Silhouette Body Measurement Benchmarks

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Abstract Anthropometric body measurements are important for industrial design, garment fitting, medical diagnosis and ergonomics. A number of methods have been proposed to estimate the body measurements from images, but progress has been slow due to the lack of realistic and publicly available datasets. The existing works train and test on silhouettes of 3D body meshes obtained by fitting a human body model to the commercial CAESAR scans. In this work, we introduce the BODY-fit dataset that contains fitted meshes of 2,675 female and 1,474 male 3D body scans. We unify evaluation on the CAESAR-fit and BODY-fit datasets by computing body measurements from geodesic surface paths as the ground truth and by generating two-view silhouette images. We also introduce BODY-rgb - a realistic dataset of 86 male and 108 female subjects captured with an RGB camera and manually tape measured ground truth. We propose a simple yet effective deep CNN architecture as a baseline method which obtains competitive accuracy on the three datasets.

1. Proposed Benchmarks

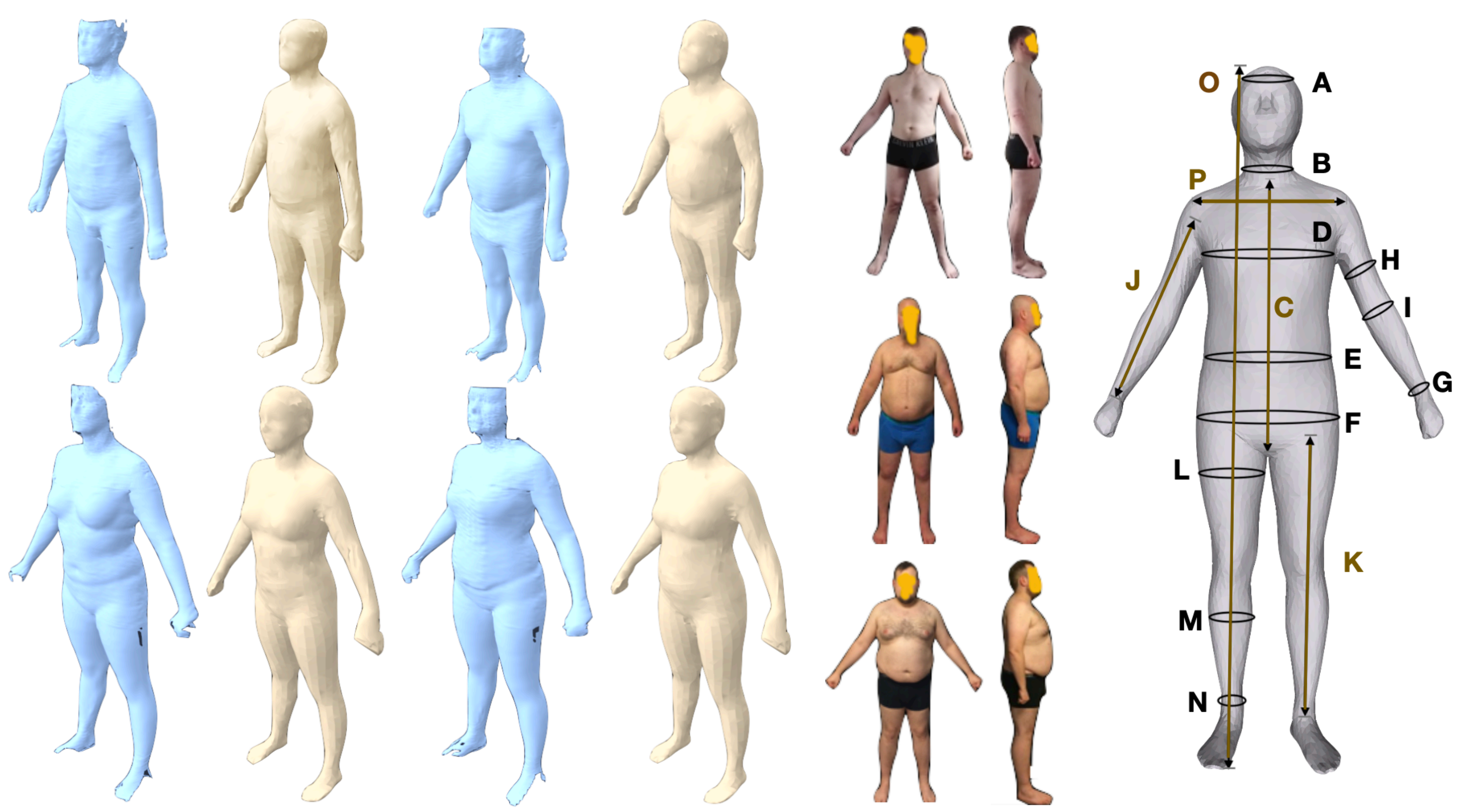


Fig 1. Examples from the proposed benchmarks, ``BODY-fit'' and ``BODY-rgb'', and the 16 body measurements (A-P) used in the method comparison. The blue meshes represent the original BODY scans containing missing points and noise (mainly in the head, feet and hand regions). The yellow meshes result from non-rigid ICP fitting of the mean shape template from the CAESAR fits datasets so that the both datasets now share the same topology. RGB images were captured using Apple iPad.

2. Proposed Method

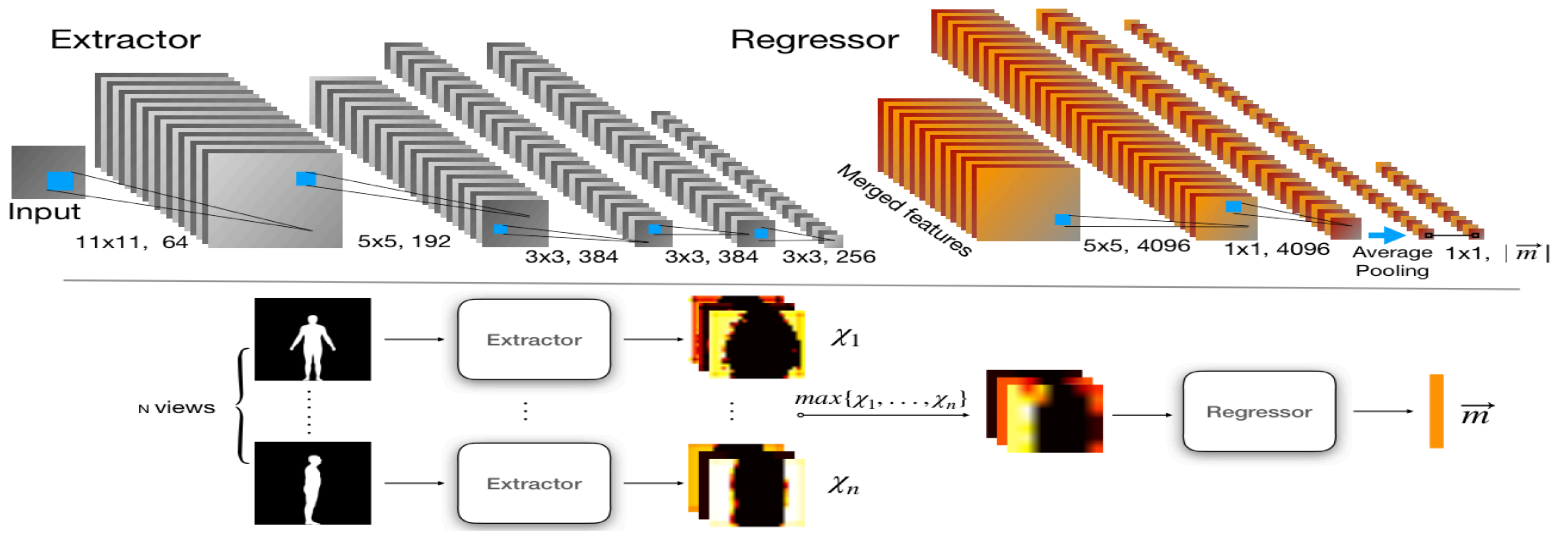


Fig 2. The overall deep architecture for the baseline method. Blue blocks denote conv kernels, and grey and yellow blocks denote the feature maps. Kernel sizes and the number of output feature maps are shown as <k * k, C>.

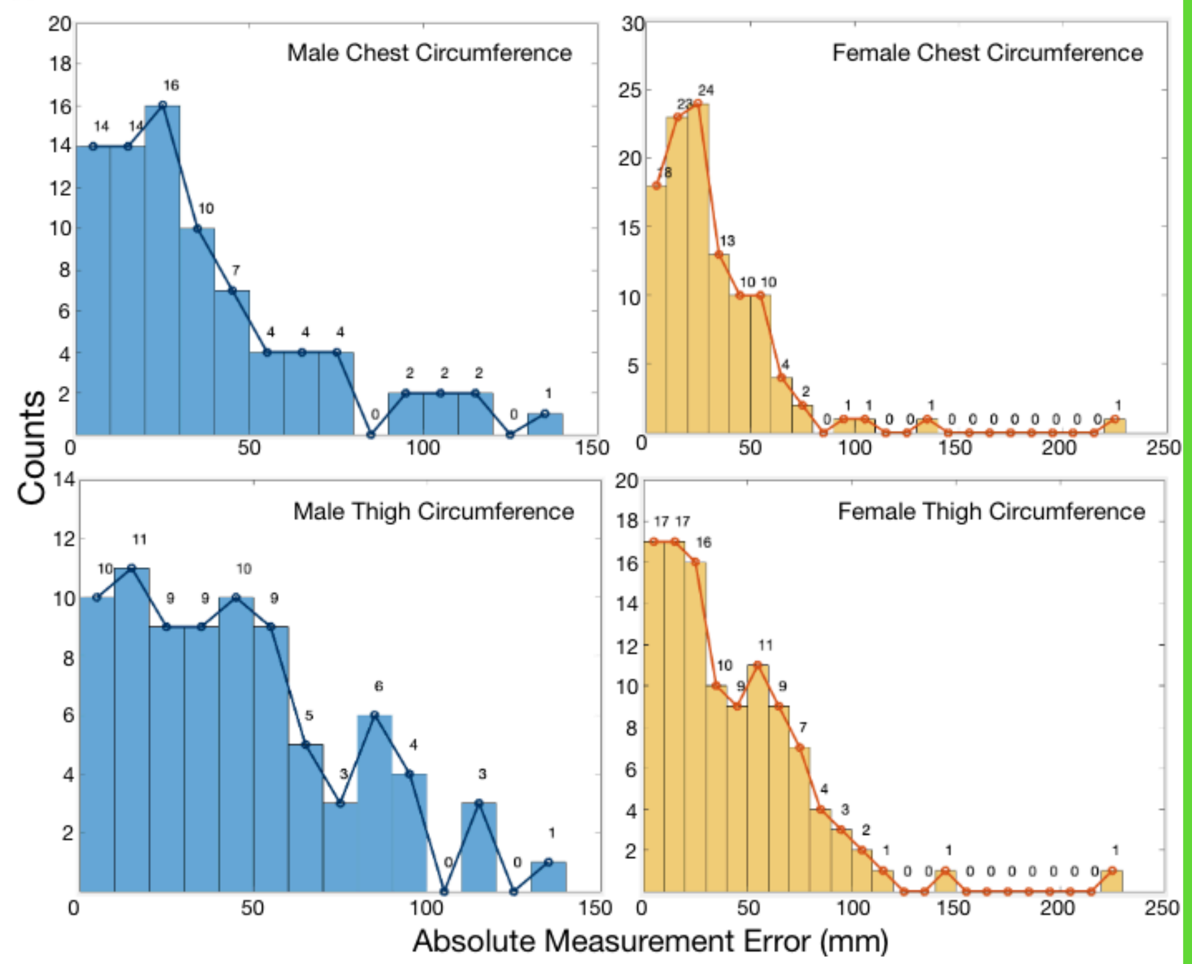
3. Experiments and Results

Our baseline achieves good accuracy on both the new dataset BODY-fit and the existing CAESAR-fit. Results are shown in following table.

To evaluate the practical performance of the baseline, 5-fold cross-validation was run on the BODY-rgb dataset. BODY-fit trained model was used as the basis model that was fine-tuned using the RGB training data. Accuracy is clearly worse than for the 3D fit datasets.The error histograms of the male and female chest (C.) and thigh (L.) circumference are shown in following figure.

Furthermore, we introduce the Measurement specific network which achieves better results than a single monolithic network for all measurements by improving the weight for target measurement.

	CAESAR-fit				BODY-fit			
	Male		Female		Male		Female	
Measure	UF-US-2 [22]	Our	UF-US-2 [22]	Our	UF-US-2 [22]	Our	UF-US-2 [22]	Our
A. Head circ.	10.6	**8.6**	18.1	**15.9**	26.0	**17.2**	13.9	**9.2**
B. Neck circ.	11.6	**9.3**	**11.6**	15.5	13.4	**11.8**	**14.5**	14.6
C. Shoulder-b/c len.	9.9	**5.4**	**10.7**	16.3	12.3	**11.2**	9.4	**7.7**
D. Chest. circ.	27.4	**18.2**	32.3	**24.8**	32.1	**23.0**	26.2	**21.7**
E. Waist circ.	27.6	**17.0**	32.0	**22.9**	42.5	**16.5**	22.3	**17.1**
F. Pelvis circ.	**22.9**	30.6	29.0	**24.0**	24.8	**13.3**	20.6	**14.7**
G. Wrist circ.	**9.5**	10.7	**12.2**	13.3	4.2	**4.1**	**4.8**	5.2
H. Bicep circ.	14.9	**12.5**	16.6	**11.5**	13.8	**11.4**	11.9	**9.3**
I. Forearm circ.	12.4	**7.9**	13.5	**10.7**	8.7	**7.2**	8.6	**8.5**
J. Arm len.	8.9	**4.2**	**8.9**	13.1	9.2	**7.6**	7.4	**6.4**
K. Inside leg len.	**9.8**	13.5	**13.3**	14.8	11.9	**9.2**	10.0	**6.5**
L. Thigh circ.	21.9	**16.5**	28.2	**16.4**	**16.9**	17.8	14.8	**11.6**
M. Calf circ.	12.5	**7.2**	16.0	**10.3**	11.0	**8.8**	13.6	**9.2**
N. Ankle circ.	9.2	**4.6**	10.6	**6.1**	6.4	**5.4**	7.2	**6.1**
O. Overall height	**14.8**	15.1	**20.2**	34.7	25.8	**9.9**	17.1	**8.6**
P. Shoulder breadth	9.0	**5.6**	**9.8**	10.9	12.0	**9.2**	9.3	**7.6**



4. Conclusion

We introduced new benchmark datasets to boost research on methods that can estimate anthropometric body measurements from image data. We propose a simple yet effective deep CNN architecture as a strong baseline.