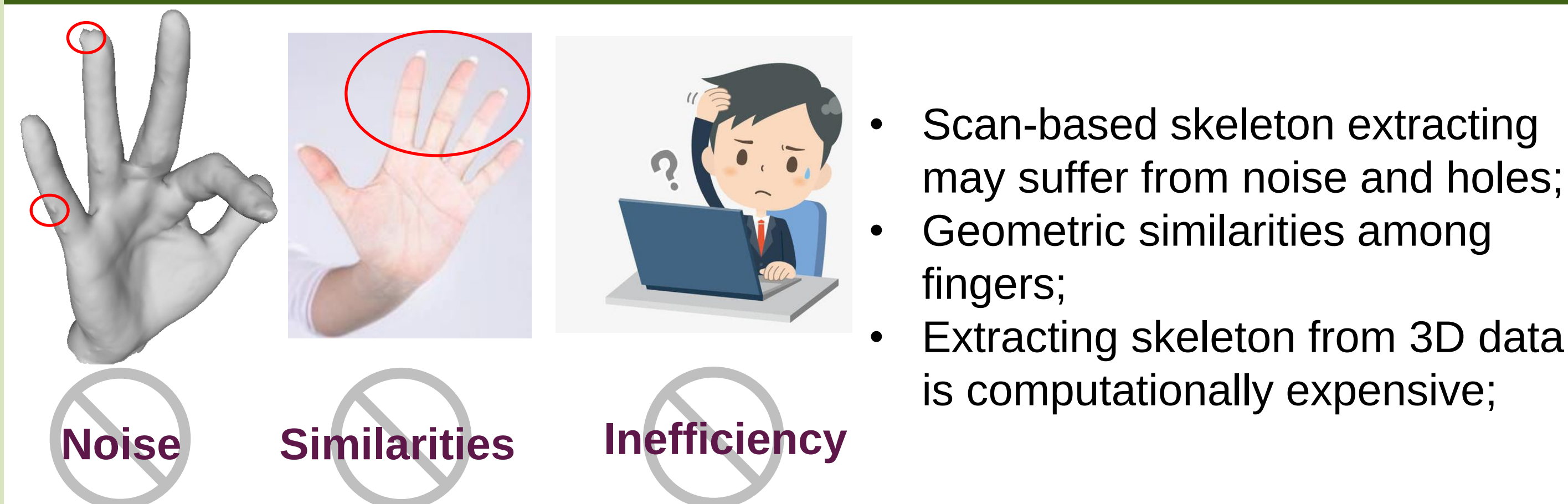


Motivations

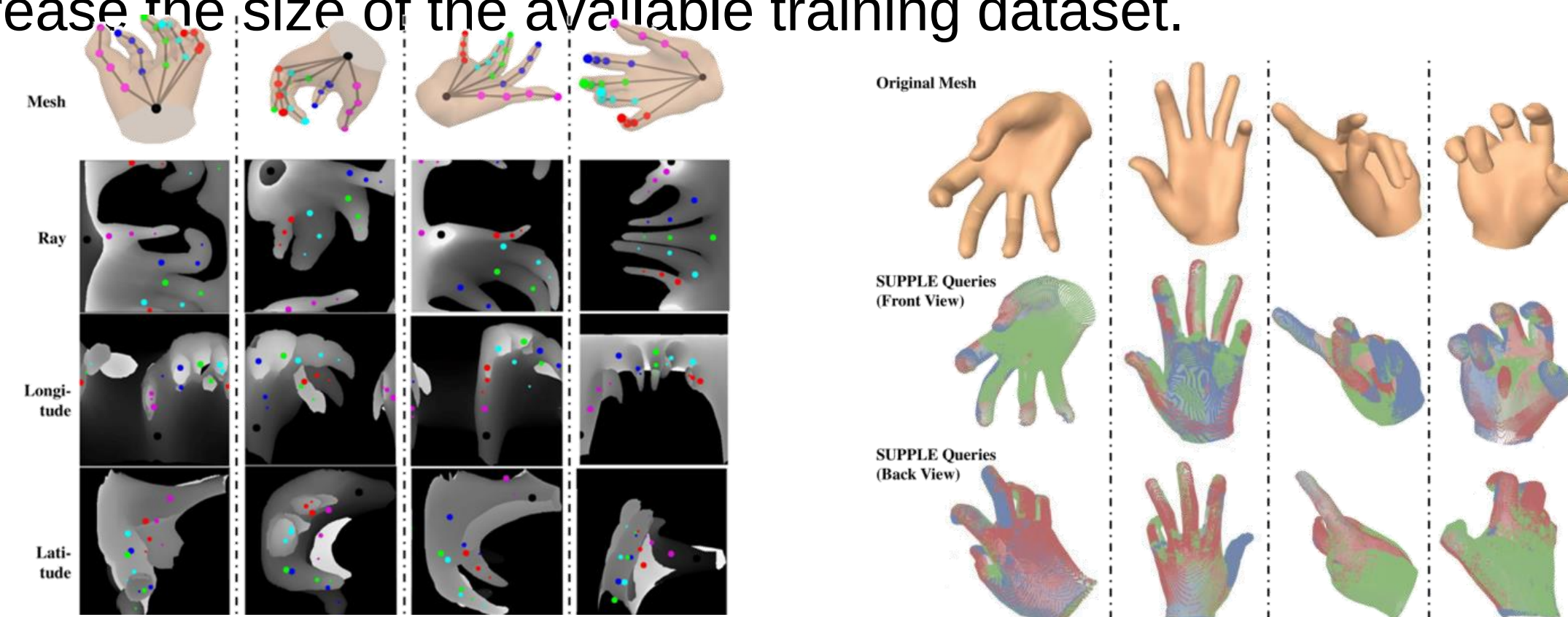


Challenges



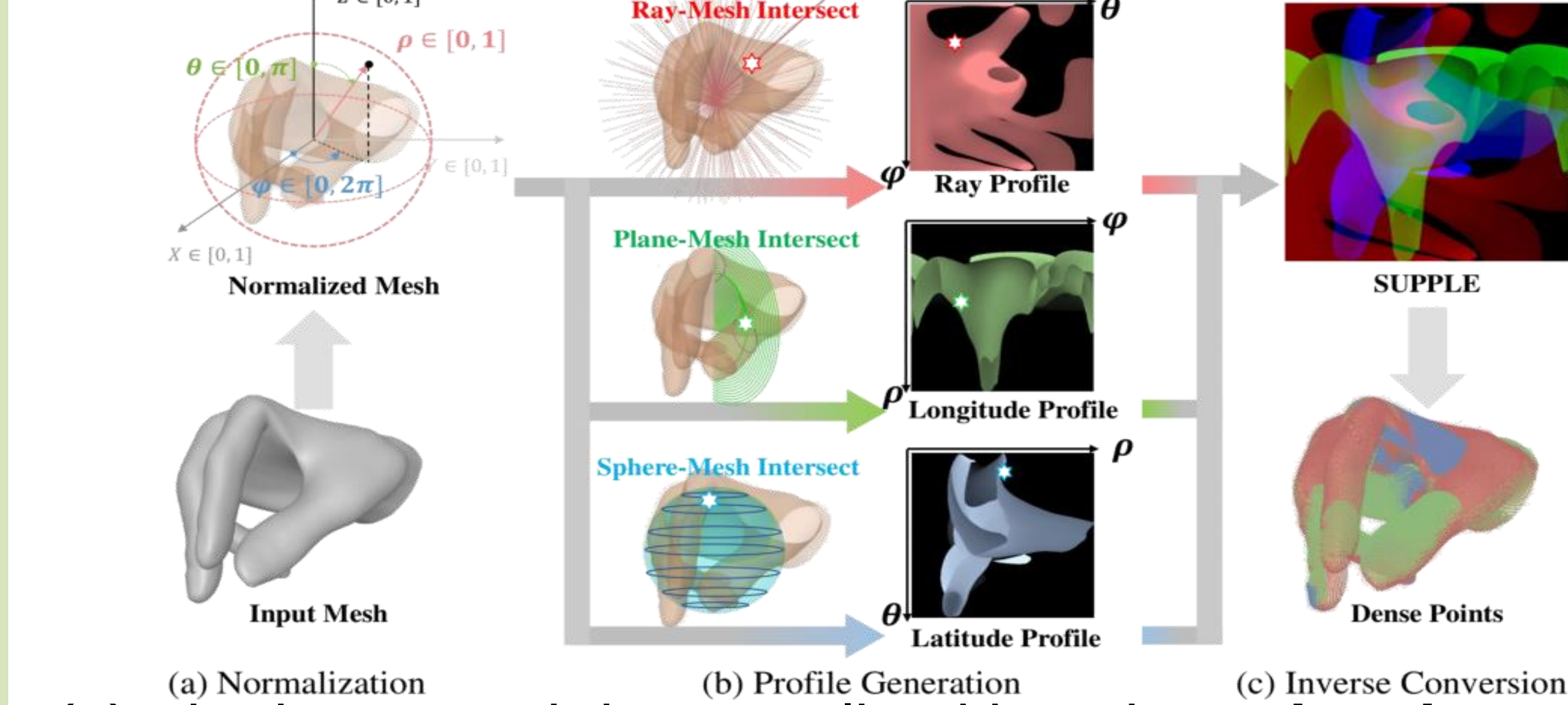
Contributions

- A novel representation is proposed to unwrap a 3D surface into image-like data effectively;
- A deep CNN architecture consuming our representation is designed to extract skeleton from hand scans and artist-designed models;
- A series of mesh data augmentation strategies are provided to significantly increase the size of the available training dataset.



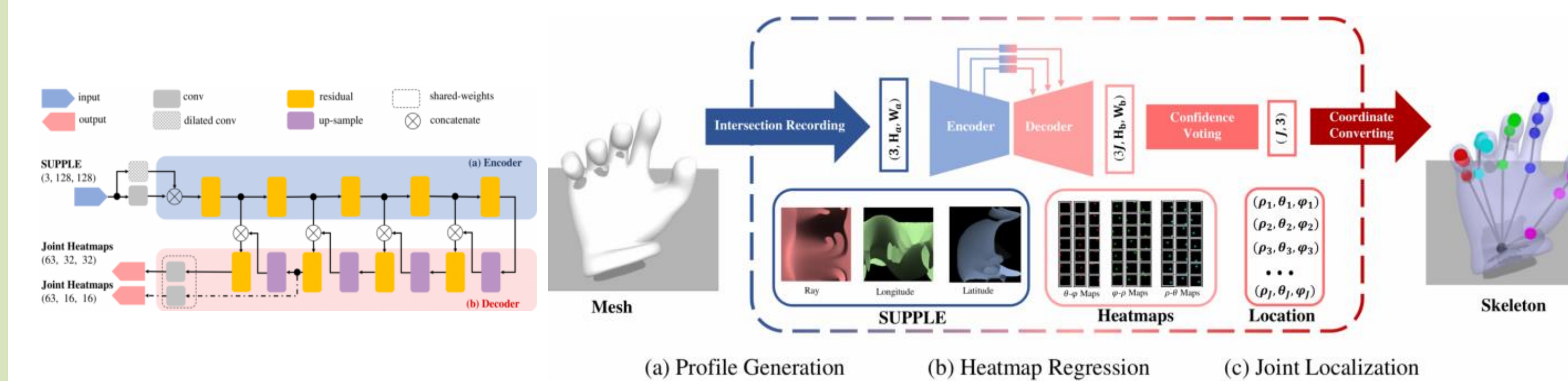
Overview

1. Mesh-SUPPLE Conversion



- (a) The input mesh is normalized into the **unit sphere**;
- (b) Three different profiles were generated through **intersecting tests**;
- (c) SUPPLE is converted back to a dense point cloud by querying pixels.

2. Skeleton Extraction



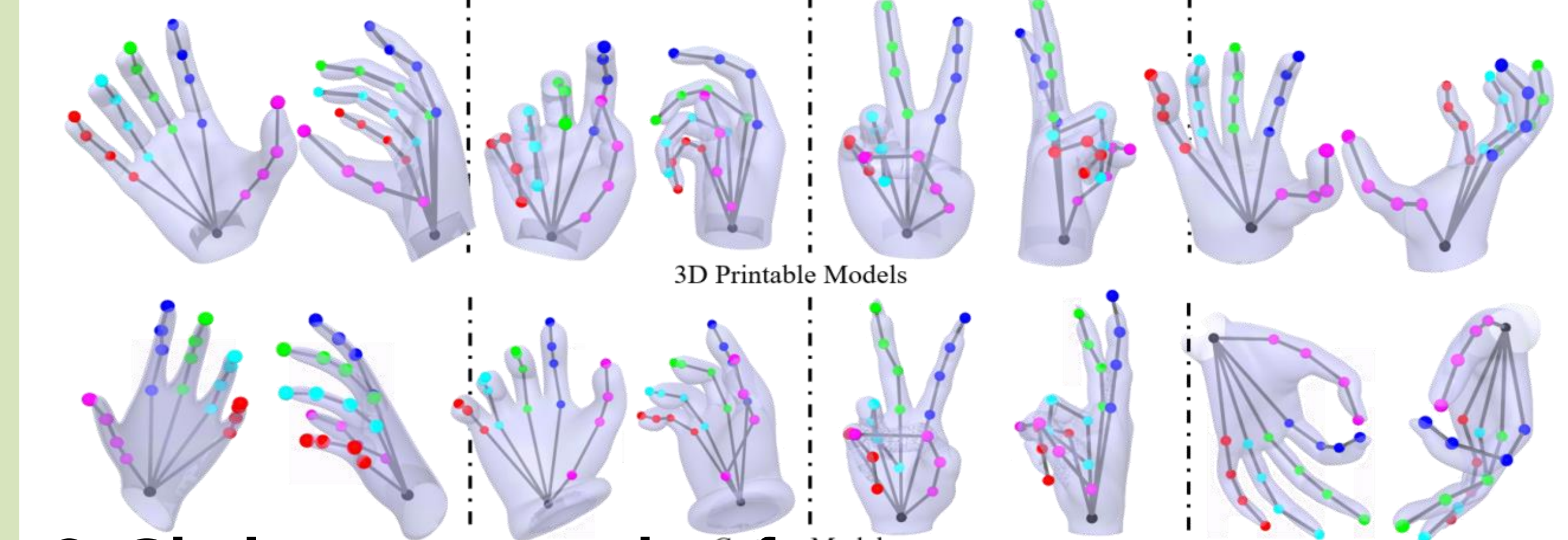
- (a) An input mesh is converted as a SUPPLE image ;
- (b) This profile combination is then processed through an **encoder-decoder network**;
- (c) The three heatmaps corresponding to each joint are transformed into the joint coordinates by voting.

For more details about **this work and other recent work** of our group , please scan the QR code on the right. 
(www.yangangwang.com)

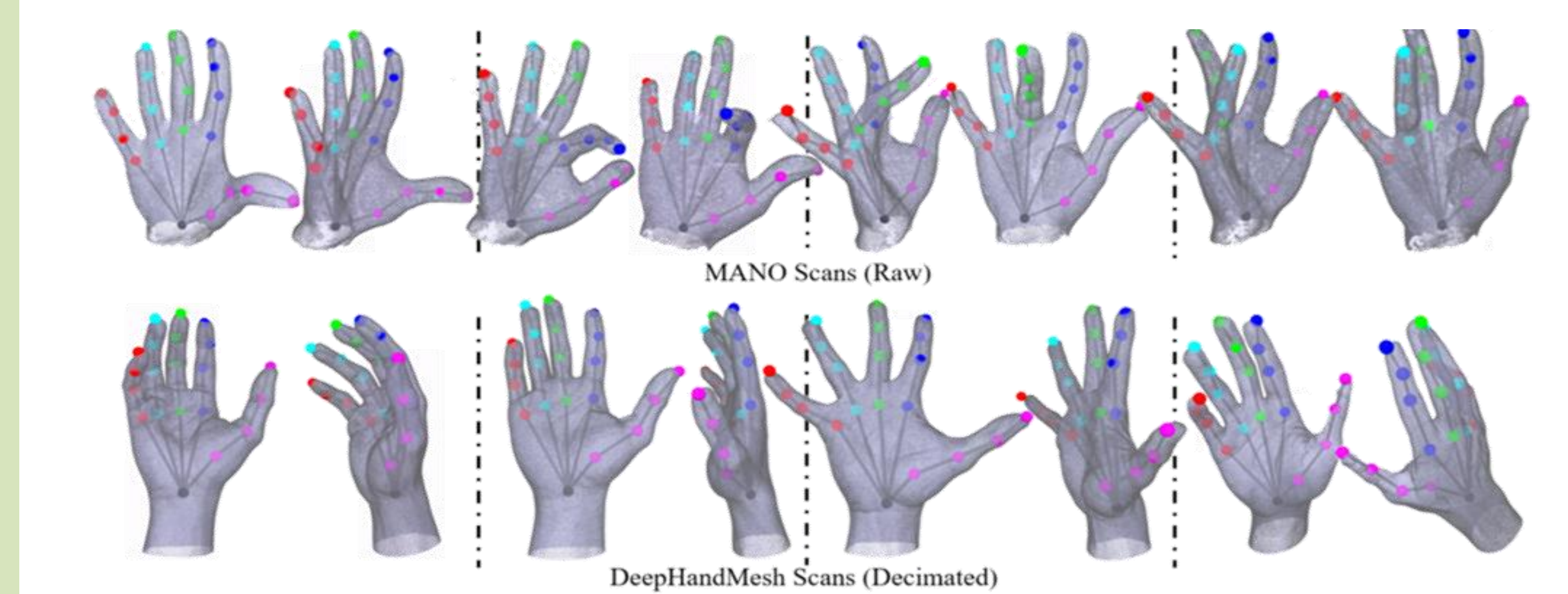


Results

1. Skeleton extraction from online meshes



2. Skeleton extraction from scans



3. Accuracy for skeleton extraction

Methods	Average CD-joint Error (mm)					
	DHM [48]	MANO [58]	Hand3D [76]	Panoptic [62]	Freihand [79]	Youtube3D [34]
Multi-View CNNs [17]	15.101	18.153	21.029	15.006	12.998	28.387
Hand Pointnet [16]	14.279	17.925	20.371	13.074	12.704	27.261
Pinocchio [5]	12.091	17.934	18.803	13.720	12.116	26.043
Volumetric [70]	11.371	16.499	17.312	12.615	11.232	25.310
RigNet [69]	7.893	13.672	14.545	7.926	10.117	23.391
Ours with a variant of P_r	6.570	12.903	11.104	7.131	7.983	15.174
Ours with a variant of P_s	7.102	12.541	11.636	11.619	8.106	16.325
Ours with a variant of P_c	4.327	8.748	7.427	4.302	6.749	11.387
Ours w/o channel softmax	4.361	8.892	7.904	4.387	6.745	13.903
Ours w/o confidence voting	4.347	8.876	7.831	4.411	6.877	14.719
Ours w/o circular padding	4.350	8.874	7.822	4.356	6.752	12.690
Ours with dense block	4.331	8.857	7.491	4.405	6.717	11.903
Ours with 16×16 output size	4.388	9.130	8.048	4.411	7.872	13.996
Ours with 64×64 output size	4.322	8.738	7.351	4.302	6.657	11.381
Ours	4.323	8.737	7.349	4.291	6.657	11.381