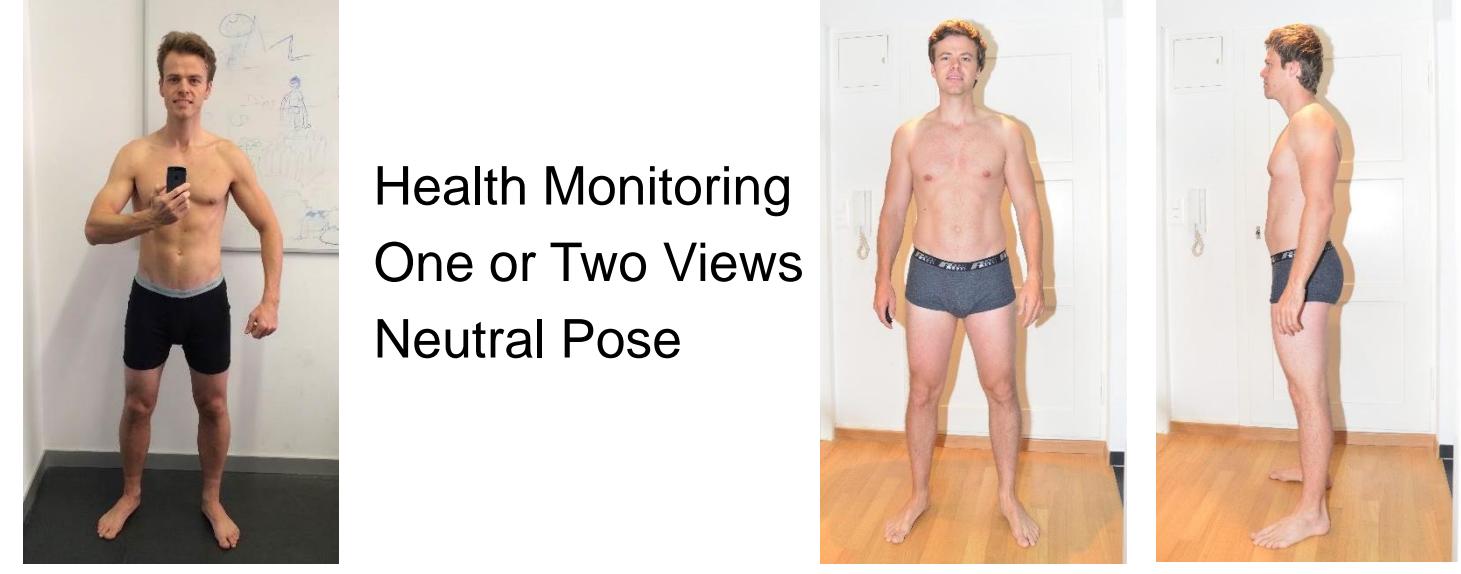


## Task Description

Goal : Human 3D Body Shape Estimation from Silhouettes

## Scenarios Considered :

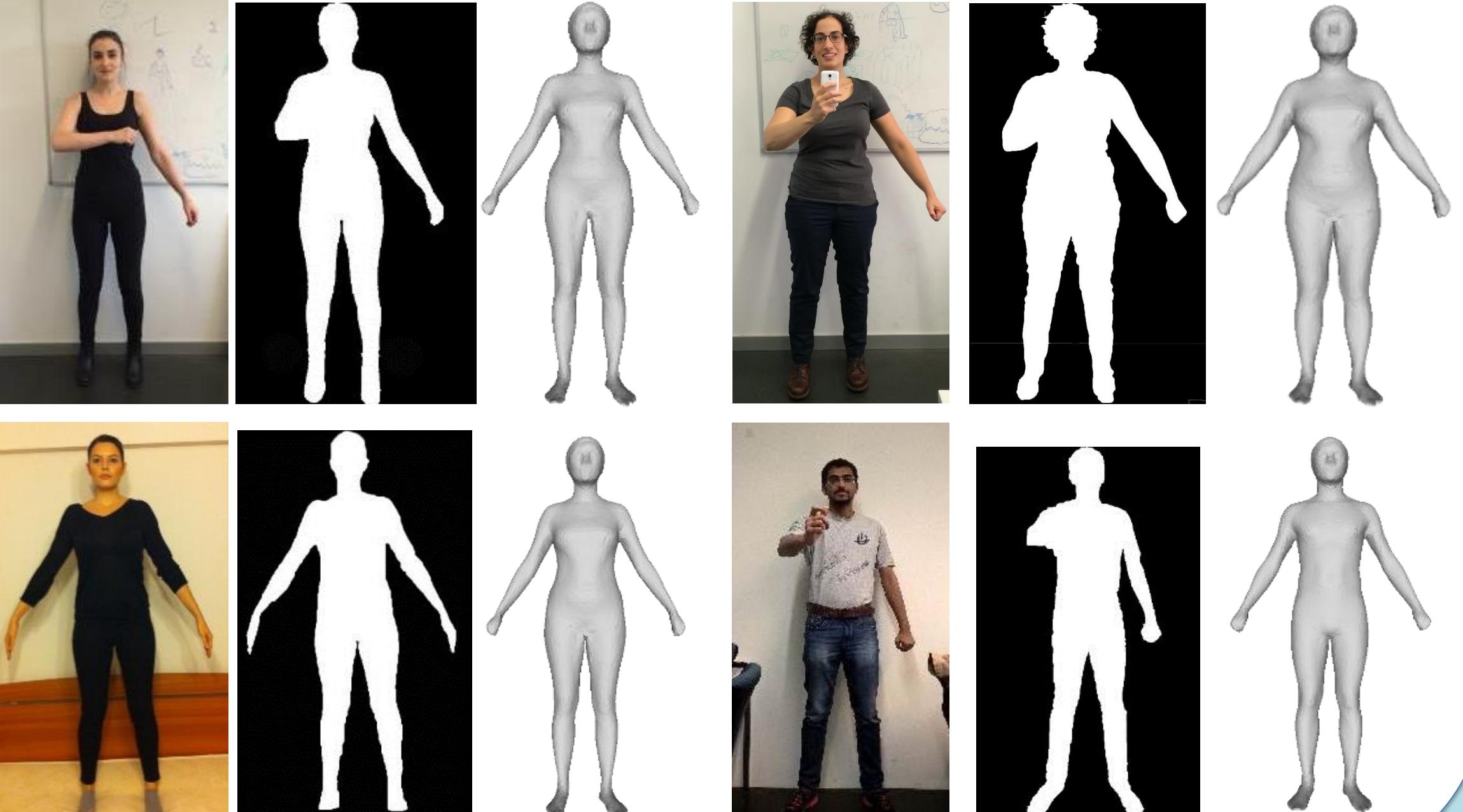
- Shape from "Selfies"
- Single View
- Poses in mild self-occlusion



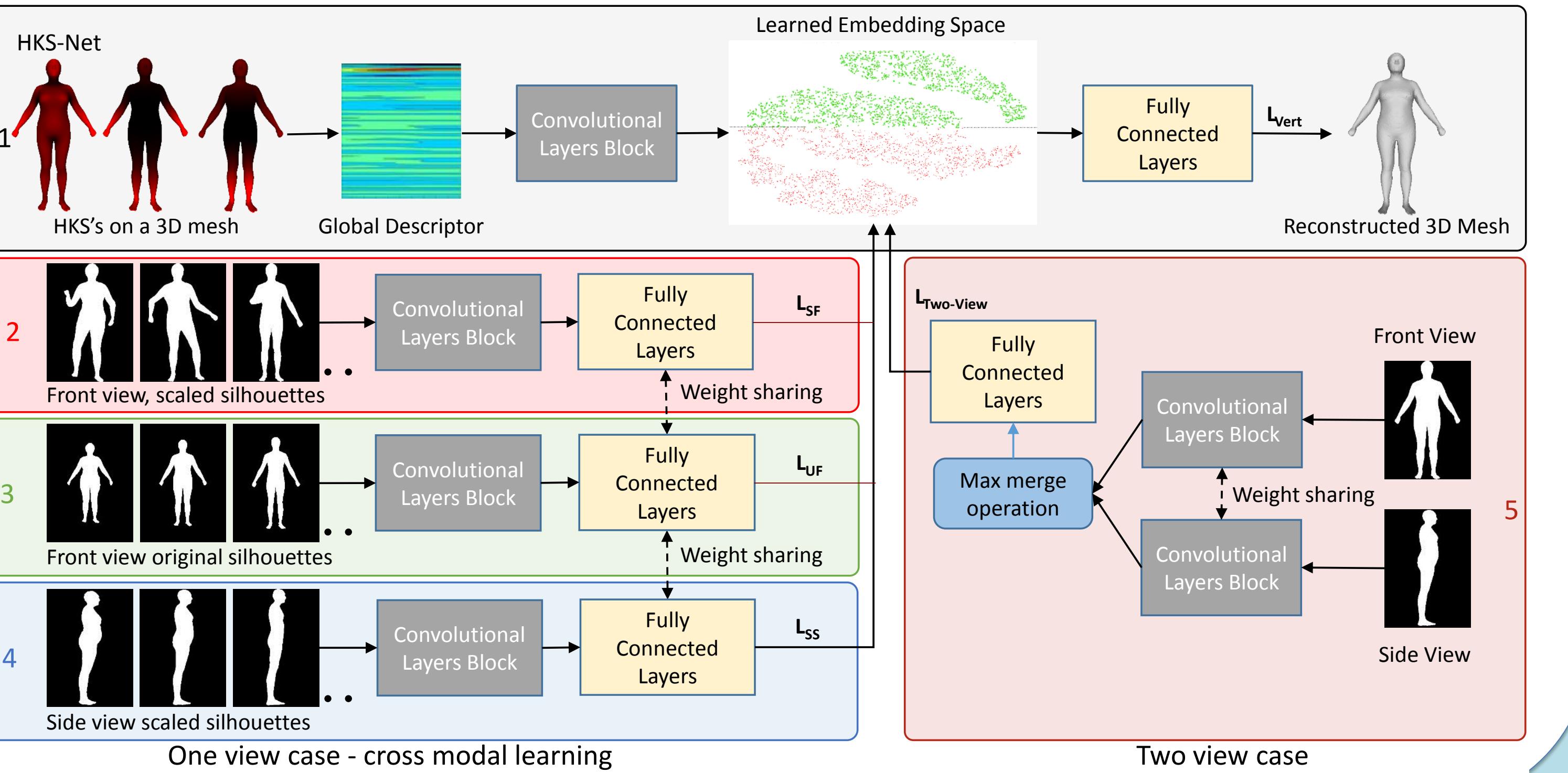
## Contributions :

- A novel architecture for shape estimation from silhouettes
- Three core components :
  - Generative** - Inverts a pose invariant 3D shape descriptor to reconstruct its neutral shape
  - Predictive** - Maps 2D silhouettes to 3D body shapes
  - Cross-Modal** - Leverages from multi-view information to boost single view predictions
- State-of-the-art system for human body shape estimation

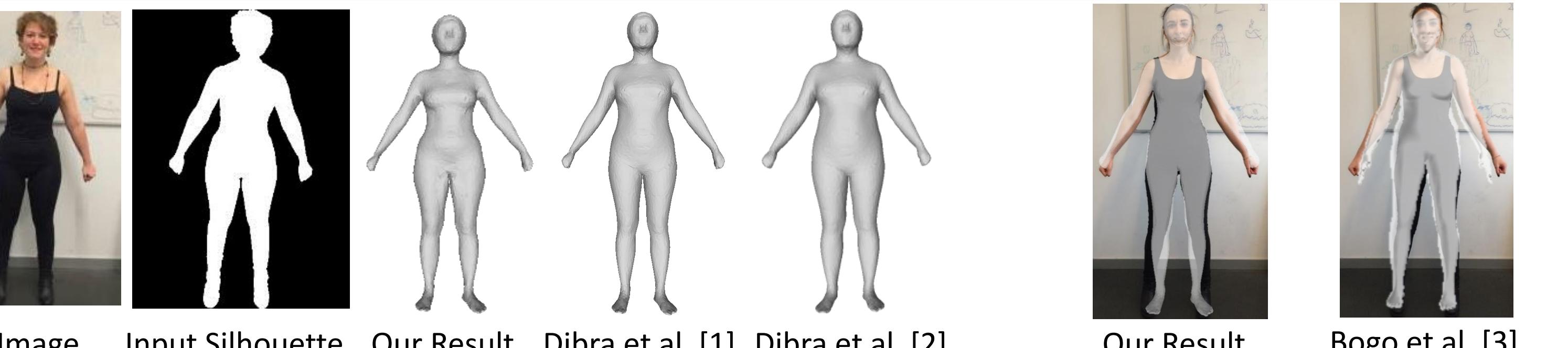
## Qualitative Results



## Full Pipeline



## Qualitative Comparison with Related Work



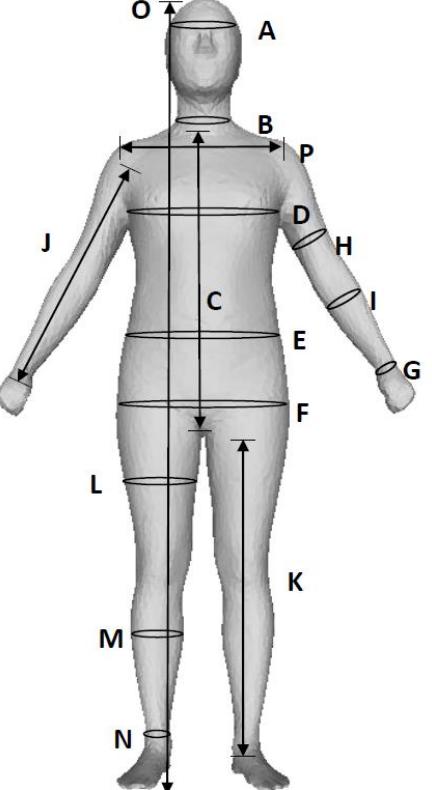
## References

- [1] Dibra, E., Jain, H., Öztireli, C., Ziegler, R., Gross, M.: HS-Nets : Estimating human body shape from silhouettes with convolutional neural networks. In: 3DV (2016)
- [2] Dibra, E., Öztireli, C., Ziegler, R., Gross, M.: Shape from selfies : Human body shape estimation using cca regression forests. In: ECCV (2016)
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- [4] Boisvert, J., Shu, C., Wührer, S., Xi, P.: Three-dimensional human shape inference from silhouettes: reconstruction and validation. In: Mach. Vision App. (2013)
- [5] Chen, Y., Kim, T.K., Cipolla, R.: Inferring 3d shapes and deformations from single views. In: ECCV (2010)
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## Quantitative Results

Name	Training Input	Test Input	Architecture
SF-1	Scaled Frontal View (SFV), Neutral Pose	SFV	2
SF-1-P	SFV, Various Poses	SFV	2
SFU-1	SFV, Unscaled Frontal View (UFV)	SFV	2 3
SFS-1	SFV, Scaled Side View (SSV)	SFV	2 4
SFUS-1	SFV, UFV, SSV	SFV	2 3 4
SFUS-HKS-1	SFV, UFV, SSV, projected HKS (PHKS)	SFV	1 2 3 4
SF-SS-2	SFV, SSV	SFV, SSV	5
UF-US-2	UFV, Unscaled Side View (USV)	UFV, USV	5
UF-US-HKS-2	UFV, USV, PHKS	UFV, USV	1 5

Table 1. Nomenclature for the various experiments and respective architectures



Measurements	SF-1-P	SF-1	SFS-1	SFU-1	SFUS-1	SFUS-HKS-1	HS-Net-1-S   1	CCA-RF   2
A. Head circumference	$4.3 \pm 3.5$	$3.9 \pm 3.1$	$3.7 \pm 2.9$	$3.7 \pm 2.9$	$3.9 \pm 2.9$	$3.1 \pm 2.6$	$4 \pm 4$	$8 \pm 8$
B. Neck circumference	$2.2 \pm 1.8$	$2.3 \pm 1.8$	$2.3 \pm 1.8$	$2.3 \pm 1.8$	$2.2 \pm 1.7$	$2.1 \pm 1.7$	$8 \pm 5$	$7 \pm 7$
C. Shoulder-blade/crotch length	$6.2 \pm 4.9$	$6.1 \pm 4.8$	$5.3 \pm 4.2$	$5.3 \pm 4.1$	$5.4 \pm 4.1$	$4.9 \pm 3.8$	$20 \pm 15$	$18 \pm 17$
D. Chest circumference	$6.7 \pm 5.4$	$6.7 \pm 5.3$	$5.9 \pm 4.9$	$5.9 \pm 4.7$	$5.8 \pm 4.8$	$5.8 \pm 4.8$	$13 \pm 7$	$25 \pm 24$
E. Waist circumference	$8.1 \pm 6.1$	$7.8 \pm 6.2$	$7.5 \pm 5.9$	$7.5 \pm 5.9$	$7.5 \pm 5.7$	$6.4 \pm 5.2$	$19 \pm 13$	$24 \pm 24$
F. Pelvis circumference	$9.3 \pm 7.5$	$8.8 \pm 7.2$	$8.4 \pm 6.7$	$8.2 \pm 6.6$	$8.1 \pm 6.5$	$7.1 \pm 5.9$	$19 \pm 14$	$26 \pm 25$
G. Wrist circumference	$2.1 \pm 1.7$	$2.1 \pm 1.7$	$1.9 \pm 1.6$	$1.9 \pm 1.6$	$1.9 \pm 1.6$	$1.7 \pm 1.5$	$5 \pm 3$	$5 \pm 5$
H. Bicep circumference	$3.9 \pm 3.1$	$3.2 \pm 2.6$	$2.9 \pm 2.4$	$2.9 \pm 2.4$	$2.9 \pm 2.5$	$2.9 \pm 2.5$	$8 \pm 4$	$11 \pm 11$
I. Forearm circumference	$3.1 \pm 2.4$	$2.9 \pm 2.3$	$3.1 \pm 2.3$	$2.7 \pm 2.3$	$2.9 \pm 2.3$	$2.6 \pm 2.2$	$7 \pm 4$	$9 \pm 8$
J. Arm length	$4.1 \pm 3.1$	$3.8 \pm 2.9$	$3.3 \pm 2.5$	$3.3 \pm 2.5$	$3.2 \pm 2.5$	$2.9 \pm 2.4$	$12 \pm 8$	$13 \pm 12$
K. Inside leg length	$7.3 \pm 5.1$	$6.8 \pm 5.2$	$6.2 \pm 4.8$	$6.5 \pm 4.9$	$5.7 \pm 4.5$	$5.4 \pm 4.3$	$20 \pm 14$	$20 \pm 19$
L. Thigh circumference	$6.3 \pm 4.9$	$6.3 \pm 5.5$	$5.8 \pm 4.9$	$5.7 \pm 4.7$	$5.8 \pm 4.8$	$5.8 \pm 4.9$	$13 \pm 8$	$18 \pm 17$
M. Calf circumference	$3.6 \pm 2.9$	$3.5 \pm 3.1$	$3.3 \pm 2.7$	$3.3 \pm 2.6$	$3.5 \pm 2.8$	$2.9 \pm 2.5$	$12 \pm 7$	$12 \pm 12$
N. Ankle circumference	$2.1 \pm 1.5$	$2.1 \pm 1.7$	$1.9 \pm 1.5$	$1.8 \pm 1.4$	$2.1 \pm 1.5$	$1.6 \pm 1.3$	$6 \pm 3$	$6 \pm 6$
O. Overall height	$12.6 \pm 9.9$	$12.4 \pm 9.9$	$11.2 \pm 8.6$	$10.9 \pm 8.4$	$10.4 \pm 8.1$	$9.8 \pm 7.7$	$50 \pm 39$	$43 \pm 41$
P. Shoulder breadth	$2.3 \pm 1.9$	$2.3 \pm 1.8$	$2.2 \pm 1.2$	$2.2 \pm 1.9$	$2.1 \pm 1.7$	$1.9 \pm 1.7$	$4 \pm 4$	$6 \pm 6$

Table 2. Body Measurement errors comparison with shapes reconstructed from **one scaled frontal silhouette**. The nomenclature is presented in Table 1. The measurements are illustrated above. Errors are expressed as Mean +/- Std. Deviation in Millimeters.

Measurements	SF-SS-2	UF-US-2	UF-US-HKS-2	HS-2-Net-MM   1	Boisvert et al. [4]	Chen et al. [5]	Xi et al. [6]
A. Head circumference	$3.9 \pm 3.2$	$3.3 \pm 2.6$	$3.2 \pm 2.6$	$7.4 \pm 5.8$	$10 \pm 12$	$23 \pm 27$	$50 \pm 60$
B. Neck circumference	$1.9 \pm 1.7$	$2.0 \pm 1.6$	$1.9 \pm 1.5$	$5.3 \pm 3.1$	$11 \pm 13$	$27 \pm 34$	$59 \pm 72$
C. Shoulder-blade/crotch length	$5.1 \pm 4.1$	$4.3 \pm 3.5$	$4.2 \pm 3.4$	$9.9 \pm 7.0$	$4 \pm 5$	$52 \pm 65$	$119 \pm 150$
D. Chest circumference	$5.4 \pm 4.8$	$5.8 \pm 4.3$	$5.6 \pm 4.7$	$19.1 \pm 12.5$	$10 \pm 12$	$18 \pm 22$	$36 \pm 45$
E. Waist circumference	$7.5 \pm 5.7$	$7.6 \pm 5.9$	$7.1 \pm 5.8$	$18.4 \pm 13.2$	$22 \pm 23$	$37 \pm 39$	$55 \pm 62$
F. Pelvis circumference	$8.0 \pm 6.4$	$8.0 \pm 6.4$	$6.9 \pm 5.6$	$14.9 \pm 11.3$	$11 \pm 12$	$15 \pm 19$	$23 \pm 28$
G. Wrist circumference	$1.9 \pm 1.6$	$1.6 \pm 1.4$	$1.6 \pm 1.3$	$3.8 \pm 2.7$	$9 \pm 12$	$24 \pm 30$	$56 \pm 70$
H. Bicep circumference	$3.0 \pm 2.6$	$2.6 \pm 2.1$	$2.6 \pm 2.1$	$6.5 \pm 4.9$	$17 \pm 22$	$59 \pm 76$	$146 \pm 177$
I. Forearm circumference	$3.0 \pm 2.4$	$2.9 \pm 2.1$	$2.2 \pm 1.9$	$5.5 \pm 4.2$	$16 \pm 20$	$76 \pm 100$	$182 \pm 230$
J. Arm length	$3.3 \pm 2.6$	$2.4 \pm 1.9$	$2.3 \pm 1.9$	$8.1 \pm 6.4$	$15 \pm 21$	$53 \pm 73$	$109 \pm 141$
K. Inside leg length	$5.6 \pm 5.1$	$4.3 \pm 3.8$	$4.3 \pm 3.8$	$15.6 \pm 12.4$	$6 \pm 7$	$9 \pm 12$	$19 \pm 24$
L. Thigh circumference	$5.8 \pm 5.1$	$5.1 \pm 4.3$	$5.1 \pm 4.3$	$13.7 \pm 10.8$	$9 \pm 12$	$19 \pm 25$	$35 \pm 44$
M. Calf circumference	$3.9 \pm 3.2$	$3.1 \pm 2.1$	$2.7 \pm 1.9$	$8.5 \pm 6.5$	$6 \pm 7$	$16 \pm 21$	$33 \pm 42$
N. Ankle circumference	$2.1 \pm 1.5$	$1.6 \pm 1.1$	$1.4 \pm 1.1$	$4.6 \pm 3.2$	$14 \pm 16$	$28 \pm 35$	$61 \pm 78$
O. Overall height	$10.6 \pm 8.6$	$7.2 \pm 6.1$	$7.1 \pm 5$				