



3D Dimension Extraction From a Scanned Hand for Design and Modeling of Hand Prosthesis Using Deep-Learning Methods

TECHNION
Israel Institute
of Technology

Tzabar Dolev
Guidance: Prof Anath Fischer

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Research Pipeline

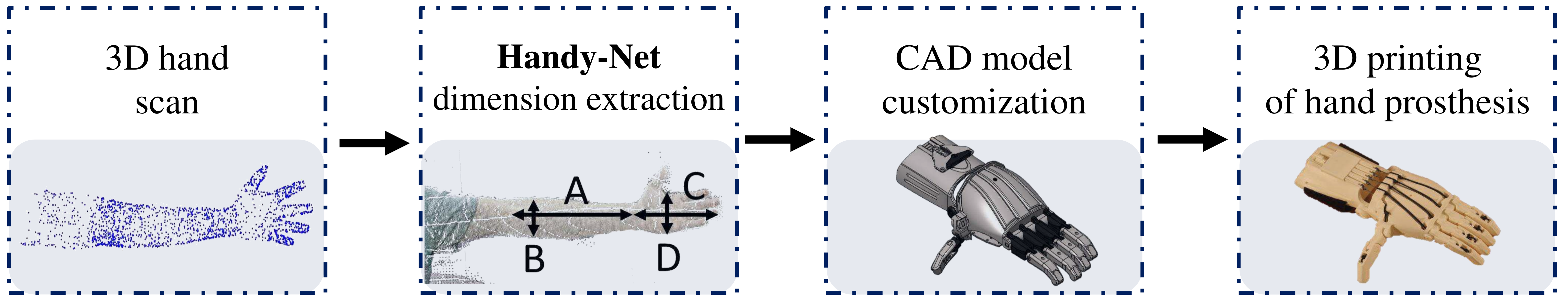


Figure 1: research pipeline

Abstract

This research proposes a dimension extraction method from 3D hand scans that allows the creation of personalized hand-prosthesis without additional engineering design. The main stages of the process include: a 3D scan of the healthy hand, processing the scanned data using a deep neural network for dimension extraction and adjusting relevant dimensions to a CAD model. The final CAD model is then 3D printed with accessible materials.

Inference Over Scanned Data

We tested hand scans from two sources:

- 64 hand scans which were captured using Intel Realsense D435
- A downloaded Artec Eva model

Inference over scanned data		
	Average accuracy	Standard deviation
Synthetic	99.2%	0.06%
Intel RealSense D435	95.6%	0.75%
Artec Eva	93.9%	3.9%

Figure 4: hand scans inference Table 1: inference over scanned data

Hands-On Dataset

- Open source model

• We define each hand pose by: $H_i = \sum_{j=1}^n R_{i_j} S_{i_j} P_{i_j} + N_i$, $H_i \in \mathbb{R}^3$
R,S – rotation and scale matrices, P – given hand joint, N – noise function.

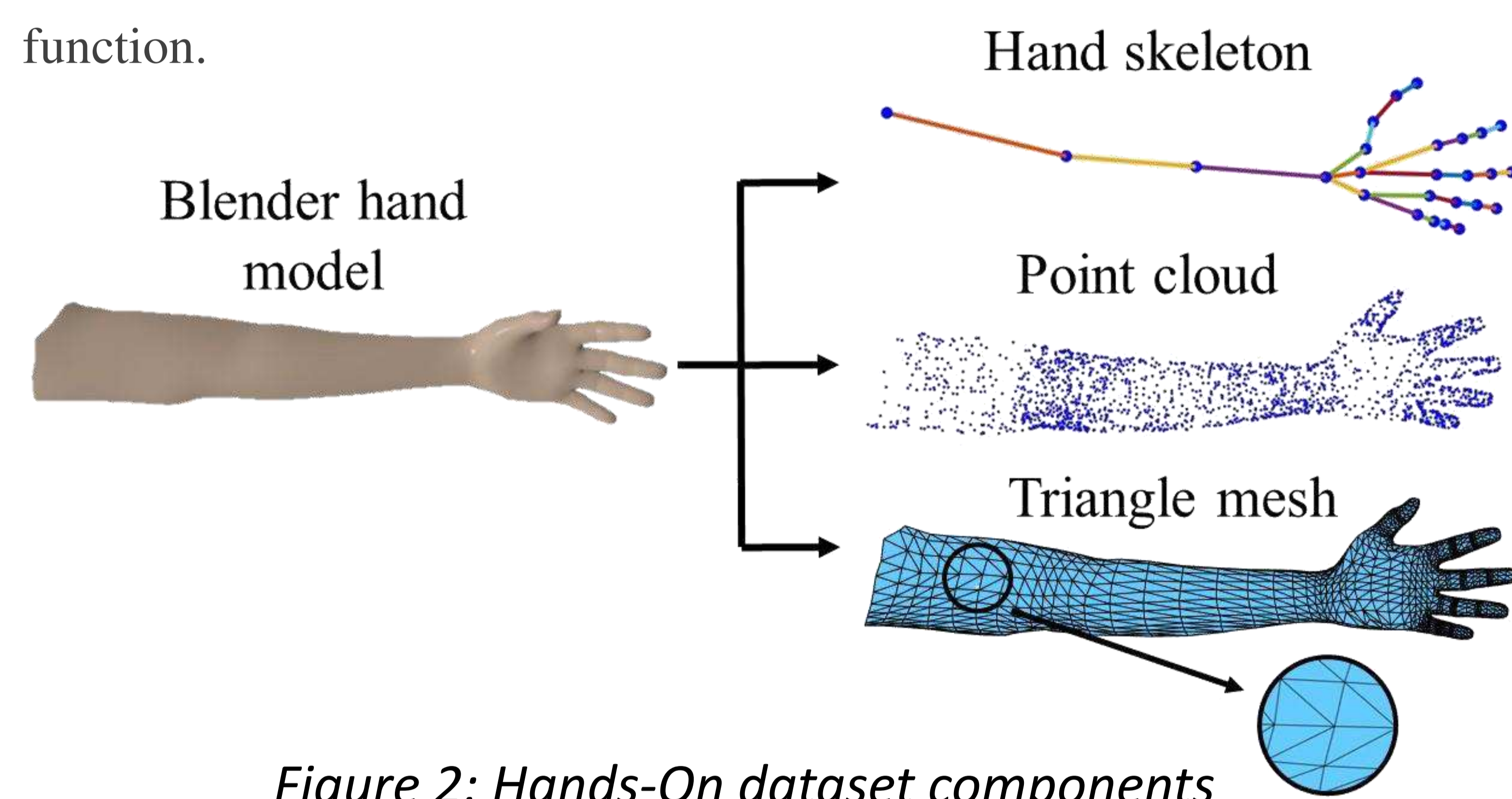


Figure 2: Hands-On dataset components

Robustness and Distance Error Analysis

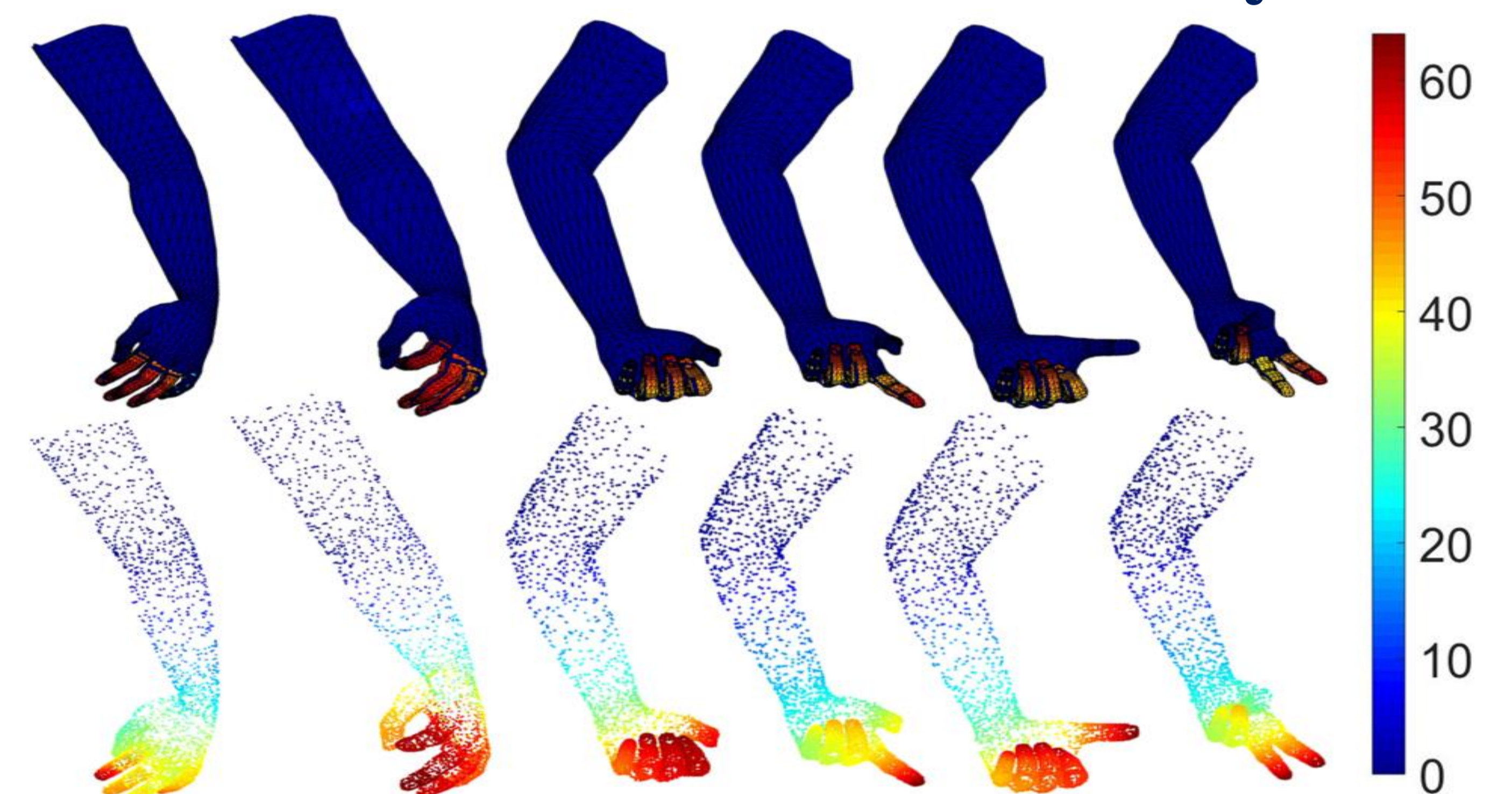


Figure 5: hand model reconstruction

Handy-Net

Deep Dimension Learning on Hand Point Clouds

- End-to-end dimensions inference neural network
- Suitable for 3D sensor data

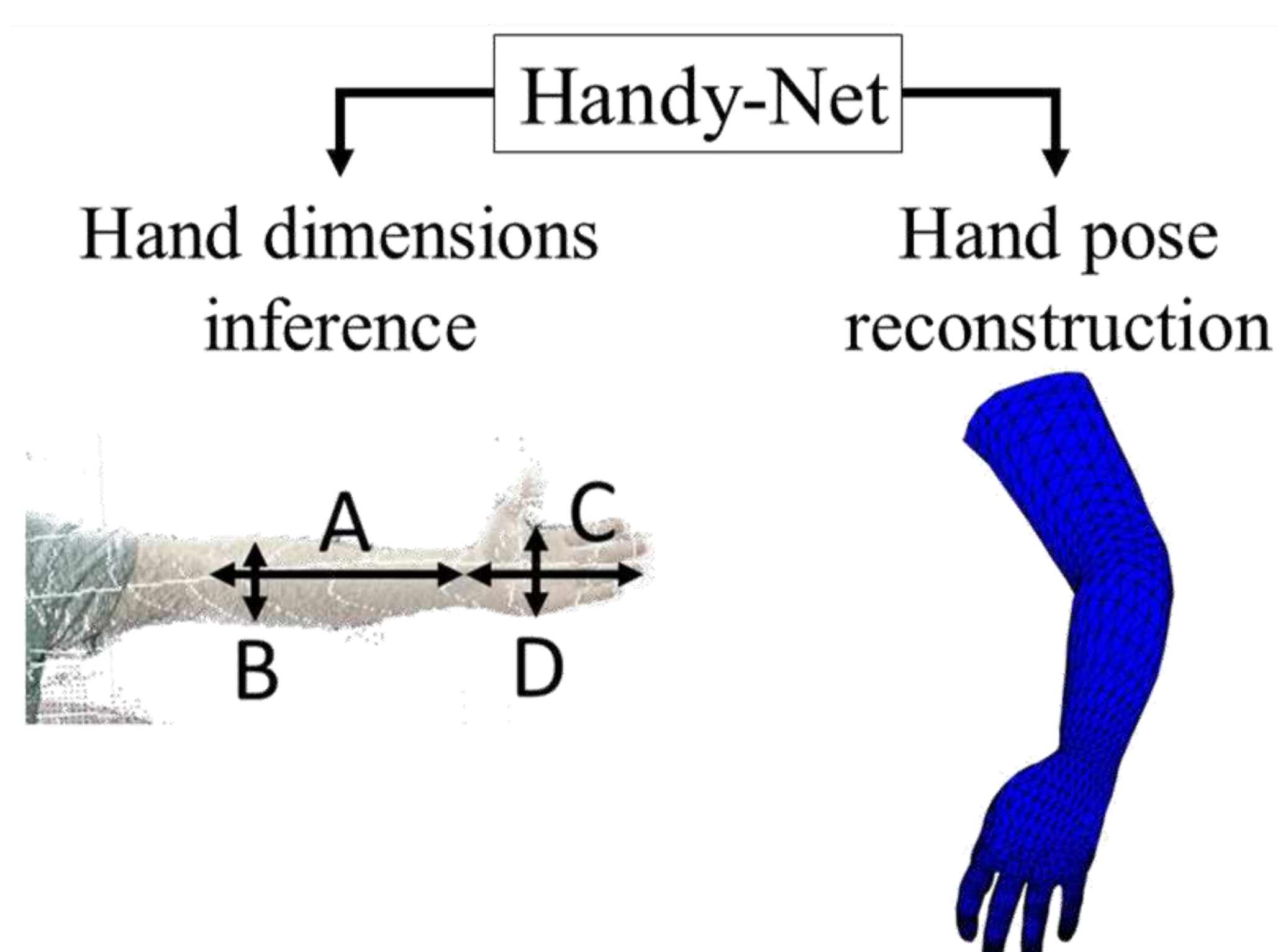


Figure 3: Handy-Net applications

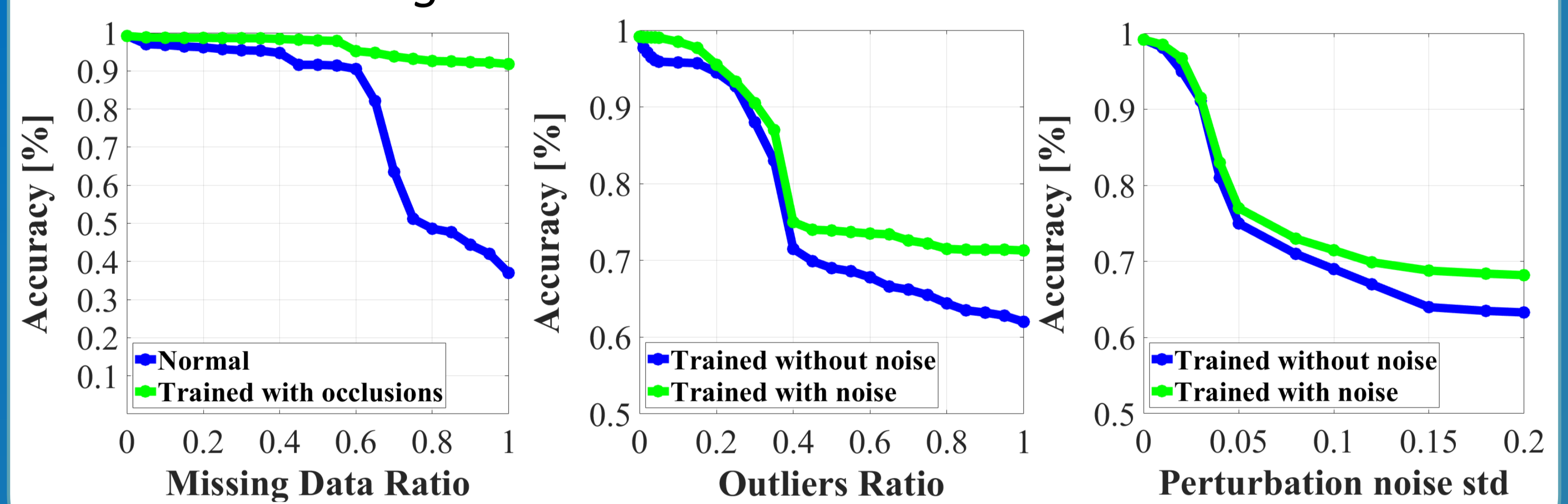


Figure 6: robustness analysis to data corruption

References

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