

A Review of Body Measurement Using 3D Scanning

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Acknowledgement

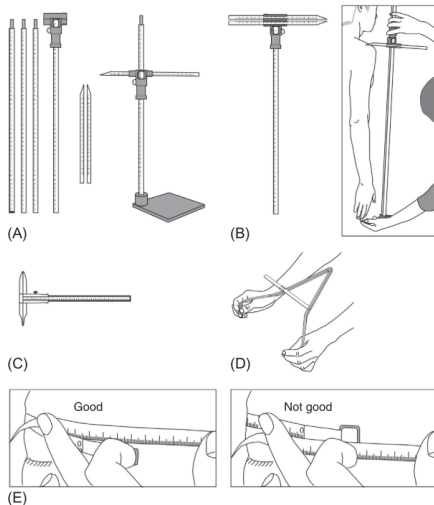
- This work has been supported by the Croatian Science Foundation under the grant number HRZZ-IP-2018-01-8118 (STEAM).



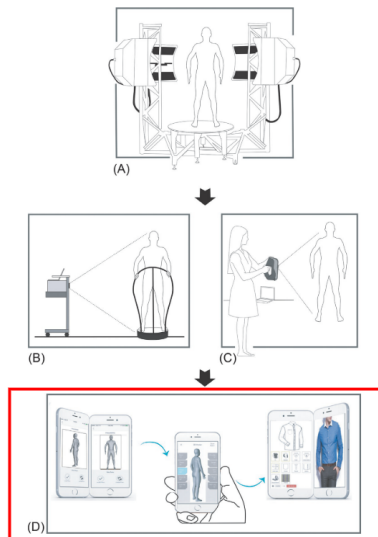
- Webpage: <https://www.fer.unizg.hr/steam>

Anthropometry - Timeline

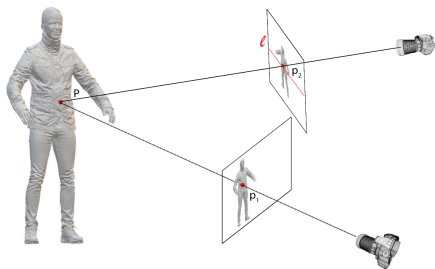
Traditional



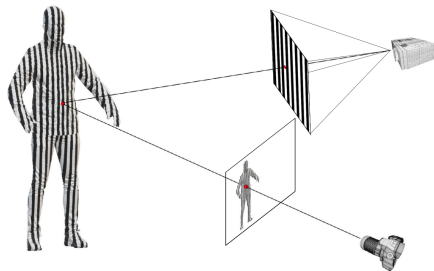
Scanning-based



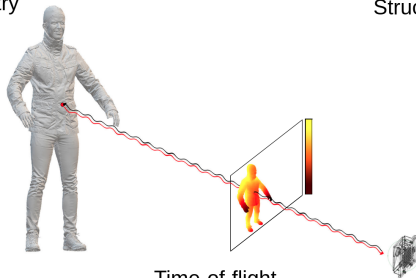
3D Scanning Technologies



Photogrammetry

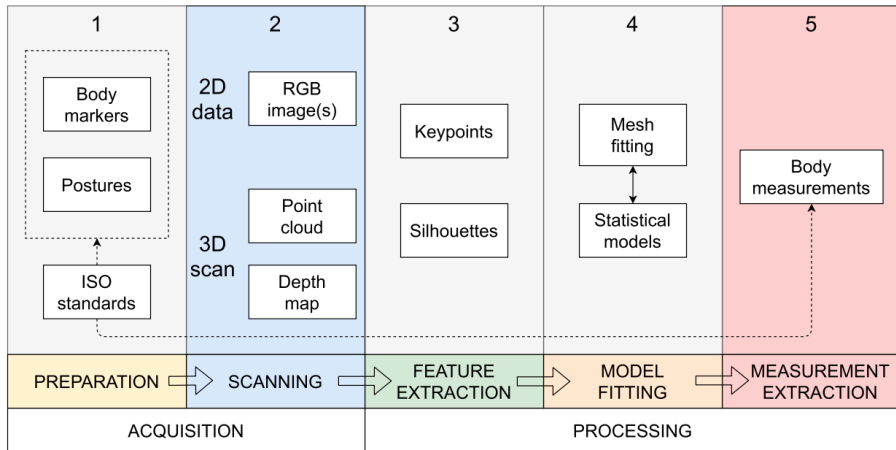


Structured light



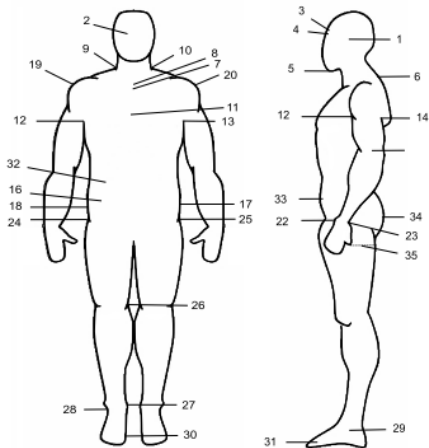
Time-of-flight

3D Scanning Pipeline

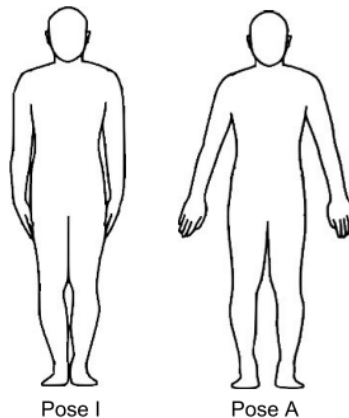


Preparation Stage

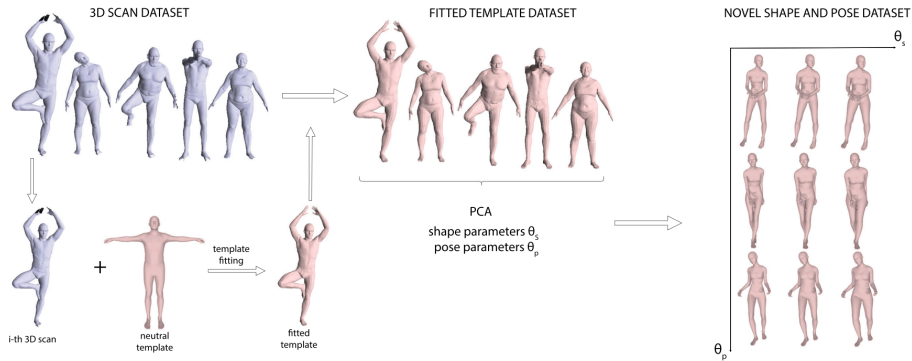
Body landmarks
(ISO 7250)



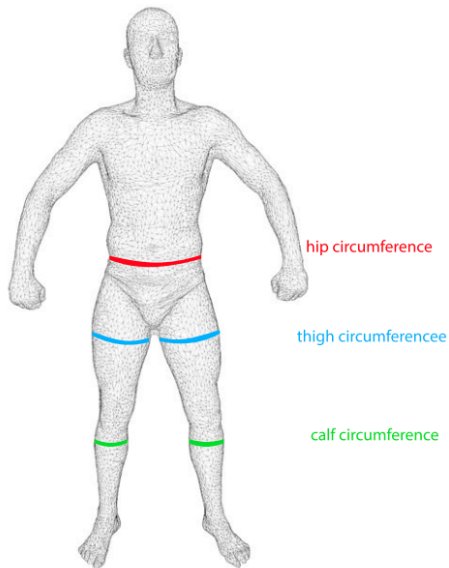
Body postures
(ISO 20685)



Model Fitting Stage



Measurement Stage



Mesh Regression



Mesh Regression Models

- Many mesh regression models:

- 1 SMPLify-X
- 2 ExPose
- 3 SPIN
- 4 VIBE
- 5 HMR
- 6 ProHMR
- 7 DSR
- 8 MeshNet
- 9 CMR
- 10 GraphCMR
- 11 ...

- Common issue: good at estimating human poses, but not precise estimating shapes
- Therefore, inapplicable for anthropometry directly

- ① No large public data that includes:
 - ① Images
 - ② Realistic data
 - ③ Sufficient number of subjects
 - ④ Ground truth shape
- ② Common measurement set for comparison
- ③ Public source code

State-of-the-art

			Circumference											Length			Breadth	Height	Mean
			From	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
2D	Smith et al. [149]	[149]	14.2	11.4	16.2	25.0	15.2	5.5	10.4	7.9	11.1	10.4	6.3	11.0	6.0	8.0	8.4	7.9	10.9
	Yan et al. [173]	[173]	11.6	12.3	26.1	28.7	22.6	6.9	13.0	7.8	18.2	11.7	7.8	13.9	9.5	11.2	7.6	20.1	14.3
	Dibra et al. 17 [45]	[173]	10.8	13.1	28.3	38.6	26.0	6.5	13.4	8.0	18.5	11.8	7.9	13.4	6.9	8.7	7.7	11.8	14.5
	Boisvert et al. [25]	[25]	11.0	27.0	21.0	14.0	42.0	21.0	23.0	13.0	33.0	12.0	14.0	20.0	20.0	34.0	30.0	9.0	21.5
	Chen et al. [34]	[149]	23.0	27.0	18.0	37.0	15.0	24.0	59.0	76.0	19.0	16.0	28.0	52.0	53.0	9.0	12.0	21.0	30.6
	Kanazawa et al. [80]	[173]	16.3	27.2	68.3	85.3	62.8	14.3	35.6	16.7	39.3	21.4	13.6	28.6	45.3	37.2	21.8	96.5	39.4
	Xi et al. [170]	[149]	50.0	59.0	36.0	55.0	23.0	56.0	146.0	182.0	35.0	33.0	61.0	119.0	109.0	19.0	24.0	49.0	66.0
	Bogo et al. [23]*	[173]	28.1	24.4	74.5	72.8	99.1	11.9	28.4	25.9	51.3	28.4	28.8	57.8	150.2	219.1	51.9	398.5	84.4
3D																			
	Yan et al. [172] [†]	[172]	-	9.1	14.3	12.4	8.9	4.5	5.5	-	7.9	3.0	10.6	-	13.2	-	-	-	8.9
	Tsoli et al. [159]	[159]	5.9	15.8	12.7	-	12.4	-	-	-	-	-	6.2	-	10.1	-	-	7.5	10.1
	Hasler et al. [64]	[159]	7.5	17.0	13.0	-	16.2	-	-	-	-	-	6.6	-	10.4	-	-	10.2	11.5
	Anthroscan [7]	[159]	7.4	21.1	12.4	-	7.5	-	-	-	-	-	7.6	-	11.7	-	-	5.6	10.4
	AE [58]	[58]	± 5	± 11	± 15	± 12	± 12	-	-	-	± 6	-	± 4	-	-	-	± 8	± 10	± 9.2

Statistical Models - *Controversial* Insights

- The correlations between the shape parameters and body measurements is linear
- Using known height and weight convincingly "beats" state-of-the-art

- Automatic anthropometry is craving for the public benchmark
- In-the-wild pose and shape estimation from images is a very active topic
- Image-based anthropometry directly usable for mobile application implementation