ShapeWorks

Statistical Shape Analysis Using Particle Systems

ShapeWorks Team

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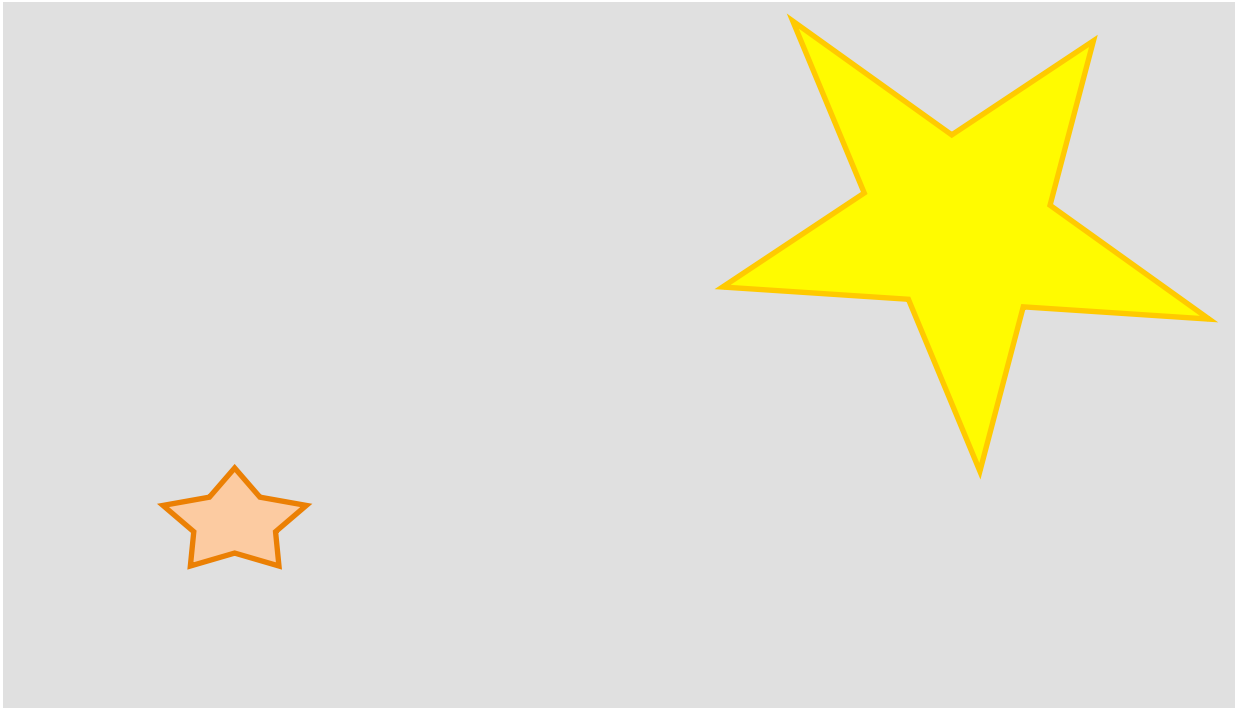
Shape



Shape = Object

Shape

Shape = Object - Location

Shape

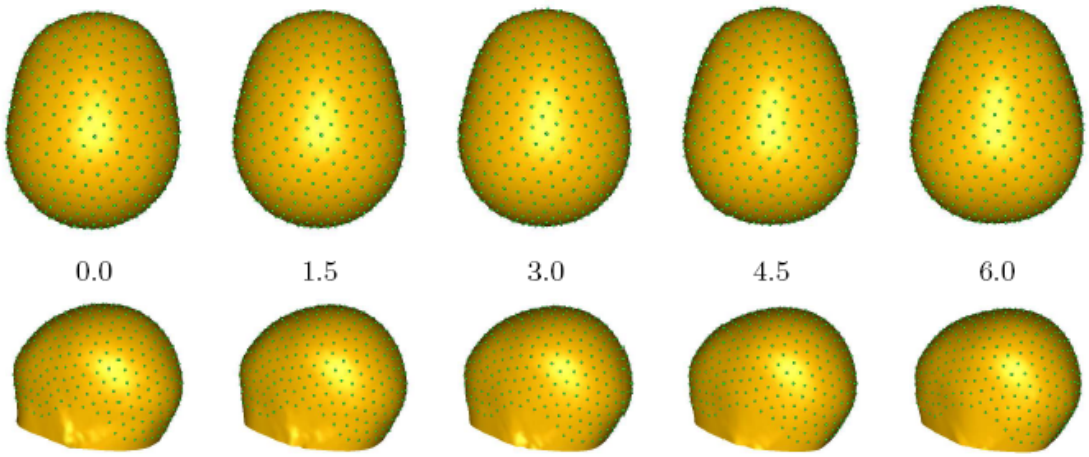
Shape = Object - Location - Orientation

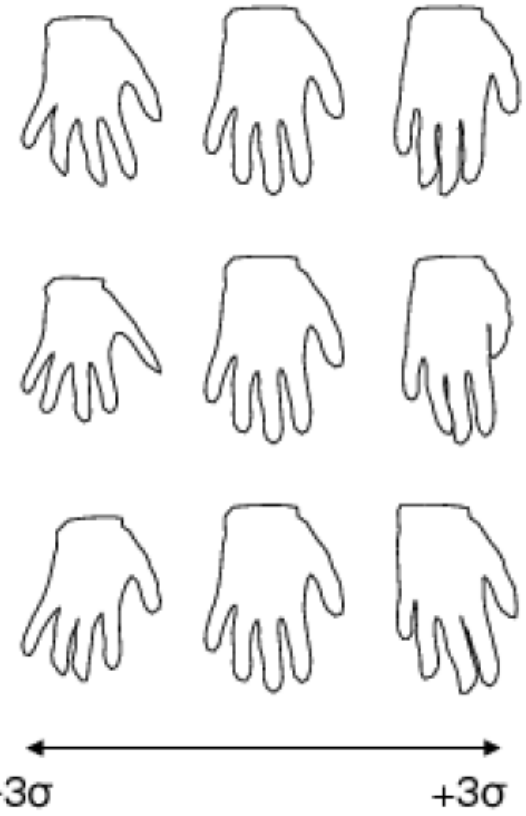
Shape

Shape = Object - Location - Orientation - Scale

Statistical Shape Analysis

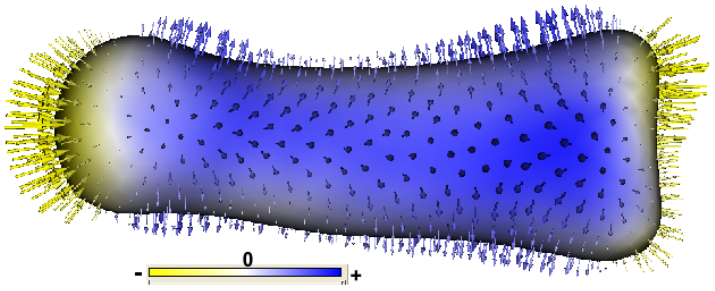
Quantify anatomical variability of populations





Anthropology & Evolutionary Biology (taxonomy)
Phenotyping
Neuroanatomy

Hypothesis testing for group differences



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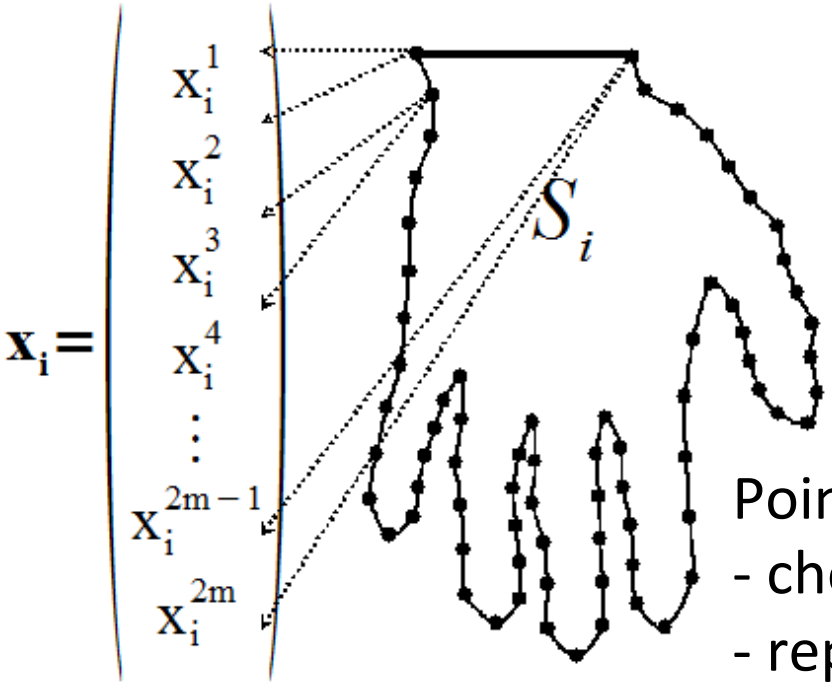
Shape Representation

Geometric surface
- segmentation output
- distance transform



Point-based representation
- choose “interesting” points i.e. landmarks
- represent shape as vector of landmarks

Can we do this automatically ??

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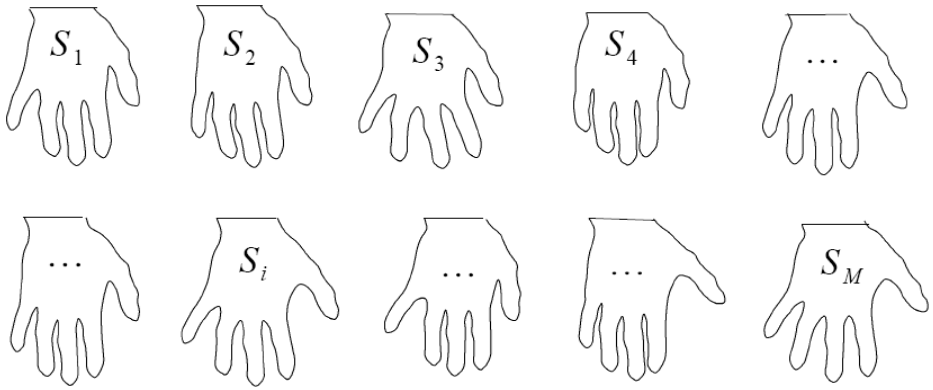
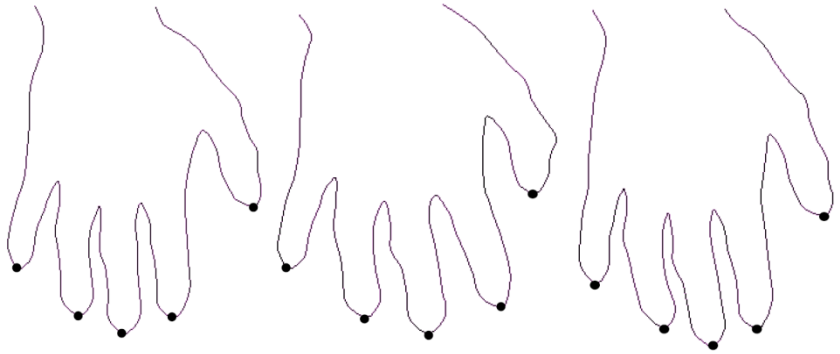
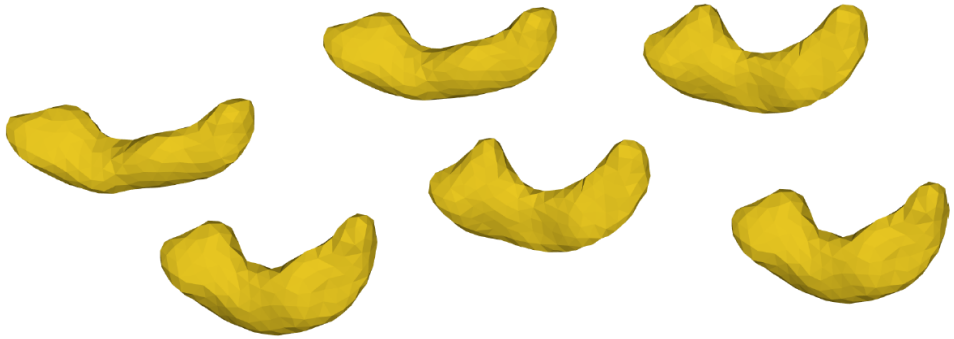
Shape Correspondence



Given a collection of shapes, we can use a point based representation for each S_i

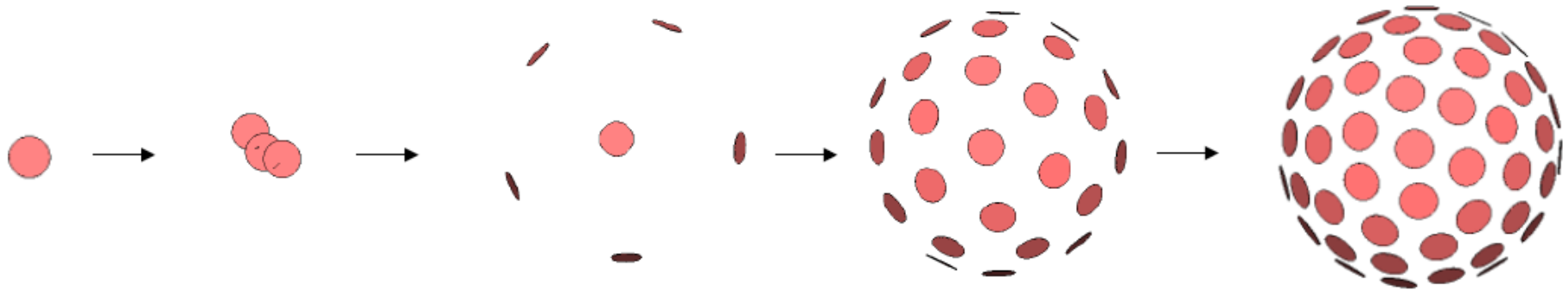
BUT…





How do we choose the “same” points ??

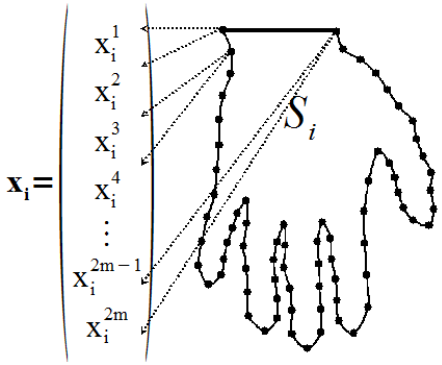
Particle System: Shape Representation



Inspiration: point set surfaces from computer graphics

Particles (interesting points):
- Computed automatically
- Distributed based on entropy based cost function
- Constrained to lie on surface

Particle System: Shape Correspondence



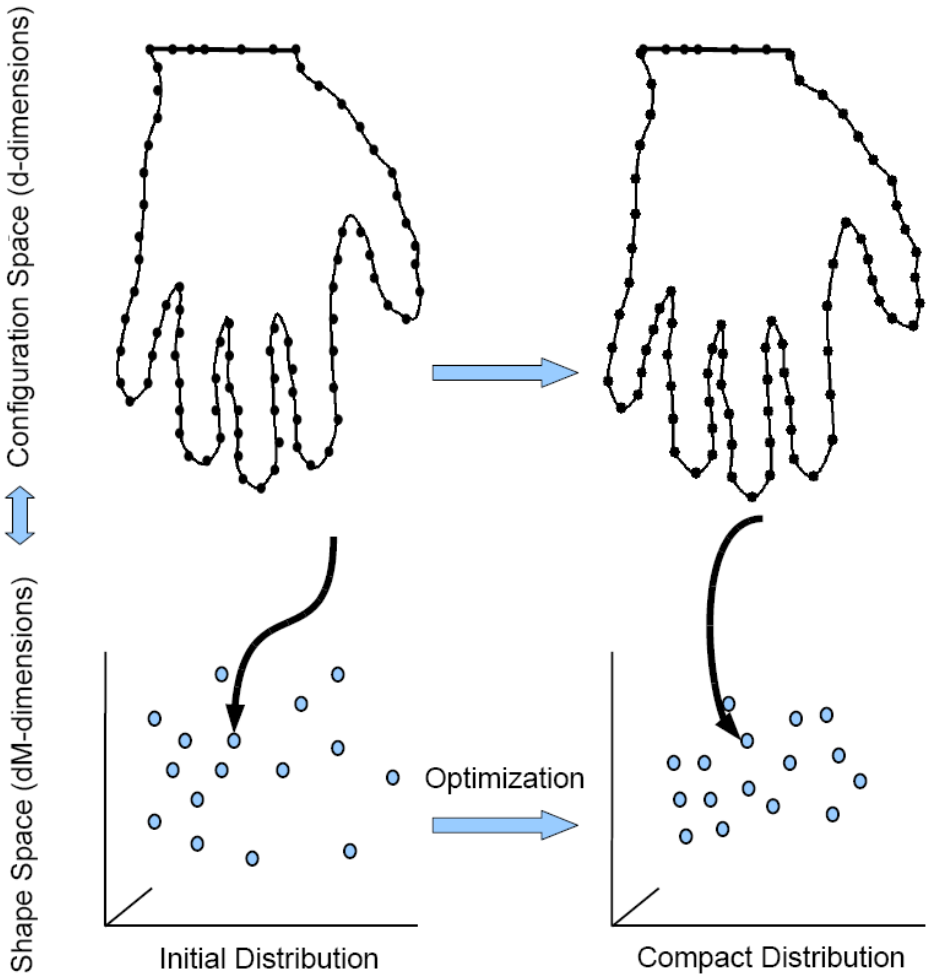
Configuration Space (d-dim)

$\mathbf{x}_i$ -> d-dimensional point

S_i -> $(\mathbf{x}_i^1, \ldots, \mathbf{x}_i^M)$

Shape Space (dM-dim)

S_i -> single point !



Trade-off: compact model v/s accurate sampling

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Tool to do everything we just saw…

DEMO