Università della Svizzera italiana

9th Eurographics Workshop on 3D Object Retrieval

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SHREC'16 Track: Partial Matching of Deformable Shapes

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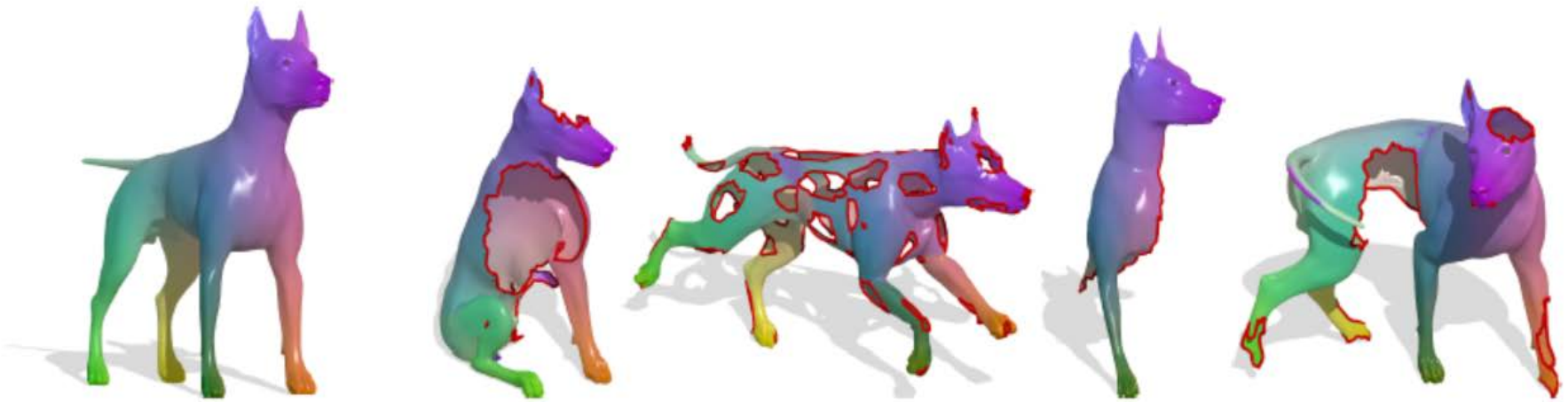
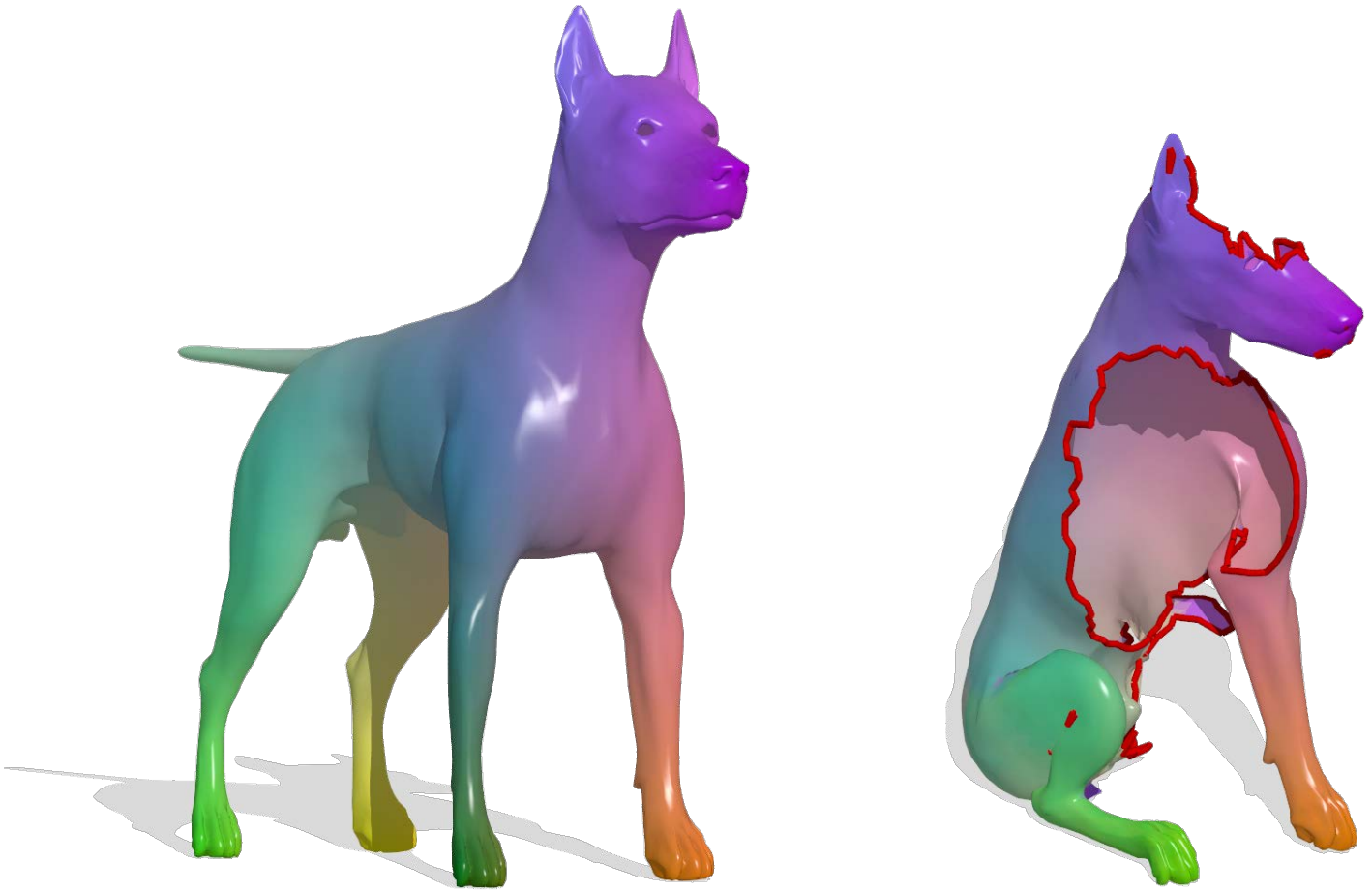


Deformable partial matching

Task: Establish a point-to-point correspondence between a **full 3D shape** and a **deformed, partial** version thereof.



Deformable partial matching

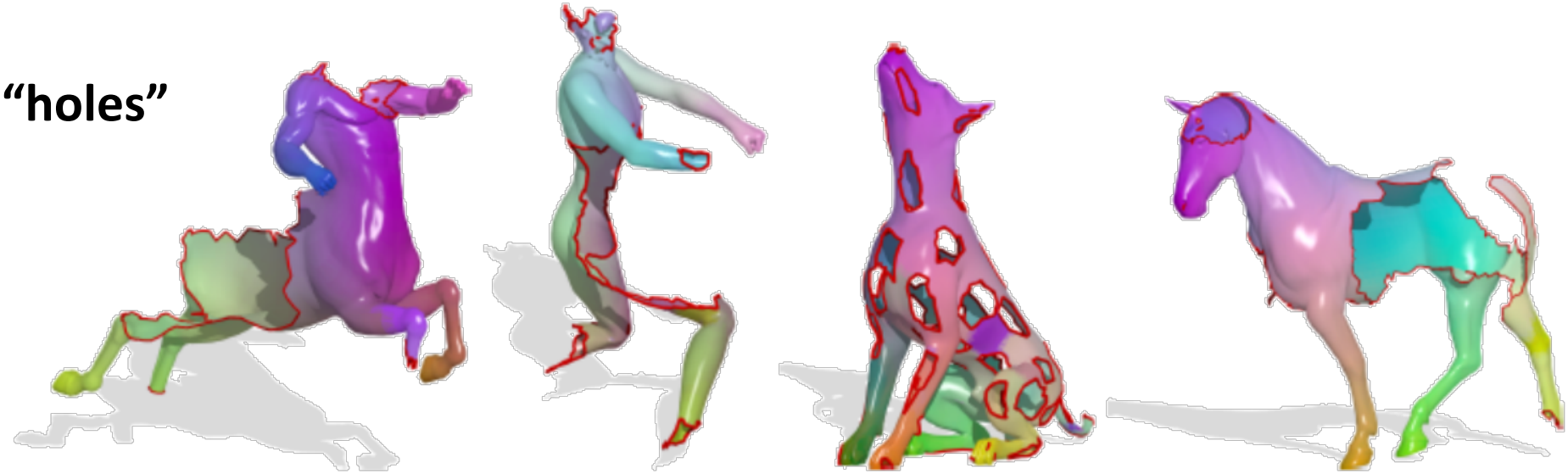
Motivation: Existing matching techniques do not deal well with **real data**, where occlusions and clutter give rise to missing parts.

The dataset

We provide **two sets** of shapes consisting of **200 shapes each**.

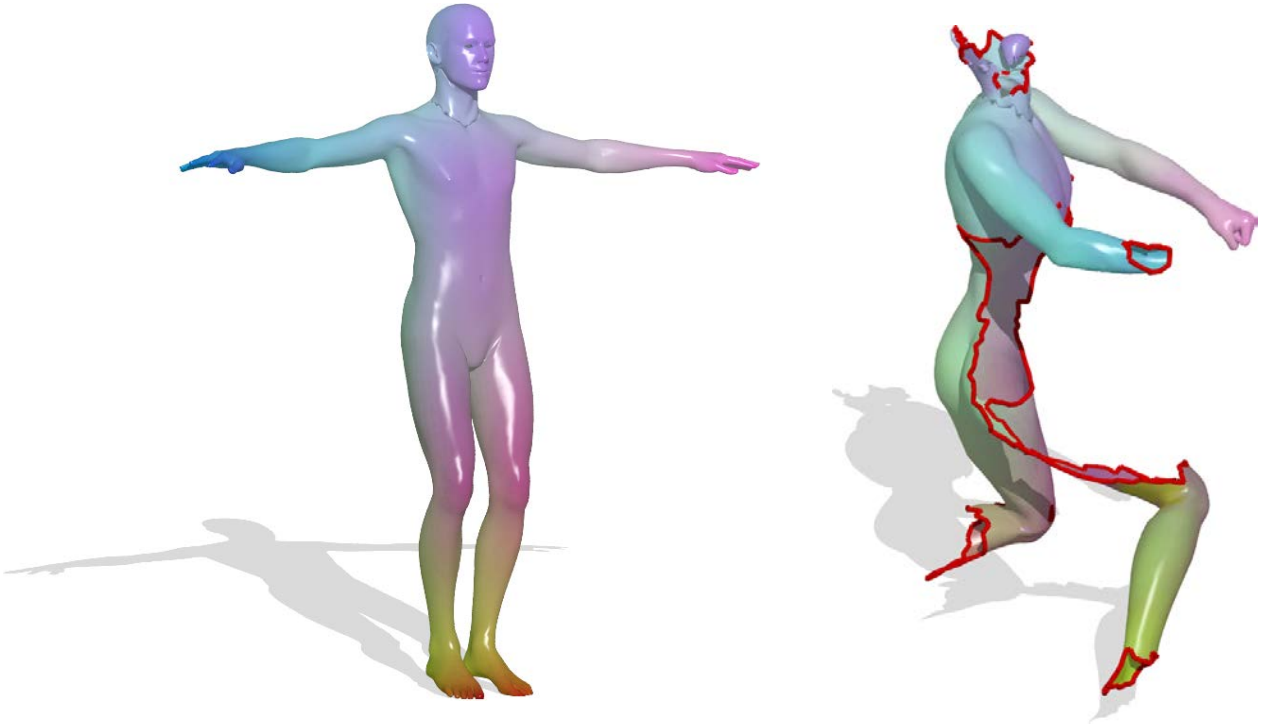
“cuts”

“holes”



The matching problem

Shapes are divided into **8 classes**.
Each shape has to be matched to the **null shape** of the same class.



This results in **400 matching problems** in total.

We additionally provide **~200 extra shapes** with dense **ground-truth**.

Participants

Five methods participated to the contest.

Minimum distortion correspondence - *sparse* (GT, IM, EN):

- "A game-theoretic approach to deformable shape matching", Rodolà, Bronstein, Albarelli, Bergamasco, Torsello. Proc. CVPR 2012.
- "Scale normalization for isometric shape matching", Sahillioğlu and Yemez. CGF 2012.
- "Elastic net constraints for shape matching", Rodolà, Torsello, Harada, Kuniyoshi, Cremers. Proc. ICCV 2013.

Functional correspondence - *dense* (PFM):

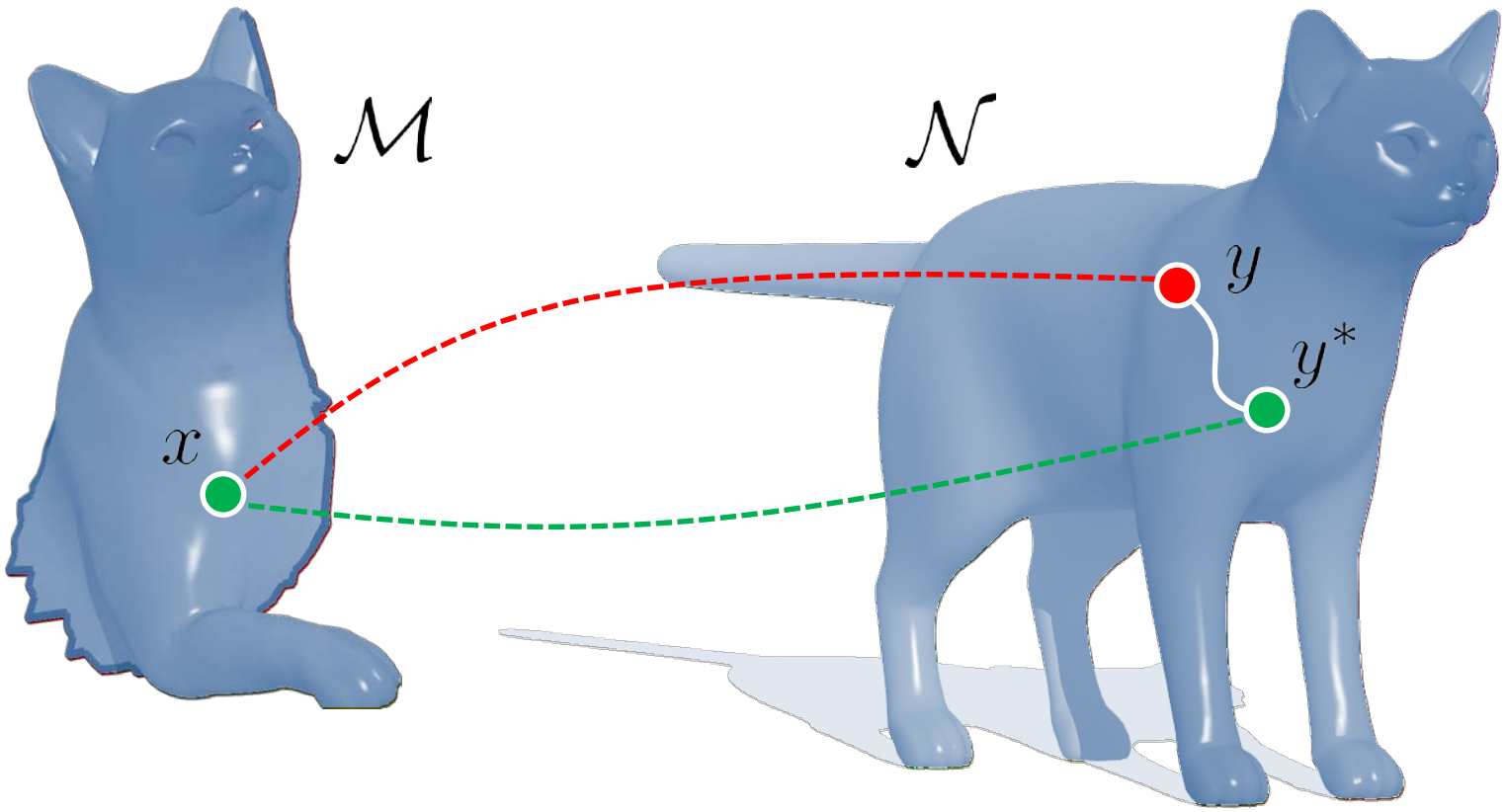
- "Partial functional correspondence", Rodolà, Cosmo, Bronstein, Torsello, Cremers. CGF 2016.

Learning-based - *dense* (RF):

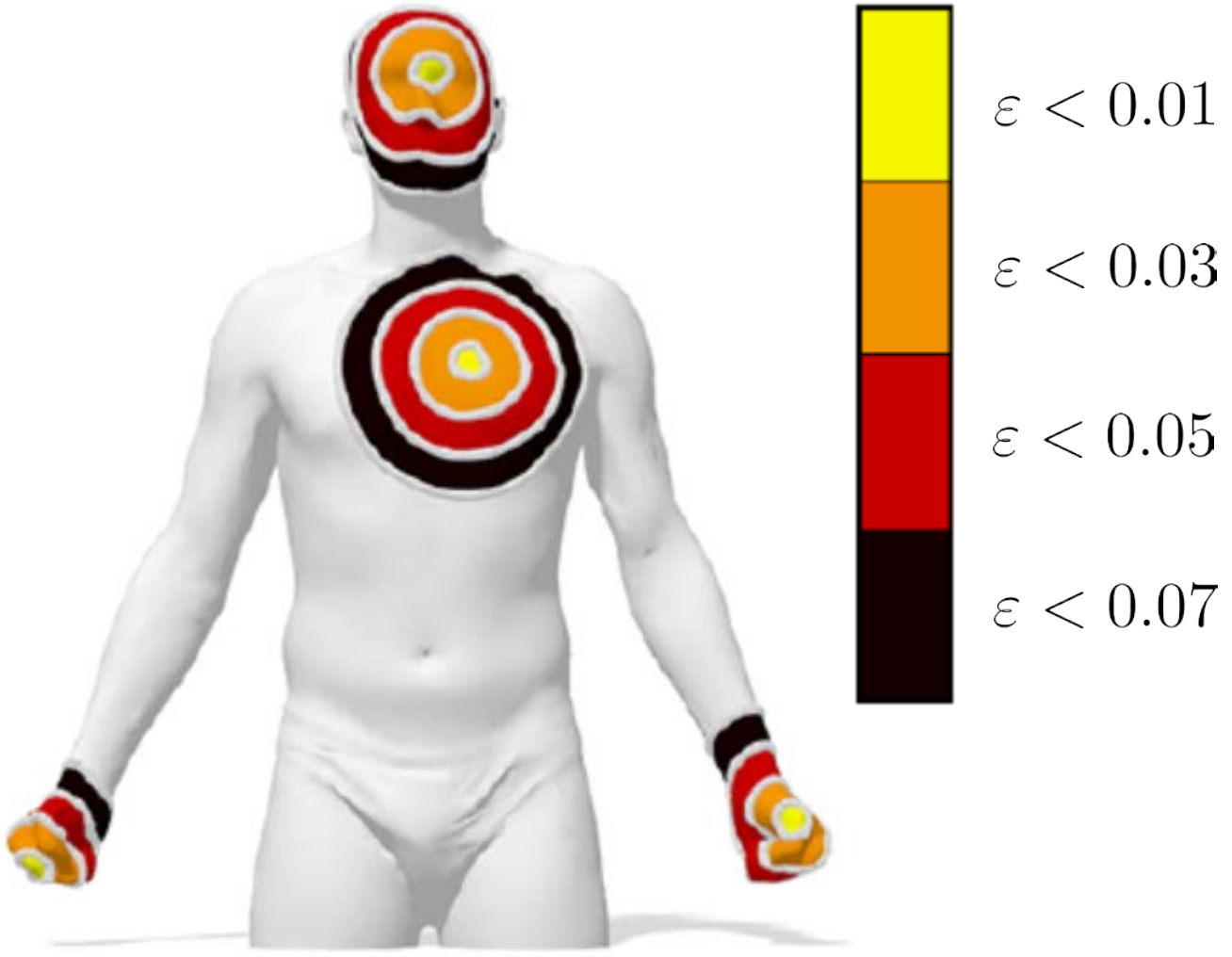
- "Dense non-rigid shape correspondence using random forests", Rodolà, Rota Bulò, Windheuser, Vestner, Cremers. Proc. CVPR 2014.

Error measure

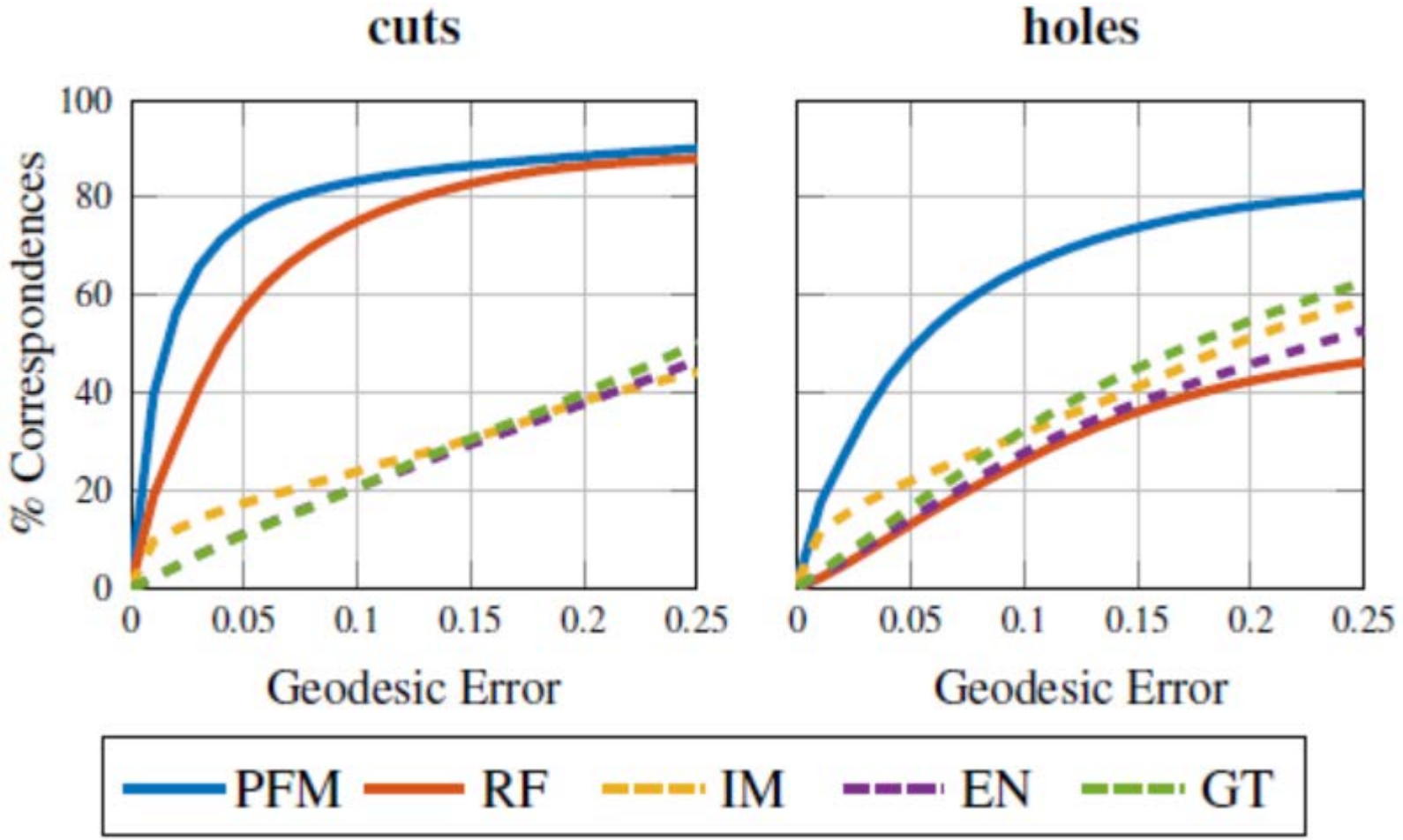
$$\varepsilon(x) = \frac{d_{\mathcal{N}}(y, y^*)}{\text{area}(\mathcal{N})^{1/2}}$$



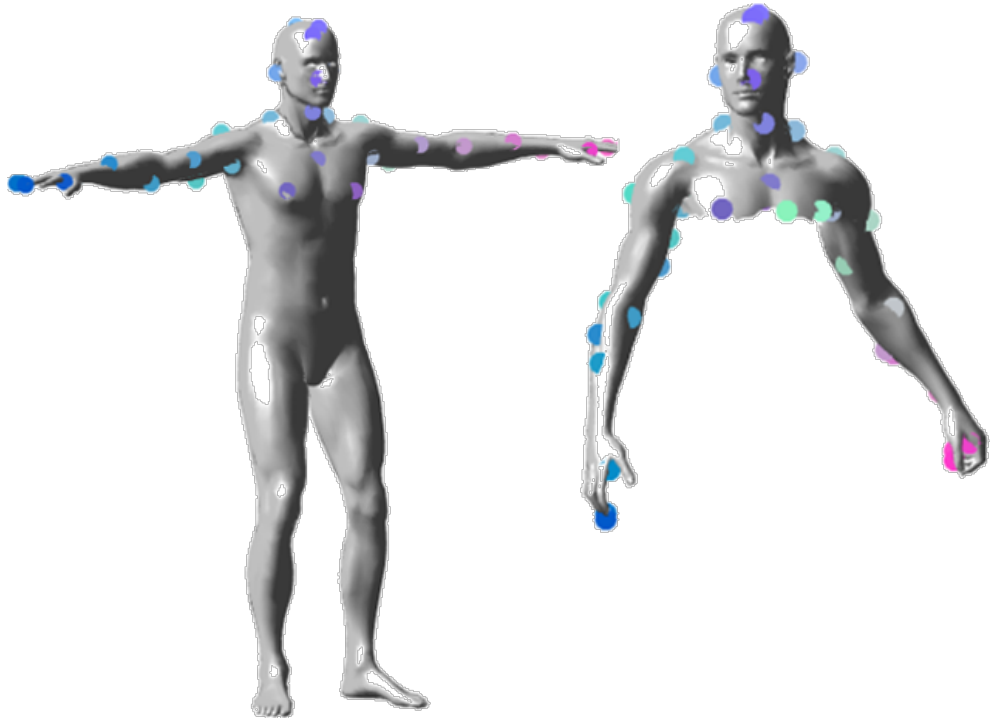
Error measure

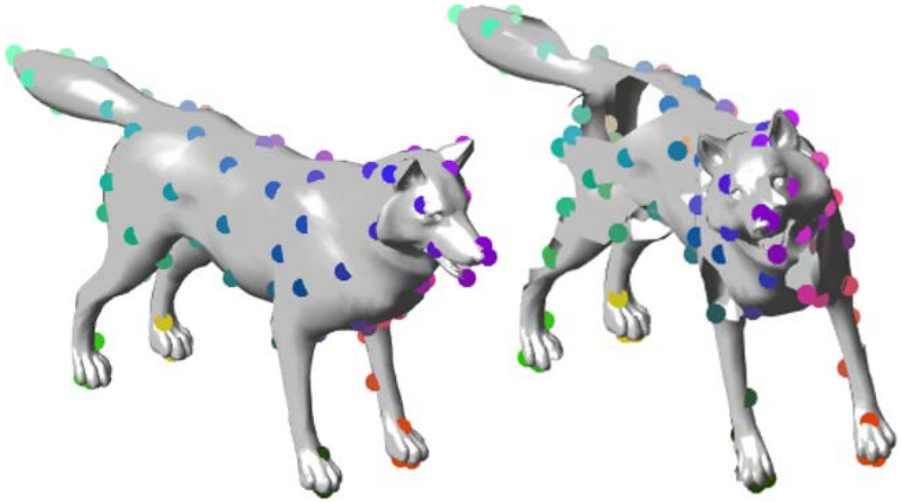


Results


cuts
holes
% Correspondences
100
80
60
40
20
0
0
0.05
0.1
0.15
0.2
0.25
Geodesic Error
Geodesic Error
PFM
RF
IM
EN
GT

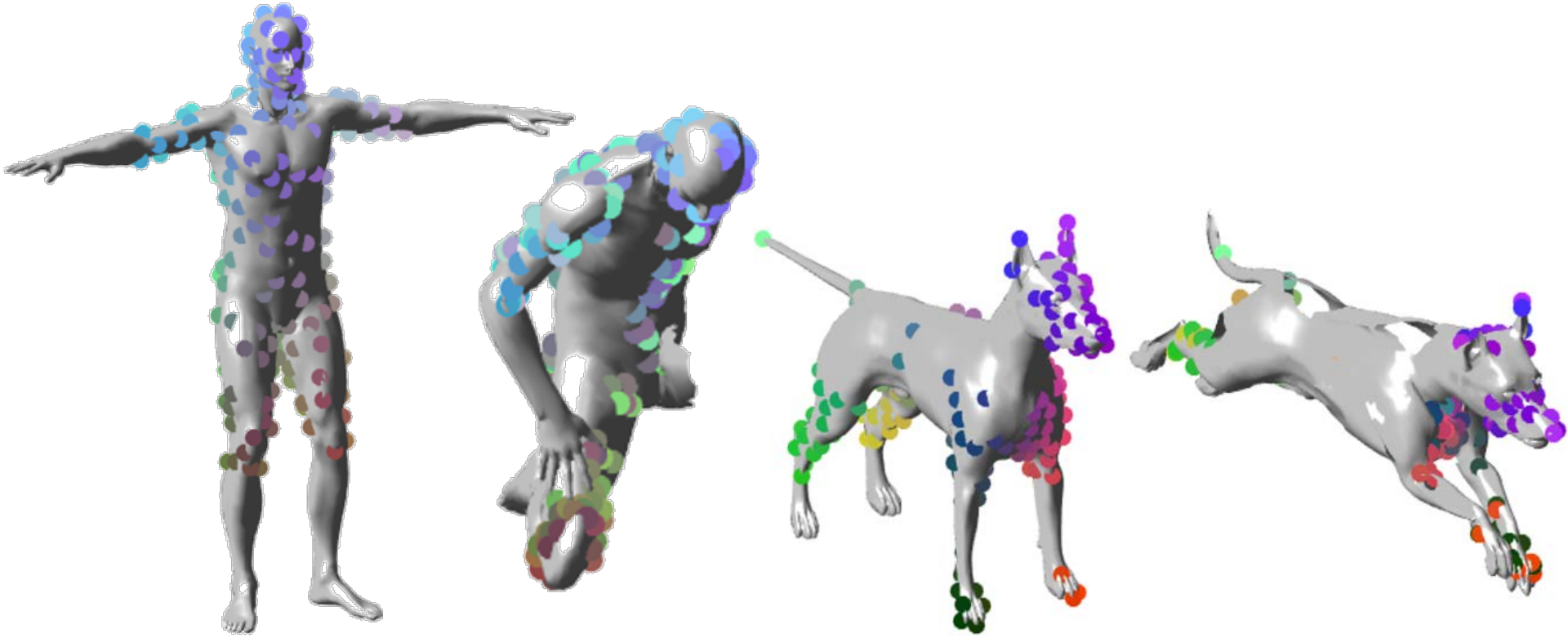
Results – IM





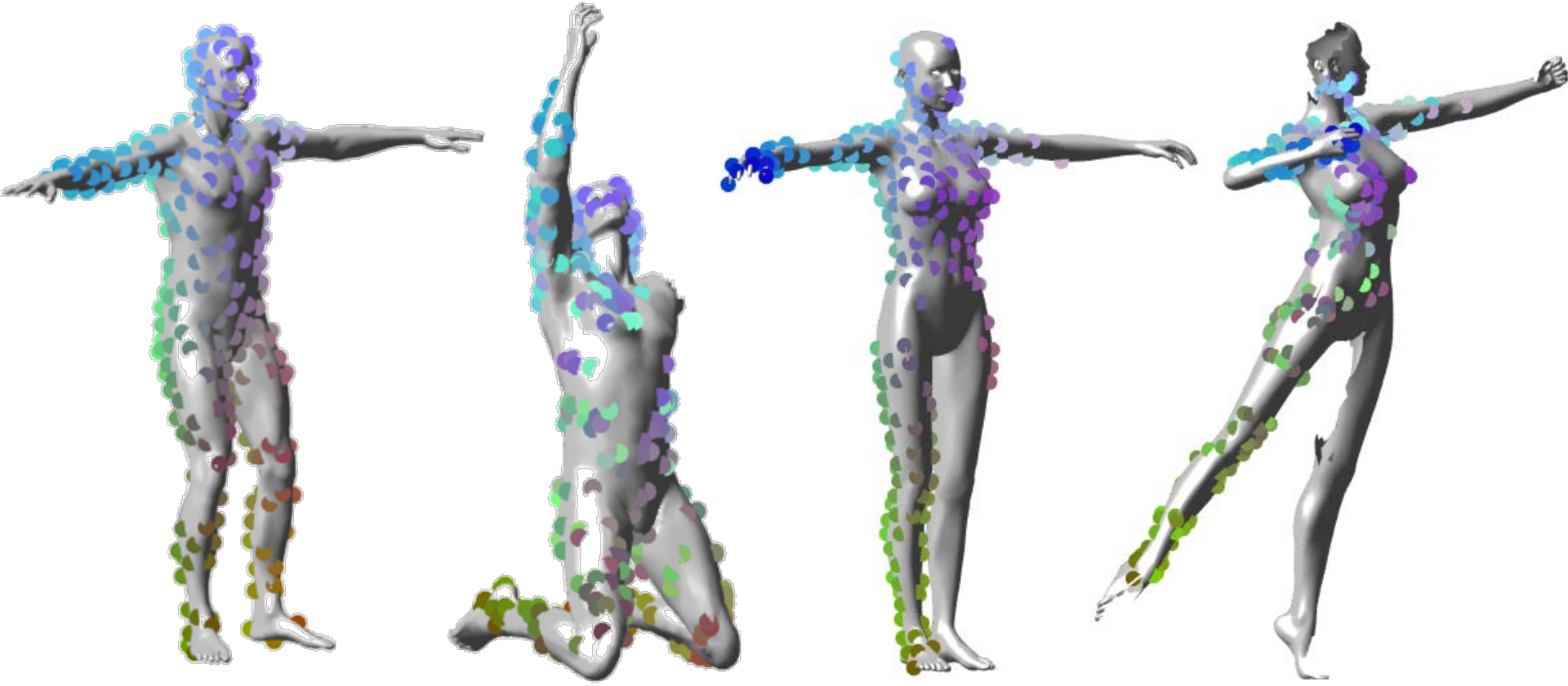
Suffers from the metric distortion due to partiality.

Results - EN



Tends to match the rigid parts.

Results - GT



Similar to EN, more sparse.

Results - RF

Learns parameters of spectral descriptors, which suffer greatly from boundary effects.

Results - PFM

Uses *extrinsic* descriptors to avoid boundary effects. The problem is regularized by using a *partiality prior* on the functional map.

Conclusions

- Partial shape matching has received limited attention so far, but it is quickly gaining practical relevance
- Partial-to-partial? Topological shortcuts and clutter?