Learning to estimate anthropometric measurements from partial 3D data

David Bojanić, mag. math.

mentor: Prof. Tomislav Pribanić, PhD
University of Zagreb Faculty of Electrical Engineering and Computing

UNIVERSITY OF ZAGREB
Faculty of Electrical Engineering and Computing

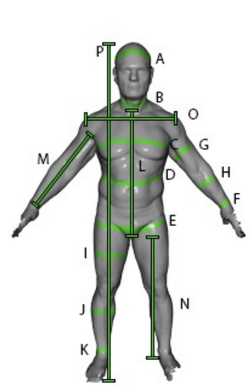
STANDARD 3D ANTHROPOMETRY PIPELINE

3D SCANNING

3D REGISTRATION
- align the partial scans
- optional data cleaning

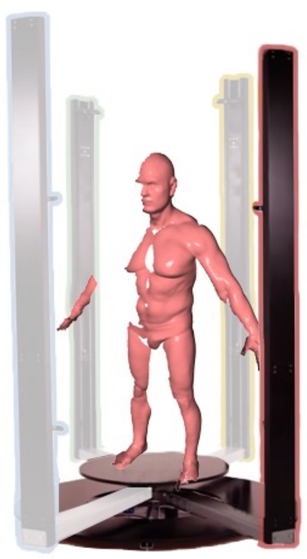
COMPLETE SCAN

3D ANTHROPOMETRY
- landmark detection
- measure estimation



	Measurement
A	Head C
B	Neck base C
C	Chest C
D	Waist C
E	Hip C
F	Wrist C
G	Bicep C
H	Forearm C
I	Thigh C
J	Calf C
K	Ankle C
L	Shoulder-crotch L
M	Shoulder-wrist L
N	Inside leg L
O	Shoulder B
P	Height

measure

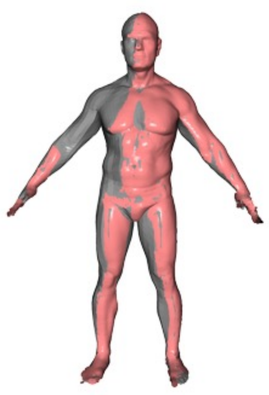


PARTIAL 3D SCANNING

+

STATISTICAL HUMAN BODY MODEL

FITTING



FITTED STATISTICAL HUMAN BODY MODEL

3D Registration

Find the optimal rotation and translation that aligns two partially overlapping 3D scans.

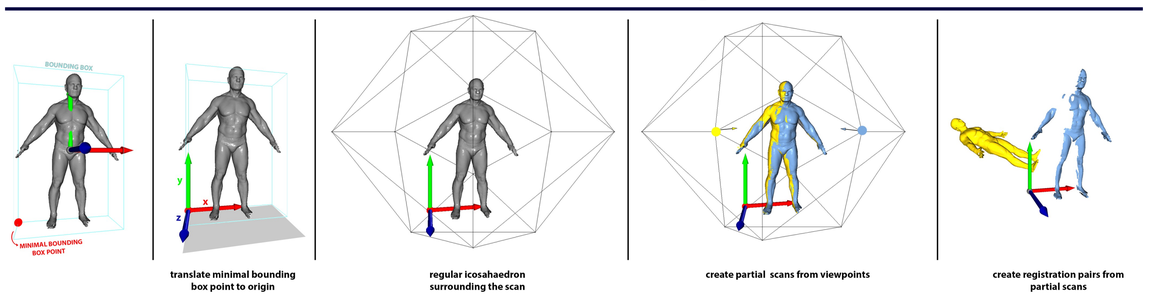
State-of-the-art limitations

(a) Learning-based methods struggle with generalization [1]
(b) 3D registration benchmarks suffer from low data variability [1]

(a) New baseline – Exhaustive Grid Search (EGS)

We propose a traditional method that exhaustively searches the rotation and translation spaces using the weighted cross-correlation.

(b) New benchmark – FAUST-partial (FP)

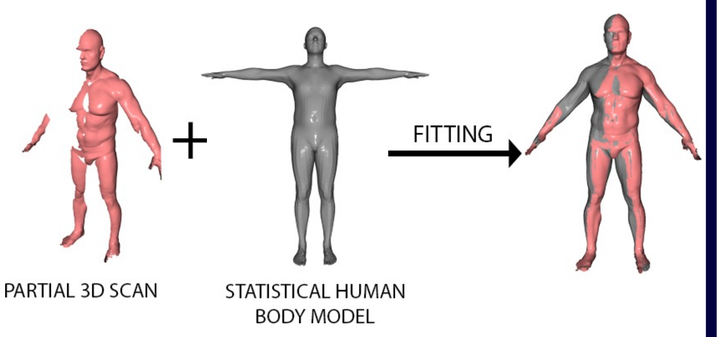


Dataset	FP - rotation			FP - translation			FP - overlap		
Difficulty	easy	medium	hard	easy	medium	Hard	easy	medium	hard
FPFH+SC2-PCR	99.64	94.54	75.21	99.76	99.53	99.58	**99.88**	84.70	**38.85**
GeDi	**99.76**	**99.94**	**99.41**	99.47	99.70	**99.70**	99.64	75.40	8.70
FCGF+SC2-PCR	98.46	91.93	85.77	98.34	98.34	98.22	98.52	63.00	17.80
GeoTransformer	64.12	55.93	47.75	66.25	64.29	64.18	63.94	22.07	2.64
EGS	99.64	97.92	78.00	99.70	**99.82**	98.81	99.47	**88.06**	37.06

Table 1. Registration recall (%) results on the FAUST-partial bechmark.

Fitting

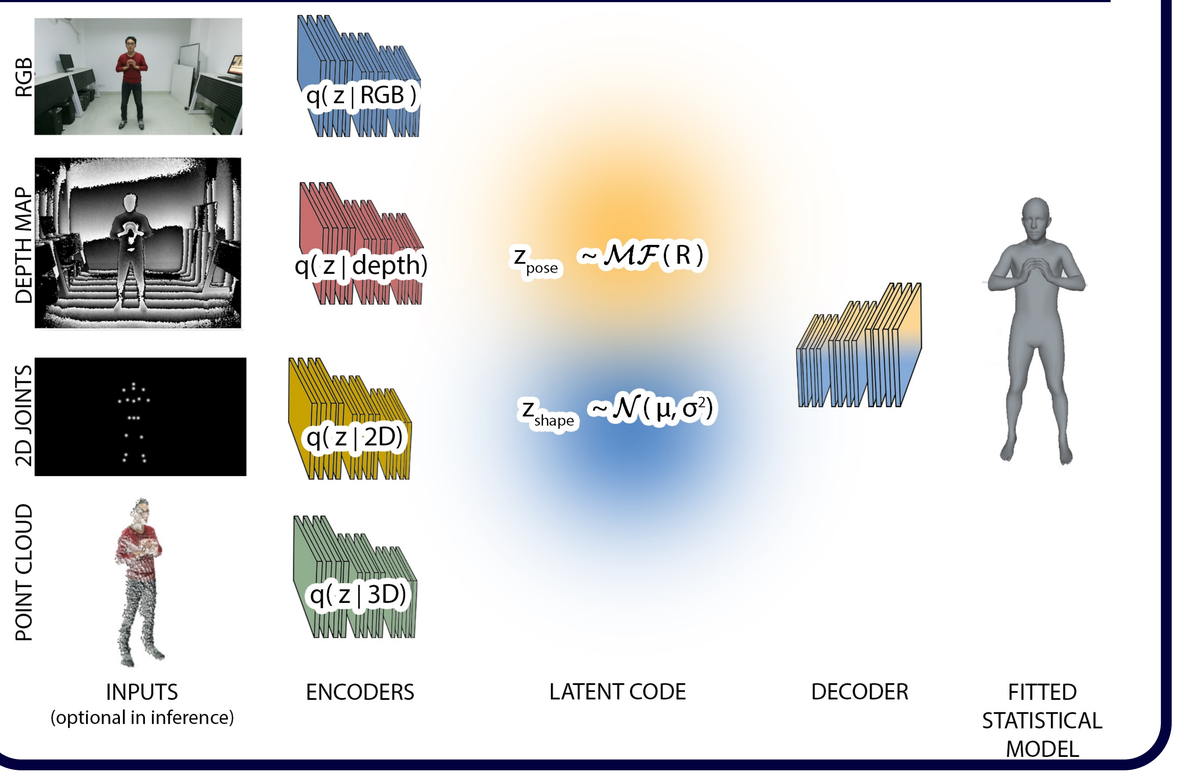
Fit a statistical human body model to a partial 3D scan so that it best describes the shape and pose of the input point cloud.



State-of-the-art limitations

(c) Need landmarks [2] or struggle with *rare* poses and shapes [3]

(c) New cross-modal probabilistic approach (future work)



Acknowledgments

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HrZZ Croatian Science Foundation

References

[1] Bojanić et al.: Deep Learning vs. Traditional 3D Registration: A Featureless 3D Registration Baseline
[2] Pishchulin et al.: Building statistical shape spaces for 3D human modeling
[3] Guanze et al.: VoteHMR: Occlusion-Aware Voting Network for Robust 3D Human Mesh Recovery from Partial Point Clouds

Contact

David Bojanić, mag. math.
david.bojanic@fer.hr
dbojanic
DavidBoja

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