BODYFITR: Robust automatic 3D human body fitting

Alexandre Saint[1,*], A. Shabayek[1], K. Cherenkova[1,2], G. Gusev[2], D. Aouada[1], B. Ottersten[1]

[1] SnT, University of Luxembourg

[2] Artec Europe SARL

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alexandre.saint@uni.lu | https://cvdatasets.uni.lu

Abstract

The proposed method, BODYFITR, automatically fits a human body model to a static 3D scan with complex poses using minimal assumptions. Automatic and reliable fitting is required for large-scale data processing. Assumptions made in other works are relaxed. The evaluation on and the comparison to 3DBodyTex [1] shows gains in performance.

Fig.1 Results on 3DBodyTex [1]
https://cvdatasets.uni.lu/

Motivation

Need:

- Bring 3D body scans in **correspondence** with a template body mesh
- **Automatic** processing
- **Robust** to arbitrary meshing, body pose and body shape

Limitations in state of the art:

- Assumption on **pose** [2]
- **Manual** landmark picking [3, 4]
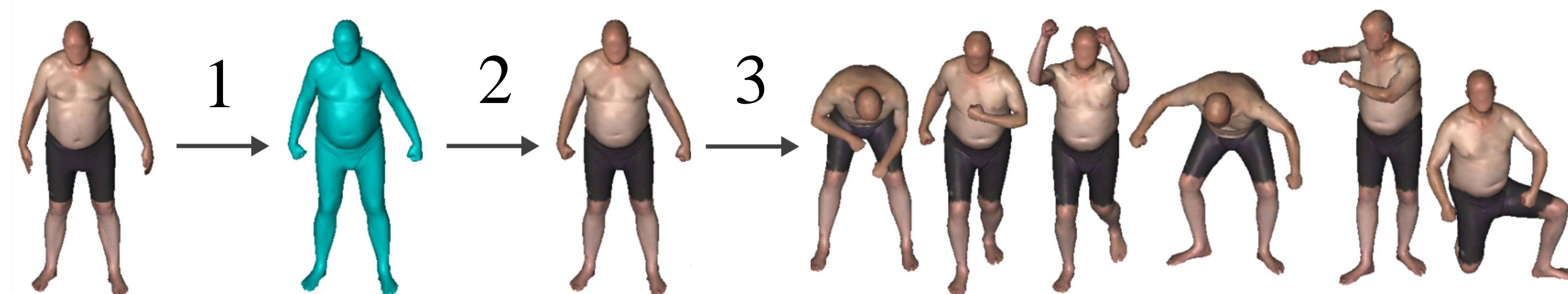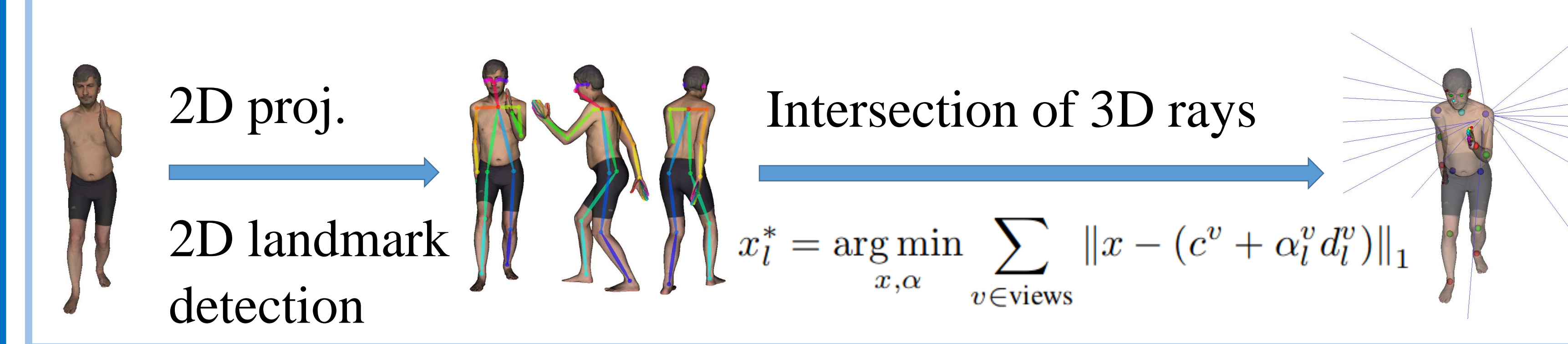- Not robust to fine **shape** details [1]

Application

Fig.3 Avatar animation: 1. fitting; 2. texture transfer; 3. reposing

Proposed robust automatic fitting

Four improvements for robustness over BODYFIT [1]:

1. Robust 3D ray intersection by optimization:

2D proj.

2D landmark detection

Intersection of 3D rays

$$x_l^* = \arg\min_{x,\alpha} \sum_{v \in \text{views}} \|x - (c^v + \alpha_l^v d_l^v)\|_1$$

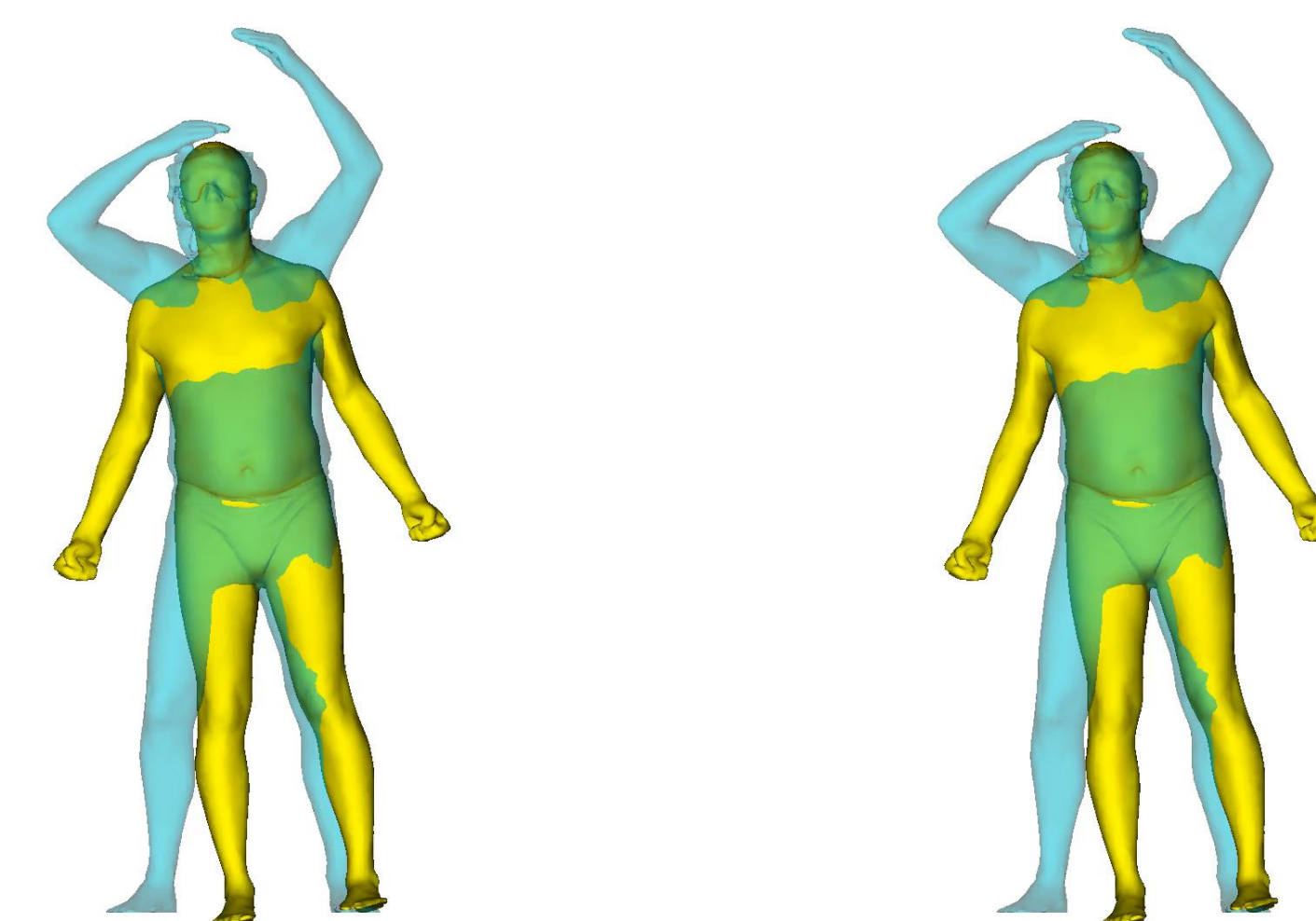### 2. Learned on the body model

Regressor g:
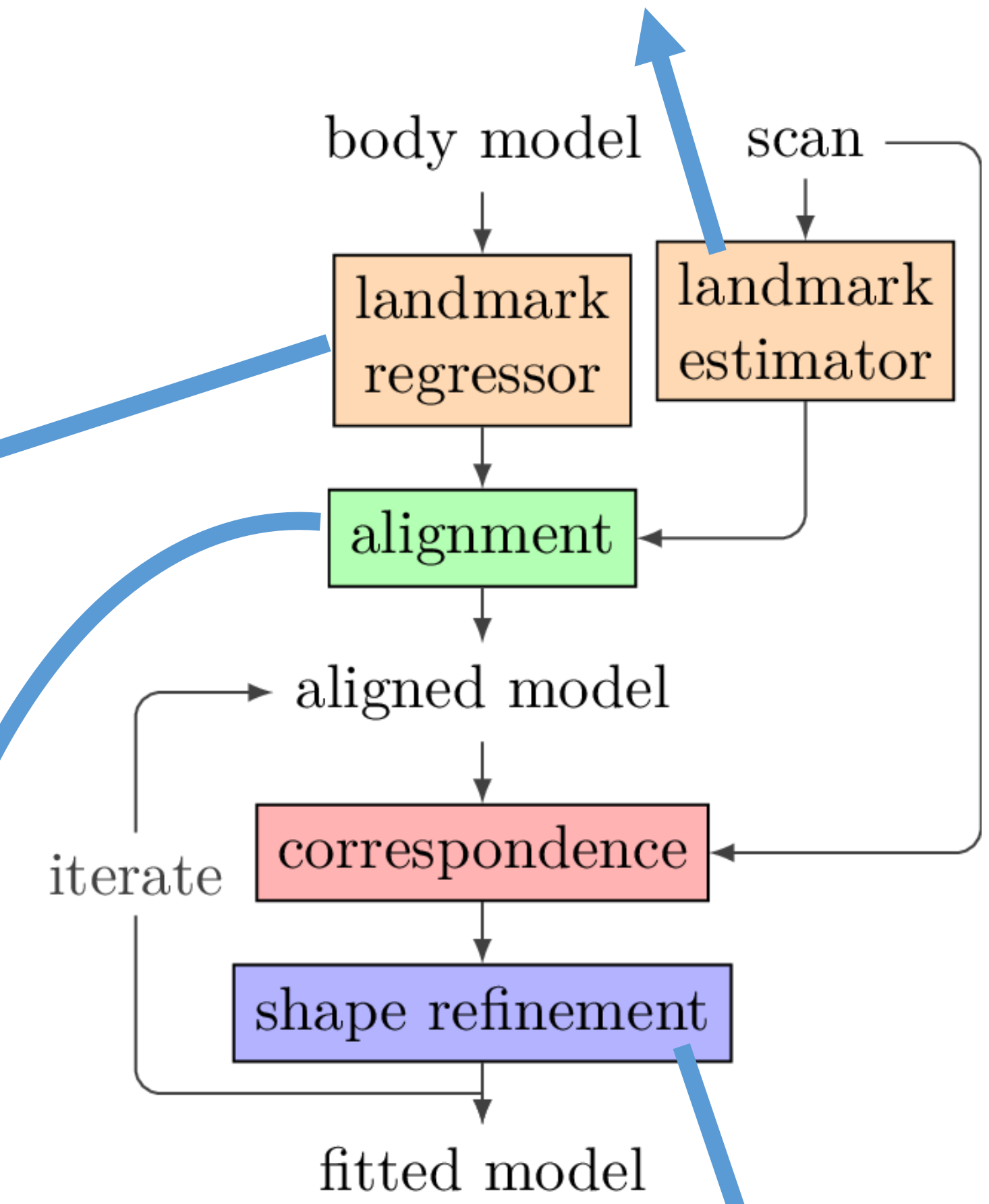
$$p_l = V^T g_l$$

Learning:

$$\arg\min_{g_l} \frac{1}{2}\|b - Ag_l\|_2^2 + \lambda\|g_l\|_1$$

3. Incremental pose fitting

4. Point-to-plane ICP

$$E_v = \sum_{(y,z) \in C} \|n_z^T(y-z)\|_2^2$$

Experiments

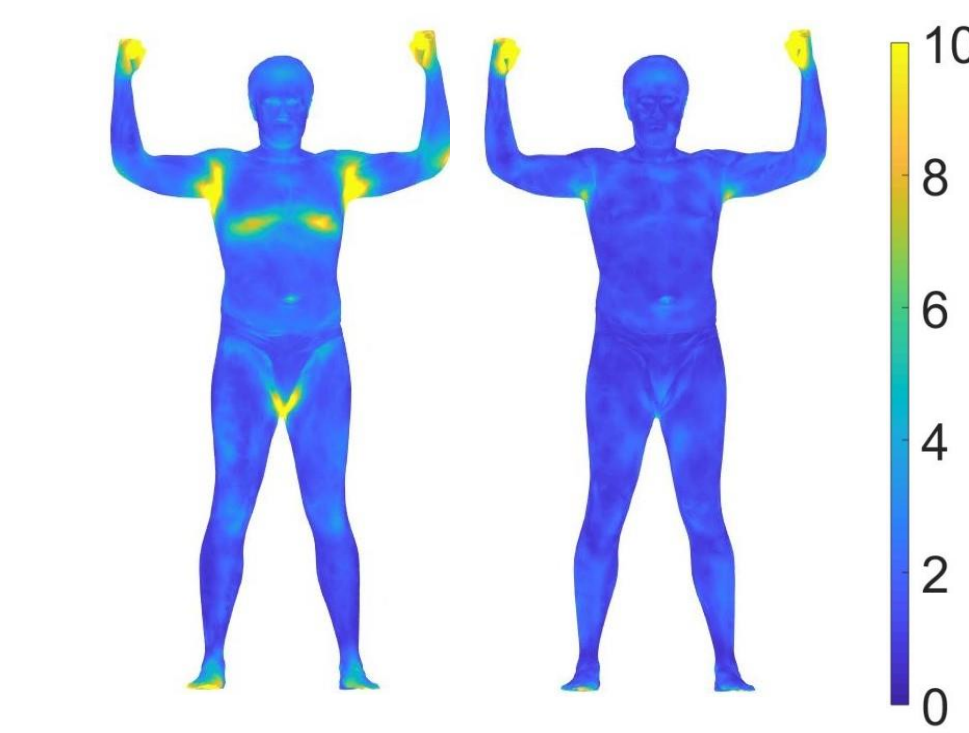Analysis of the fitting error compared to [1].

	[1]	Ours
mean	3.10	2.40
median	1.54	1.33

[1]   **Ours**
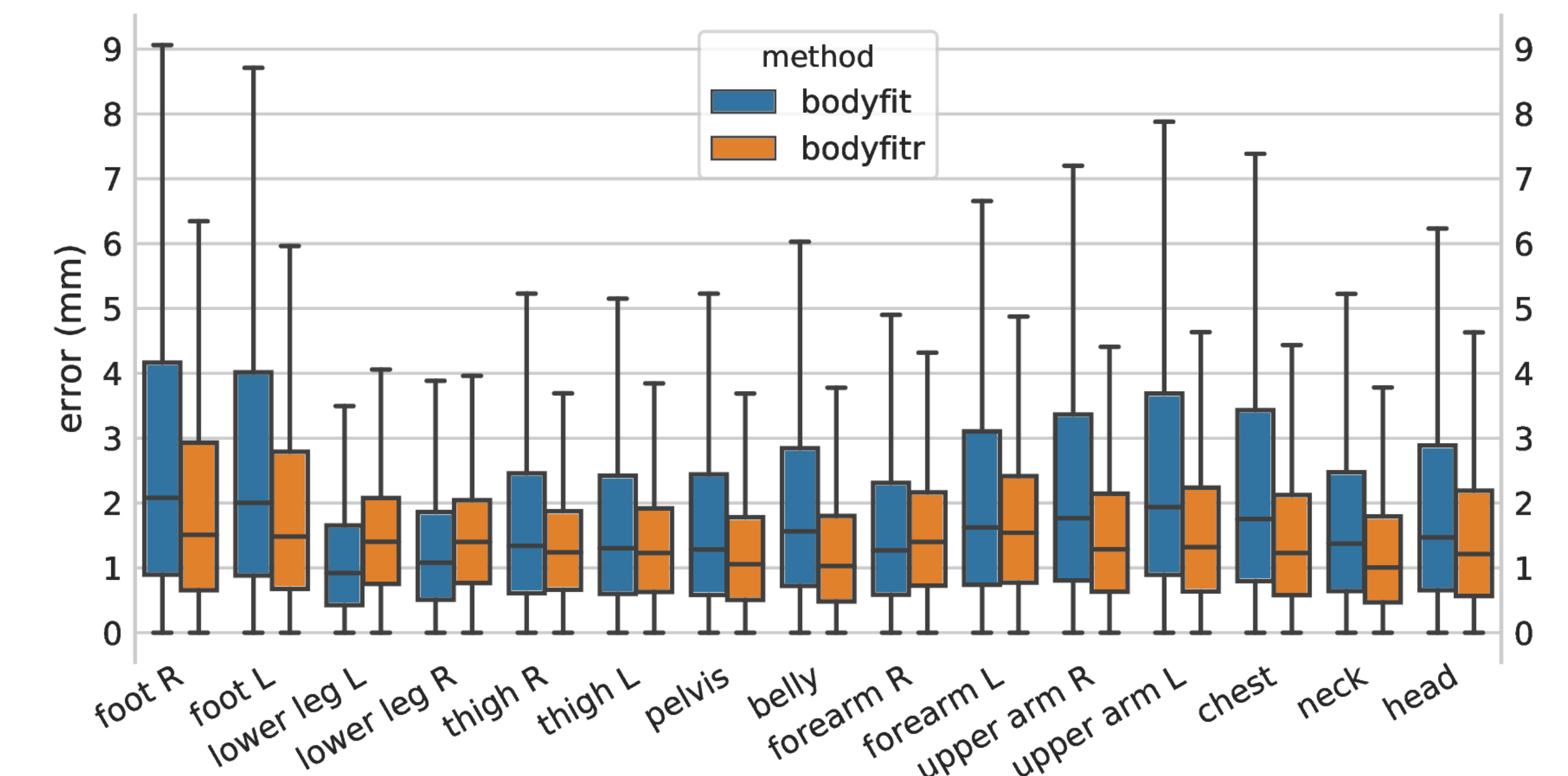Fig.1 Per-vertex error (mm)   Tab.1 Global error (mm)

Fig.2 Error per body part (mm). Blue: [1]. Orange: ours.

Conclusion

- Robust fitting given challenging pose and shape variations thanks to improved building blocks over [1].
- No hard assumption on the data.

References

[1] Saint et al., "3DBodyTex: Textured 3D Body Dataset.", 3DV 2018, IEEE.

[2] Tsolis et al., "Model-based anthropometry: [...]", WACV, 2014.

[3] Yang et al., "Estimation of human body shape [...]", ECCV, 2016.

[4] Zhang et al., "Detailed accurate human shape estimation [...]", CVPR, 2017.