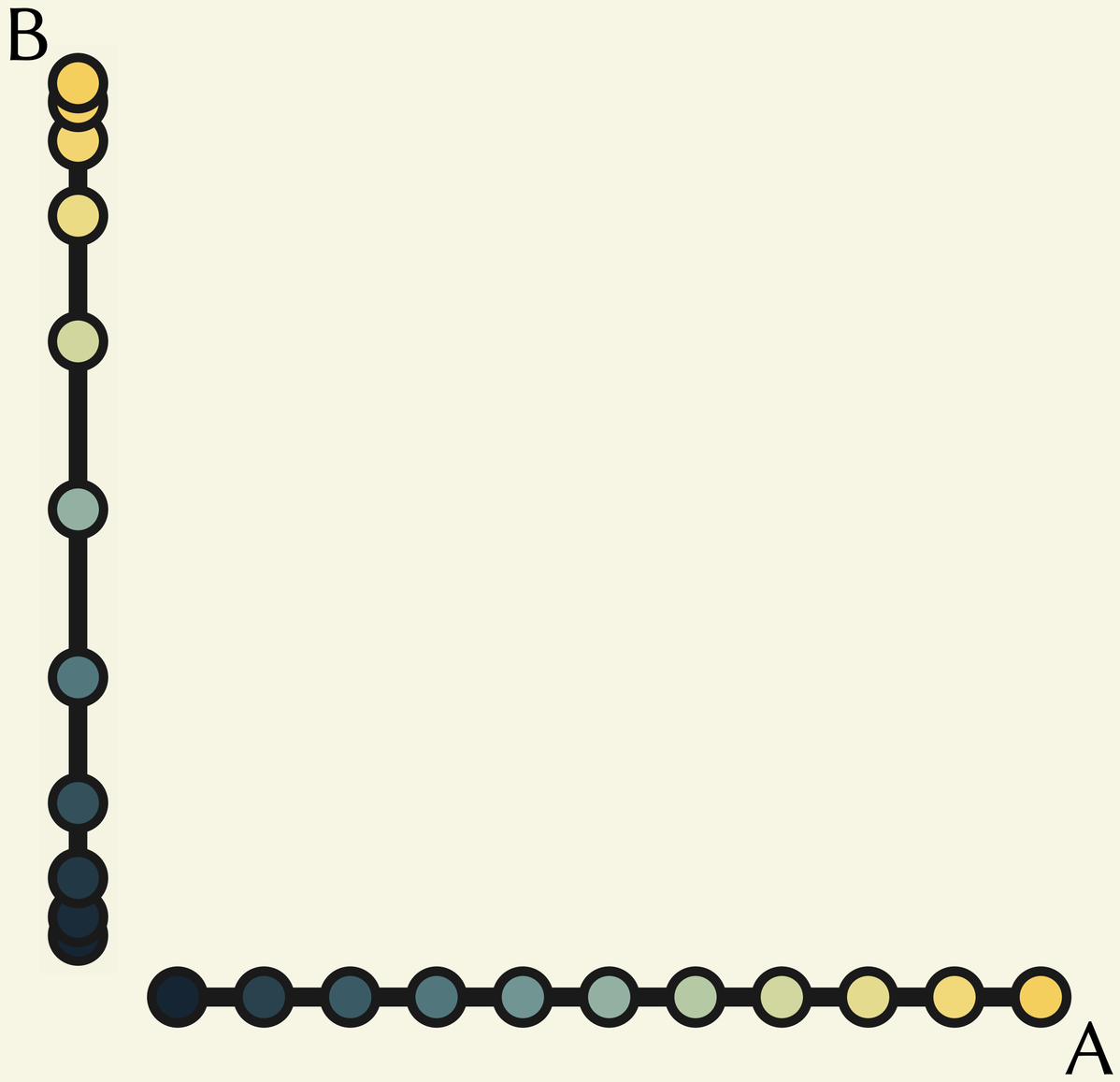
Mark Gillespie

geometry.cs.utah.edu

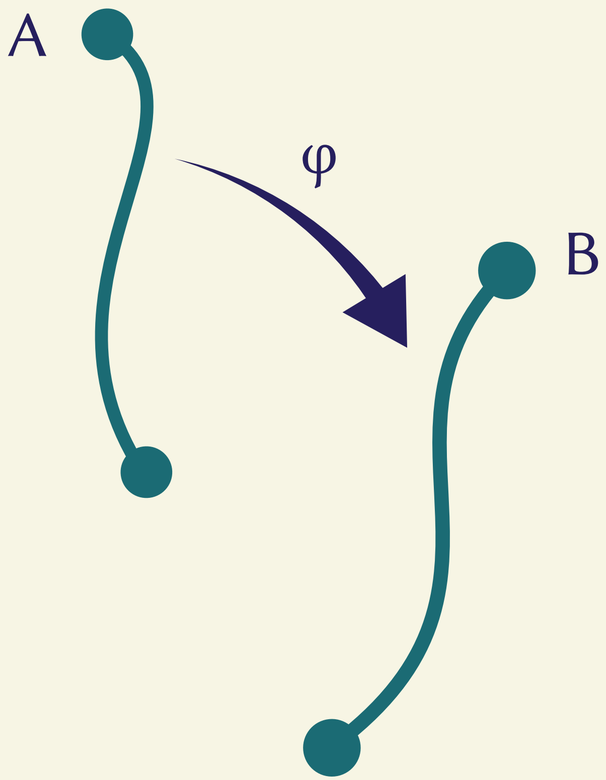
mark.gillespie@utah.edu

Example:
1D Curves

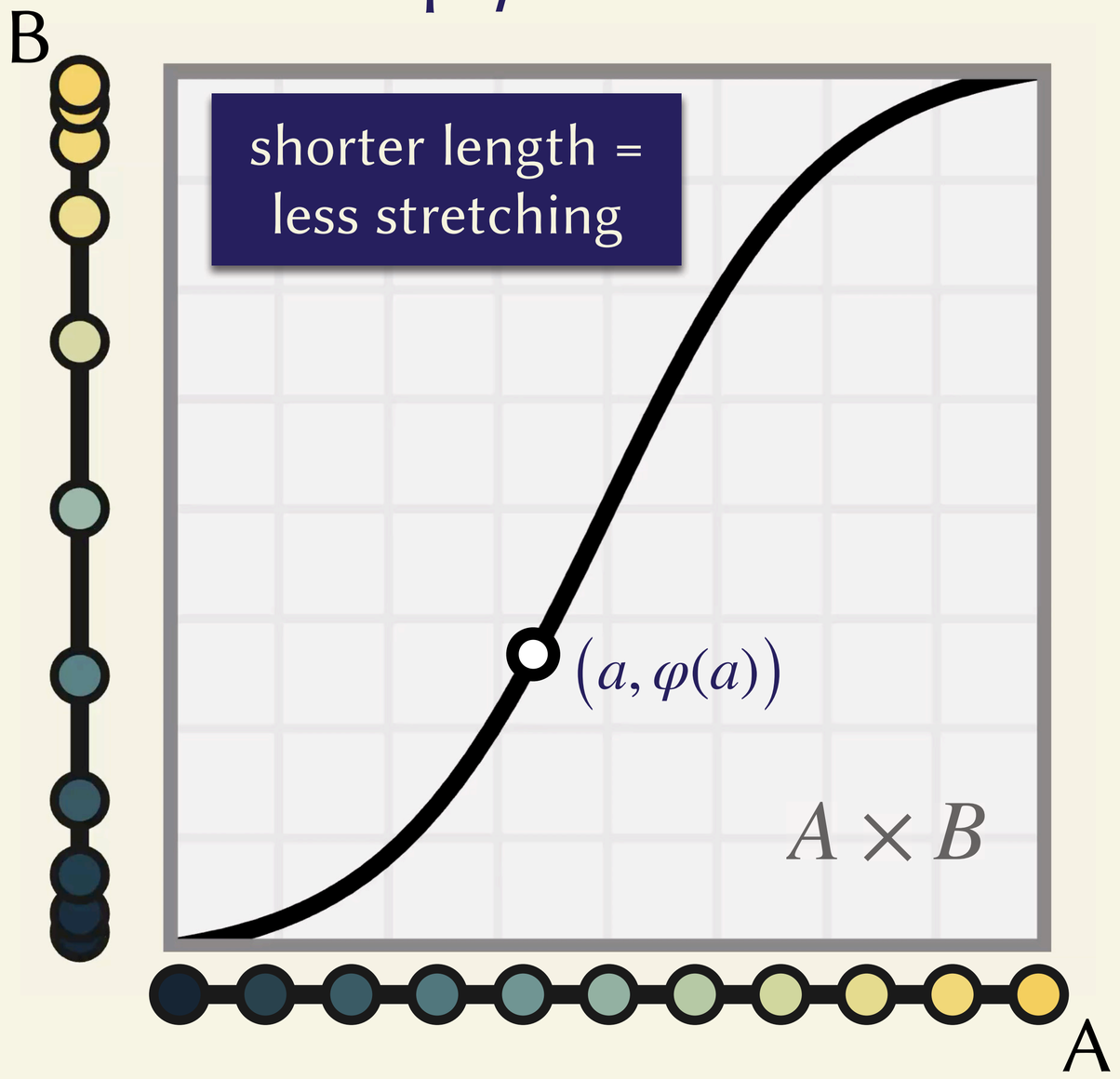




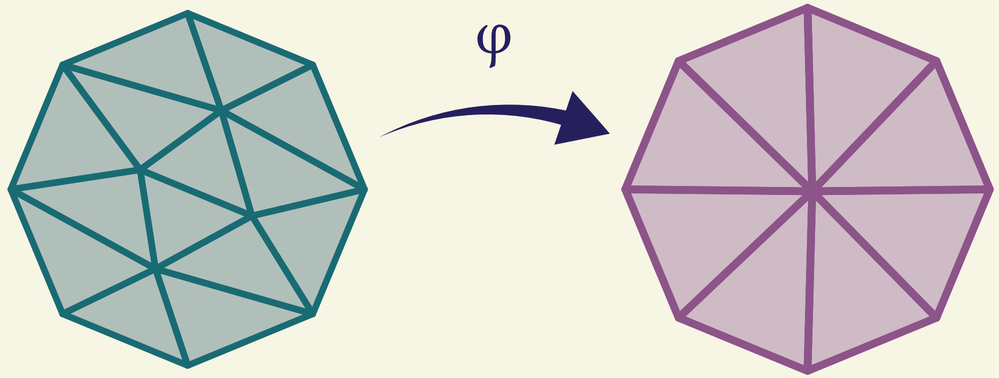
Example: 1D Curves



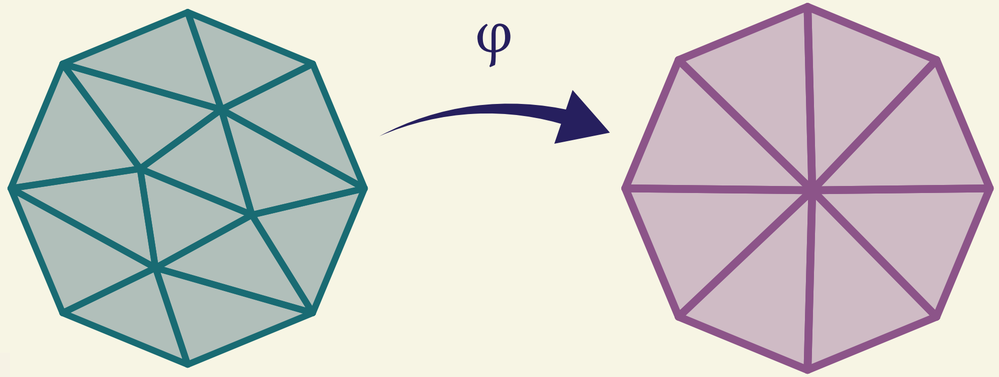
map $\varphi : A \to B$

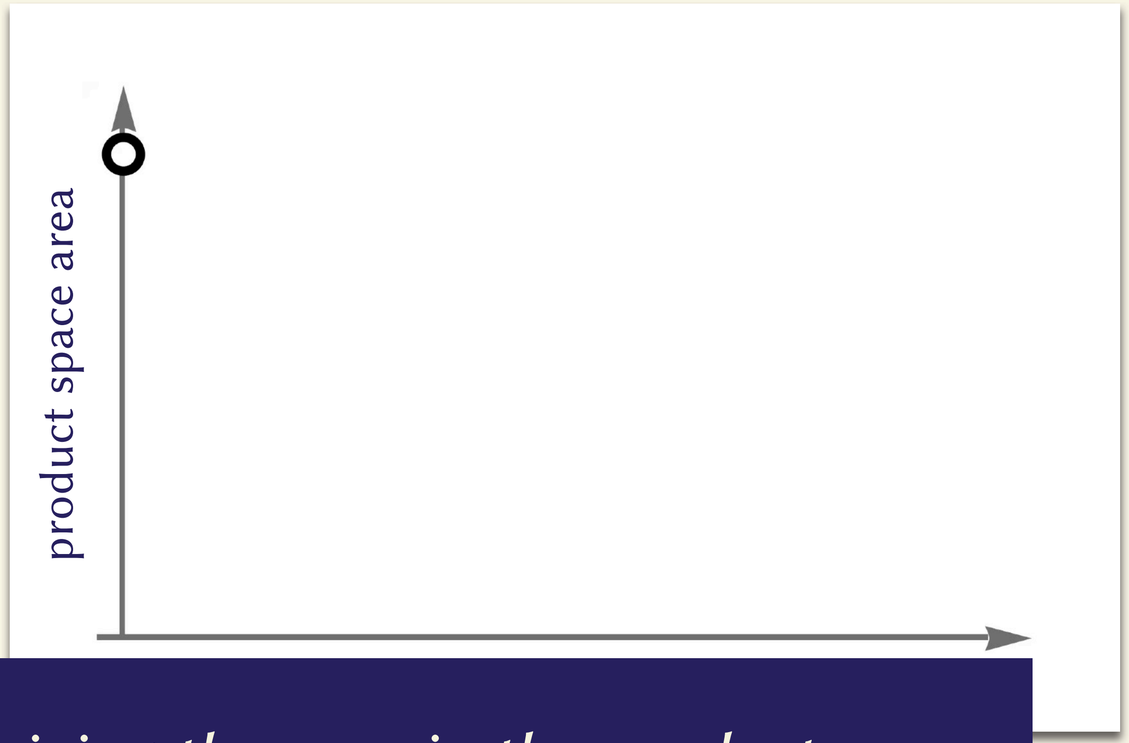


Example:
2D Disks



Example: 2D Disks





Find a good map by minimizing the area in the product space

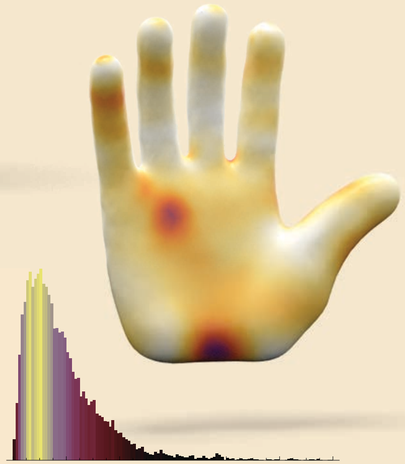
Map Distortion

source hand

map
[ours]

distortion
(area)

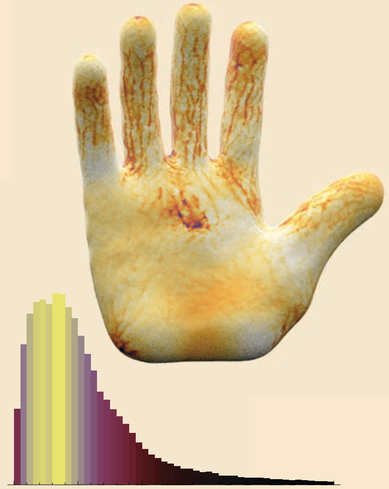
distortion
(symmetric Dirichlet)



our simpler optimization yields lower distortion in both senses

map
[Schmidt et al. 2020]

distortion
(area)



distortion
(symmetric Dirichlet)

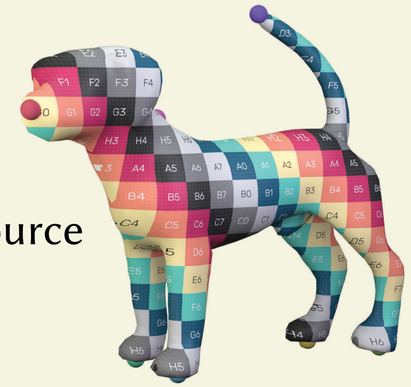
Mark Gillespie

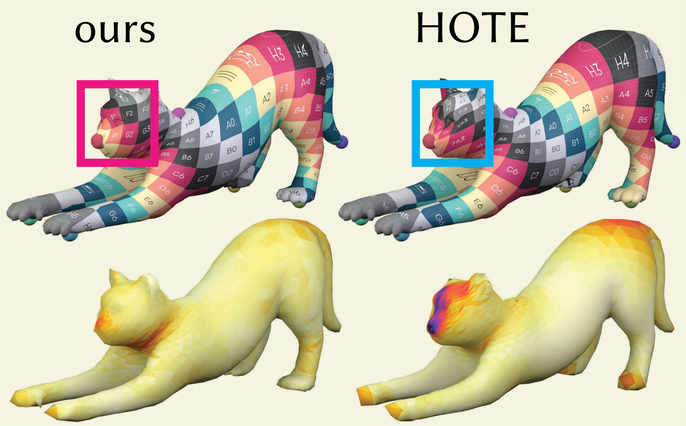
geometry.cs.utah.edu

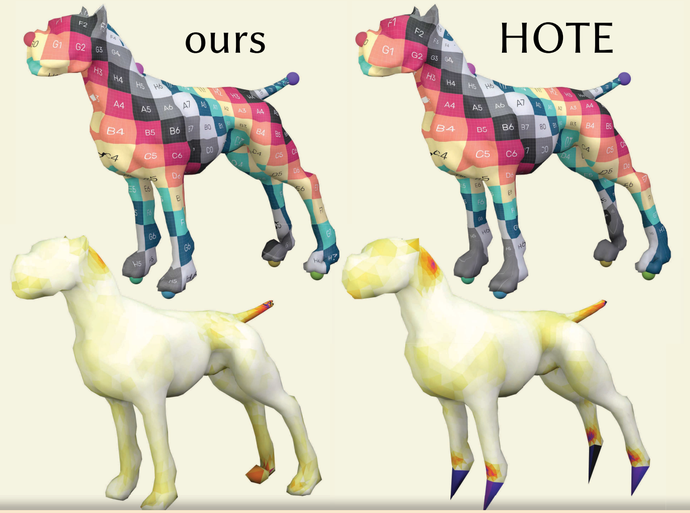
mark.gillespie@utah.edu

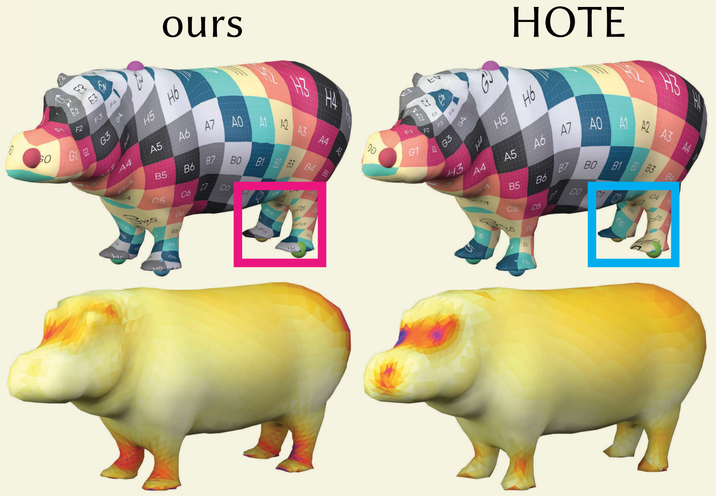
vs Hyperbolic Orbifold Tutte Embedding

[Aigerman and Lipman 2016]





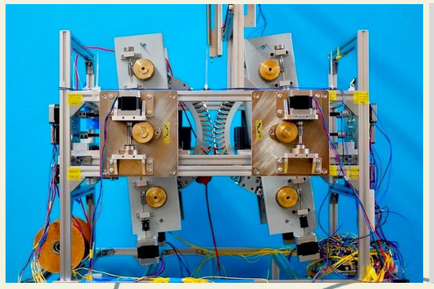


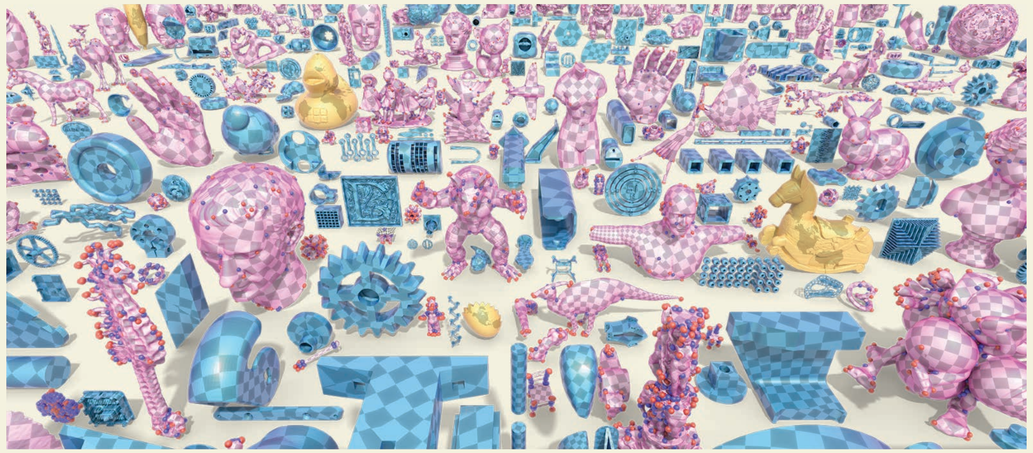


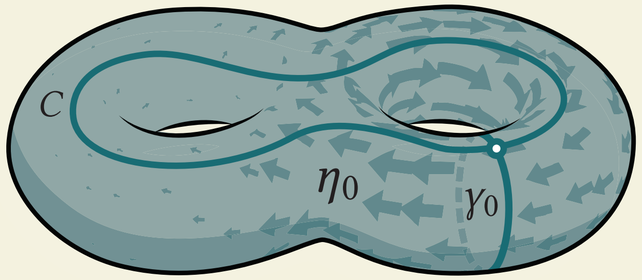
Symmetric Dirichlet Energy

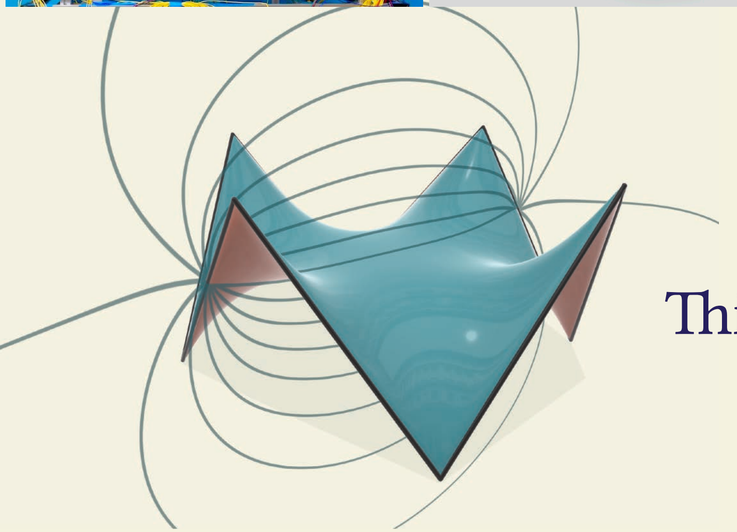
	ours	HOTE
cat	2.7	13.5
hippo	8.9	25582.5
dog	3.4	14.8

Mark Gillespie
geometry.cs.utah.edu
mark.gillespie@utah.edu

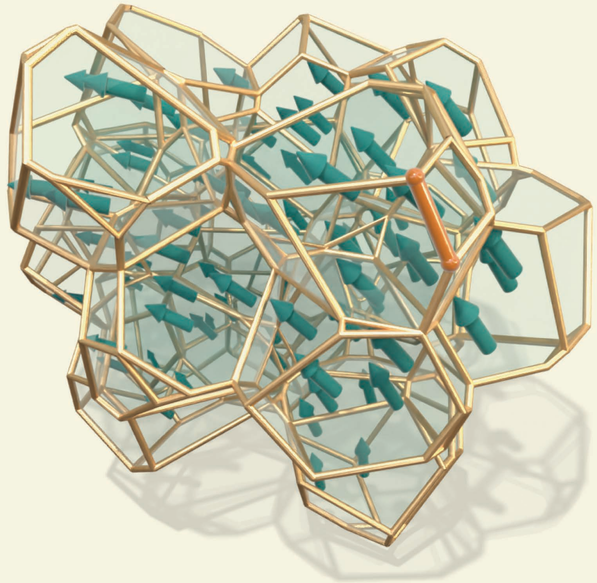


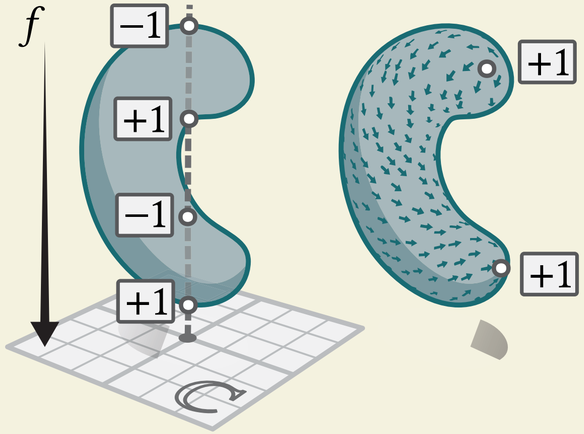




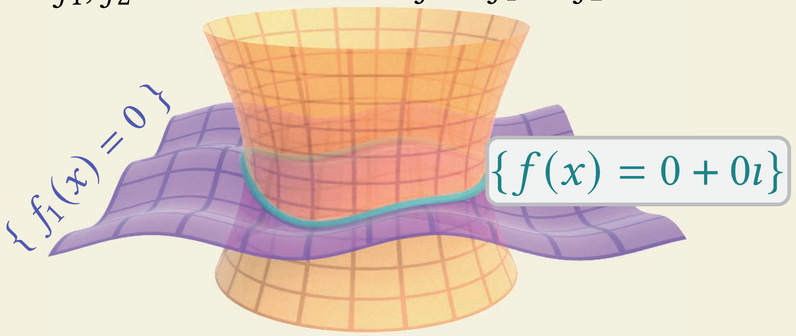


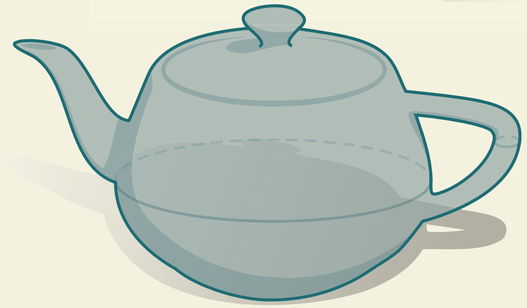
Thinking deeply about the **geometry** yields
more efficient algorithms
and **higher-quality** outputs





$f_1, f_2 : \mathbb{R}^3 \to \mathbb{R} \iff f = f_1 + \imath f_2 : \mathbb{R}^3 \to \mathbb{C}$





Mark Gillespie geometry.cs.utah.edu mark.gillespie@utah.edu

mark.gillespie@utah.edu
geometry.cs.utah.edu

Thanks for listening

please reach out if you want to talk more!