

EFFICIENT GLOBALLY OPTIMAL 2D-TO-3D DEFORMABLE SHAPE MATCHING

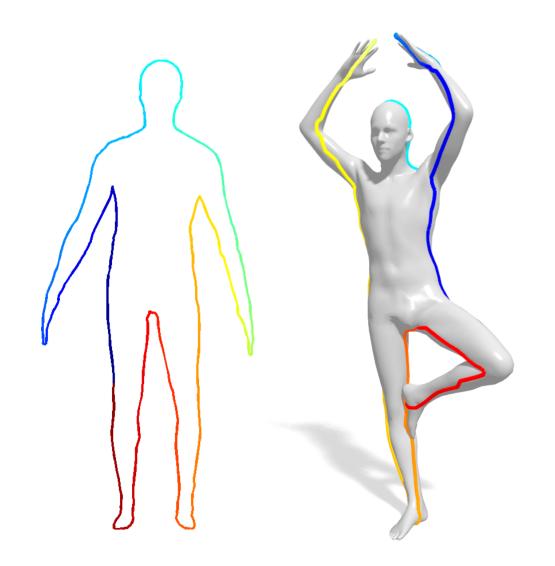
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THE TASK

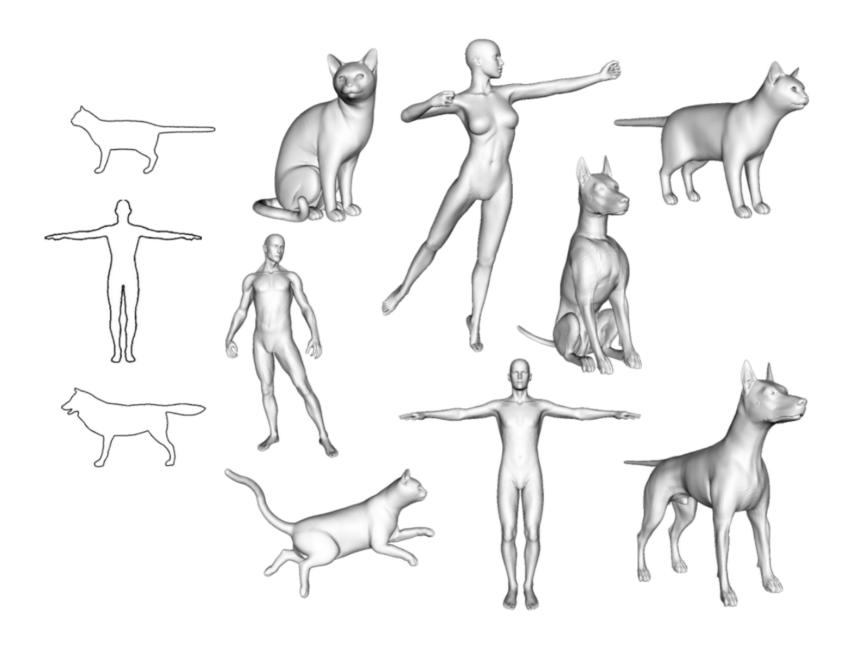




Finding a continuous matching between a 2D template shape and a 3D model that matches points which look alike

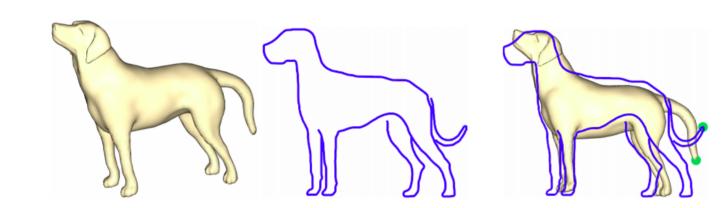
RETRIEVAL

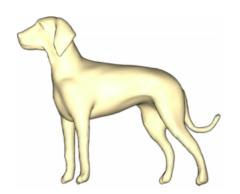




SKETCH-BASED MODELLING



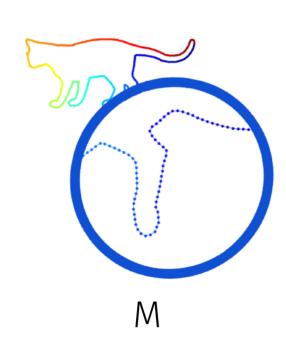


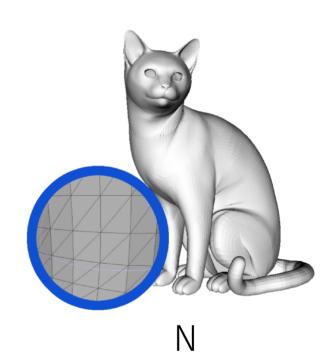


Kraevoy et al., 2009

INPUTS



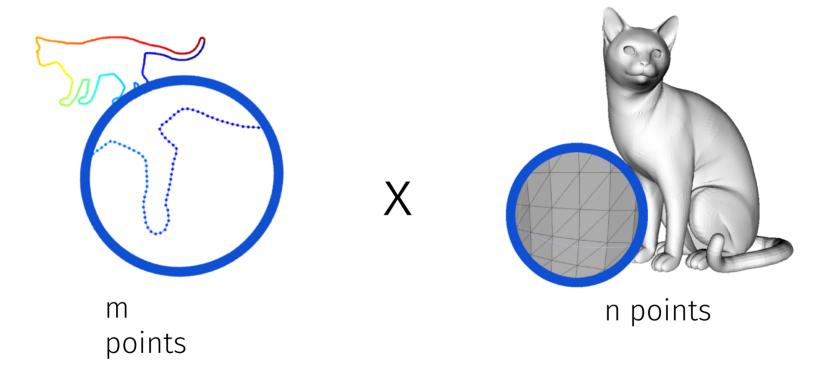




$$\varphi^* = \underset{\varphi:M \to N}{\operatorname{arg\,min}} E(\varphi)$$

PRODUCT MANIFOLD

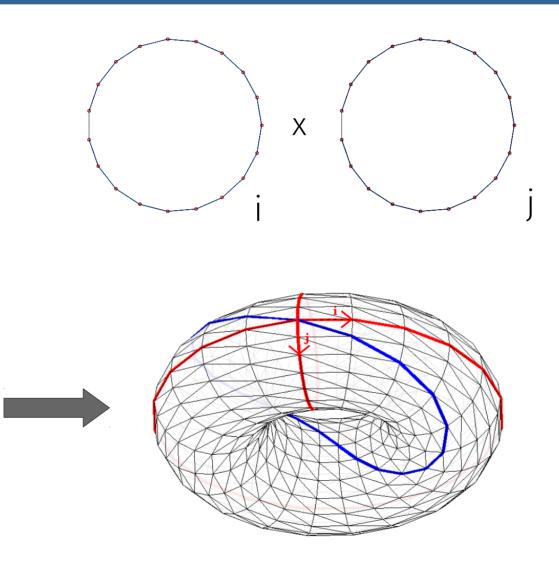




Each node in the product manifold represents a possible match between a point on the contour and on the model.

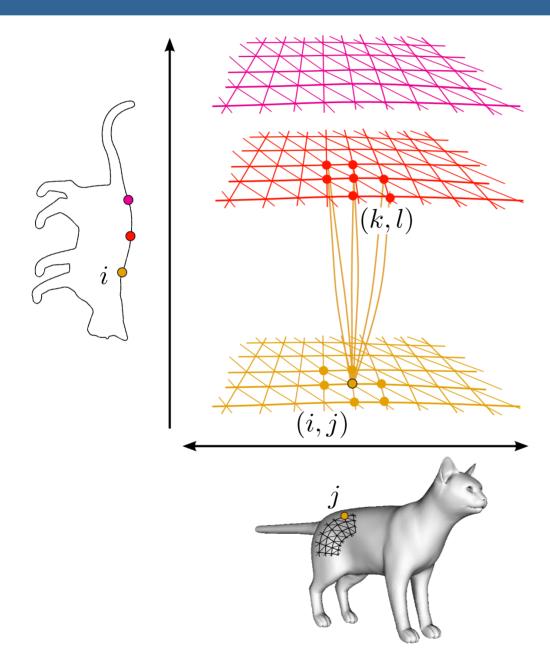
PRODUCT MANIFOLD





PRODUCT MANIFOLD



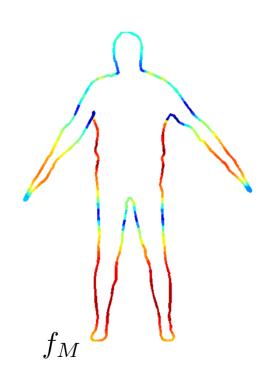


An edge between (i, j) and (k, l) exists if both i, k and j, l are the same or neighbors on the original shapes.

ENERGY FORMULATION



$$E(\varphi) = \int_{\Gamma_{\varphi}} \operatorname{dist}(f_M(s_M), f_N(s_N)) \, \mathrm{d}s$$

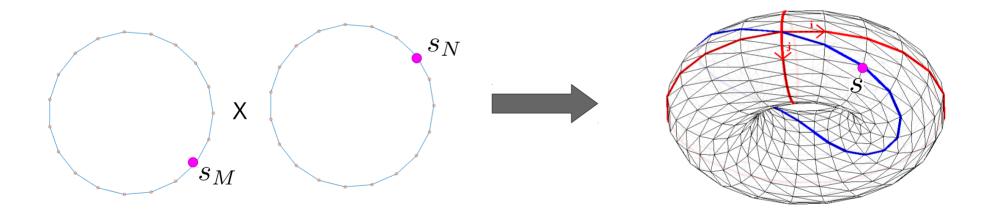




ENERGY FORMULATION

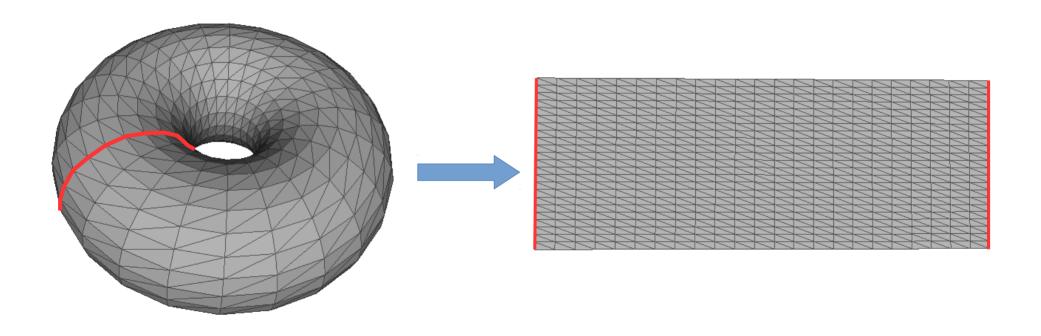


$$E(\varphi) = \int_{\Gamma_{\varphi}} \operatorname{dist}(f_M(s_M), f_N(s_N)) \, \mathrm{d}s$$



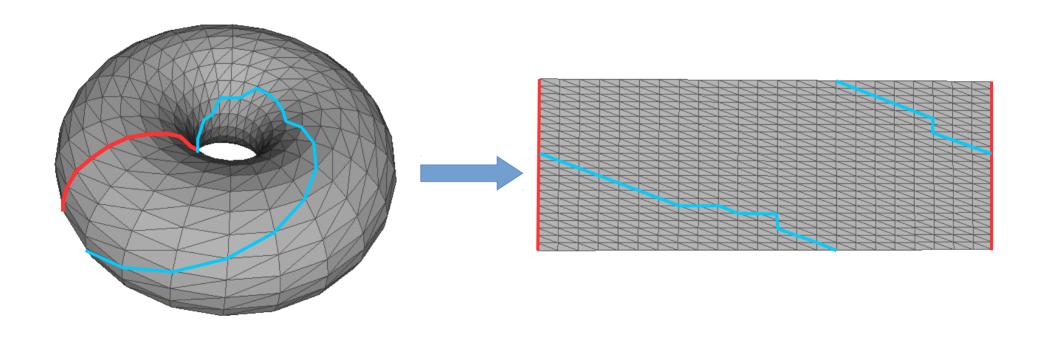
SLICED PRODUCT MANIFOLD





SLICED PRODUCT MANIFOLD





RUNTIME



Given a 2D template shape M and a 3D model shape N, discretized at m and n vertices, respectively, we can find a minimizer in $O(mn^2 \log(n))$ time.

If $n = O(m^2)$, this leads to the subcubic runtime of $O(n^{2.5} \log(n))$.



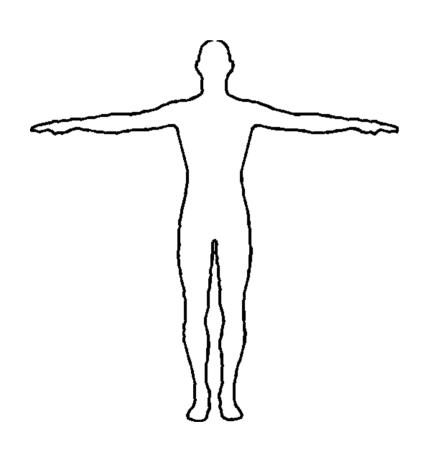
m vertices

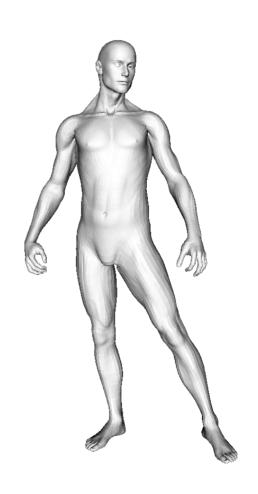


n vertices

FEATURES







SPECTRAL FEATURES



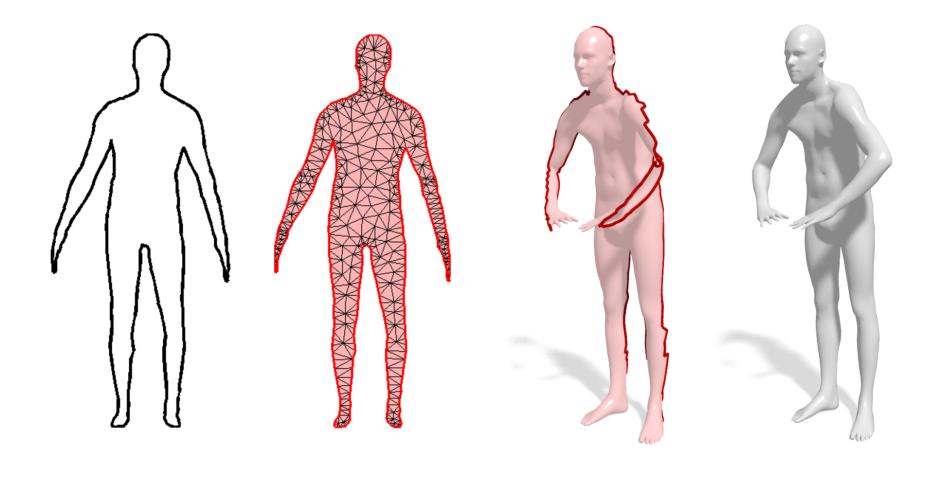


Purely based on intrinsic properties and therefore invariant to isometric deformations



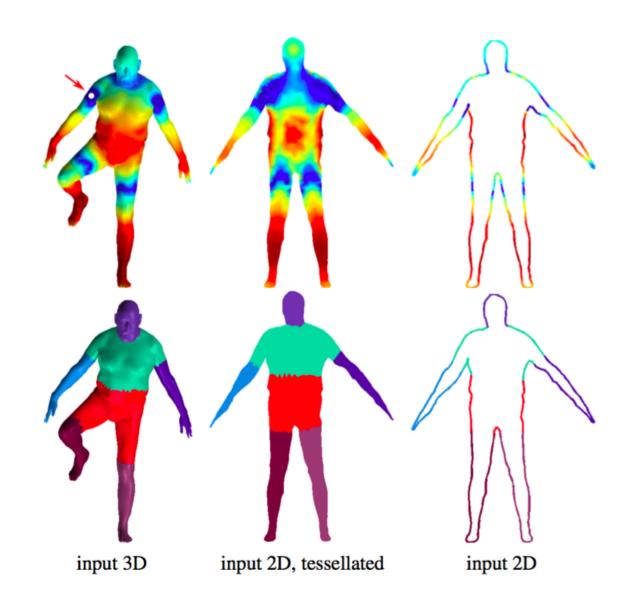
SPECTRAL FEATURES





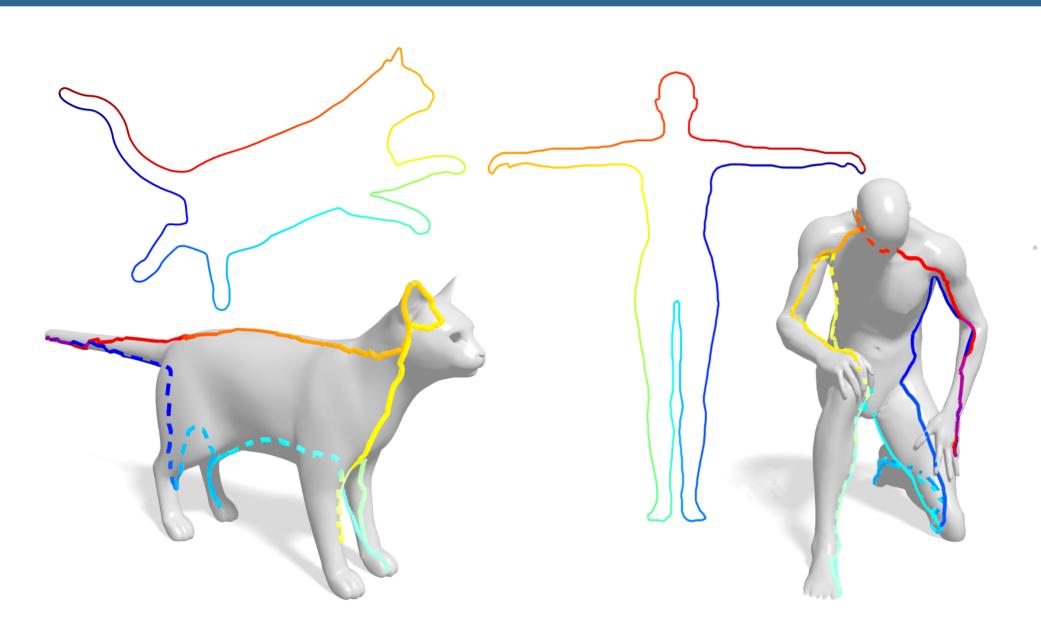
SPECTRAL FEATURES





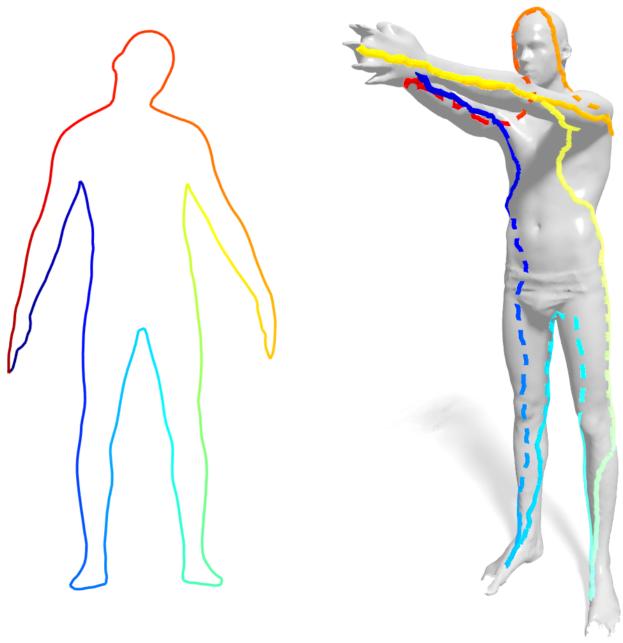
RESULTS





RESULTS

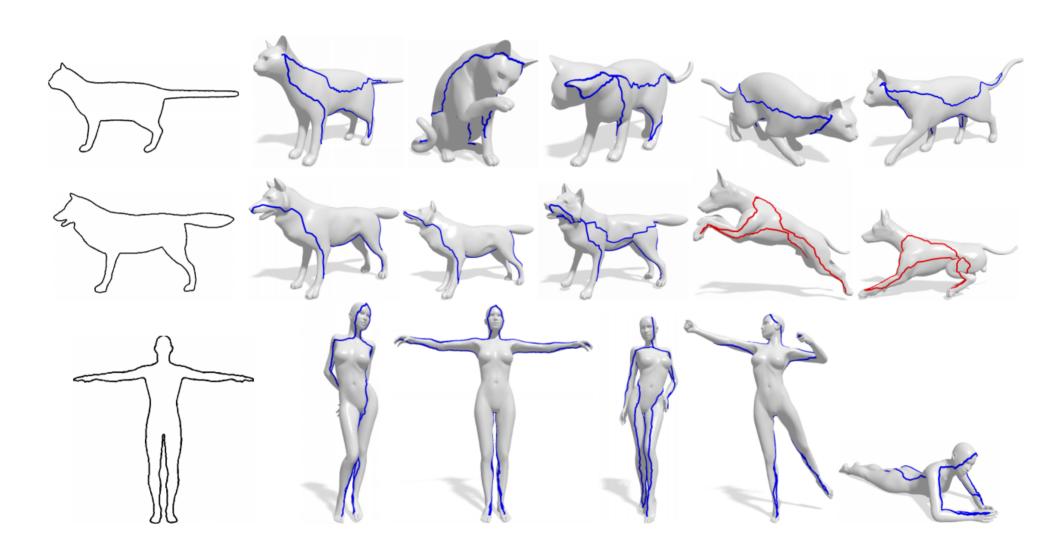




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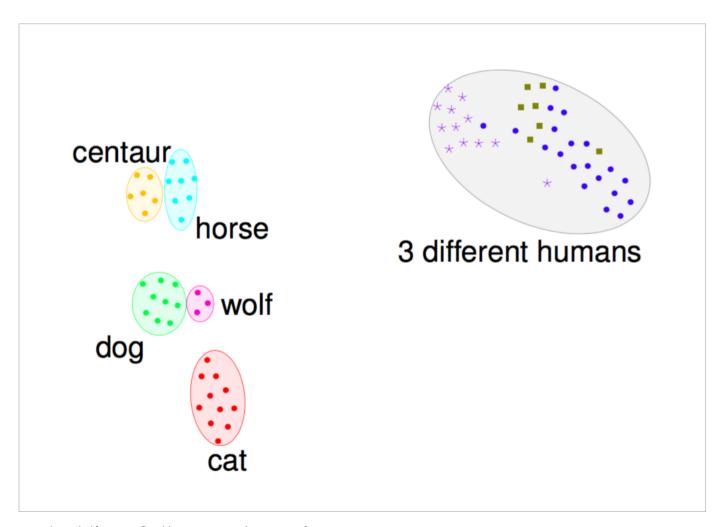
RETRIEVAL RESULTS





CLASSIFICATION





Embedding of all Tosca Shapes into 2D

CONCLUSION



- Fully automated Matching
- Provable subcubic time, even faster in normal cases
- Globally optimal solution
- Continuous solution
- Comparable 2D-to-3D Features



Thank you for your attention!

Questions?