Human shape and pose recognition

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Artificial Vision

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Introduction

What is it? What is it used for?

Pose / shape recognition

- Image of the human body
- Information on its spatial position / pose / morphology

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Applications

- action recognition
- animation
- gaming

Pose and Shape: how to define them?

Pose

- Human skeleton
- Joints
- constraints on movement
- Proportions / height

Shape

- General form / appearance of a person
- Weight, clothing, etc...

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In Practice

Inputs

2D images

- *in-the-wild* images
- occlusion, challengin viewpoint, crowded scenes, etc...

Depth Images

- Purpose built applications (real time)
- Kinect

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Joints / Keypoints

- Standard approach
- Ideal for MoCap (Motion Capture)

Dense pose mapping

- Projection of the body parts on the image
- difficult to define

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Mesh Representation

- Full 3D model
- SMPL: Skinned Multi-Person Linear mode
- Anatomically correct model

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Engineered Datasets

MoCap

MoCap

- CMU. Videos associated with 3D keypoints.

Hand-labeled datasets

LSP / MPII / COCO

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Hand-labeled datasets

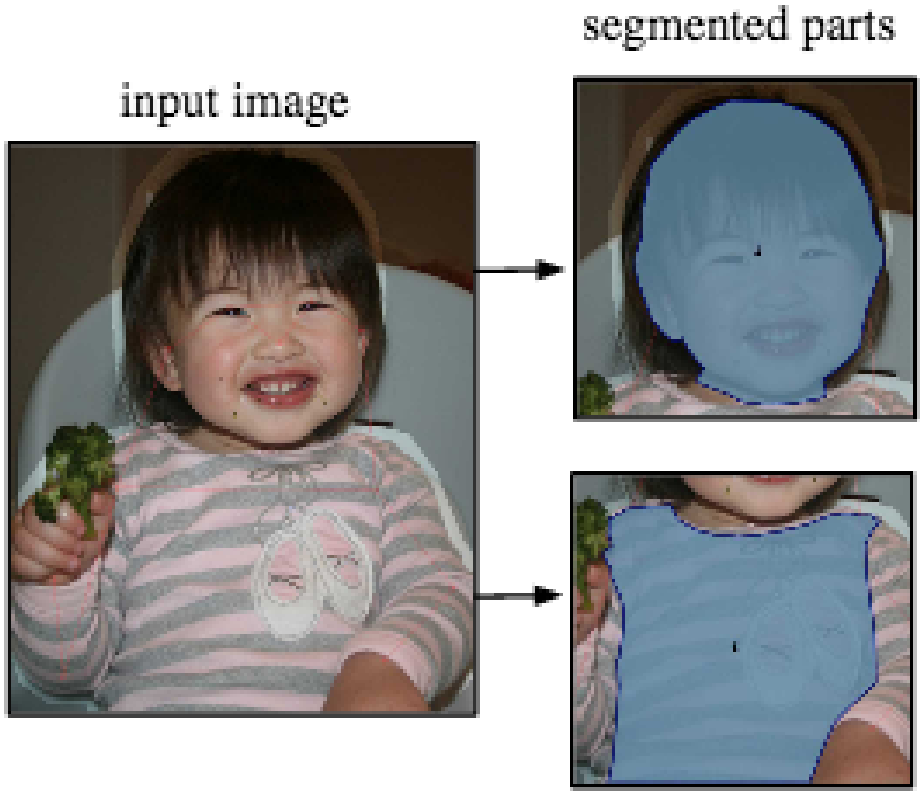
DensePose COCO. by Güler, Neverova, and Kokkinos, 2018

DensePose COCO

- establish ground truth correspondences between the SMPL model and persons appearing in the COCO dataset
- manually-collected (Facebook team)
- 50K humans, 5 million annotated image/surface pairs

Hand-labeled datasets

DensePose COCO : annotation system. by Güler, Neverova, and Kokkinos, 2018



TASK 1: Part Segmentation

Hand-labeled datasets

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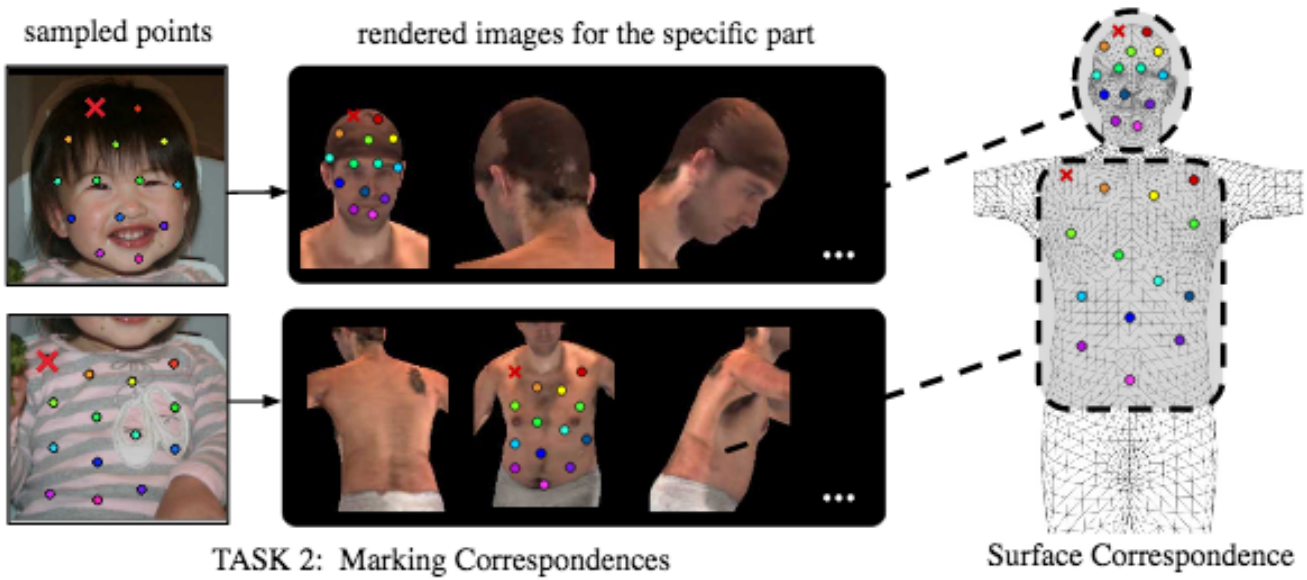

Synthetized dataset creation

Varol et al., 2017

SURREAL

- Synthetic hUmans foR REAL tasks
- 6 million frames

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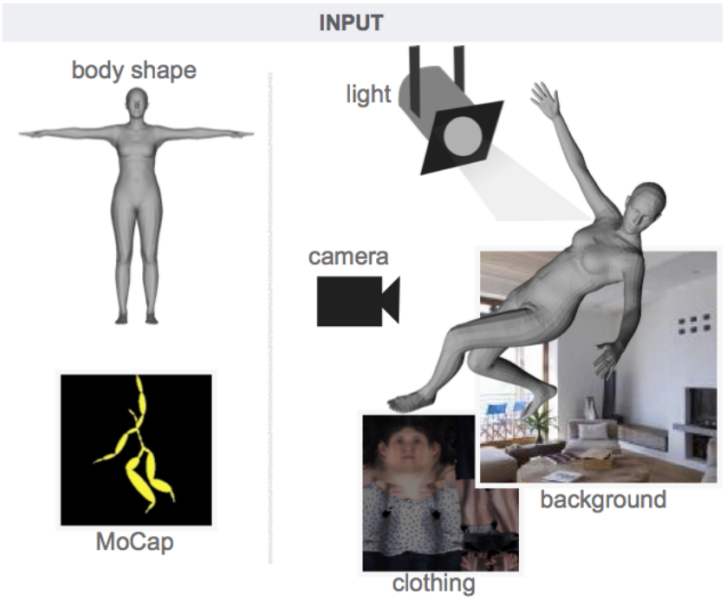

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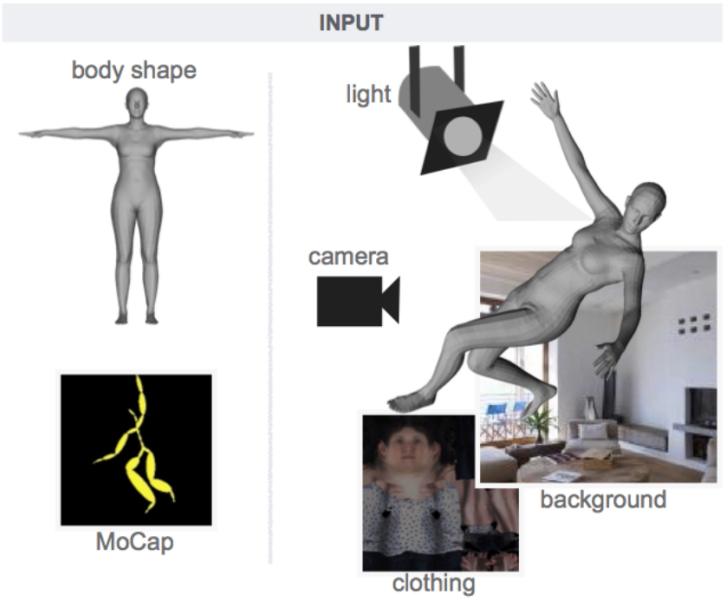

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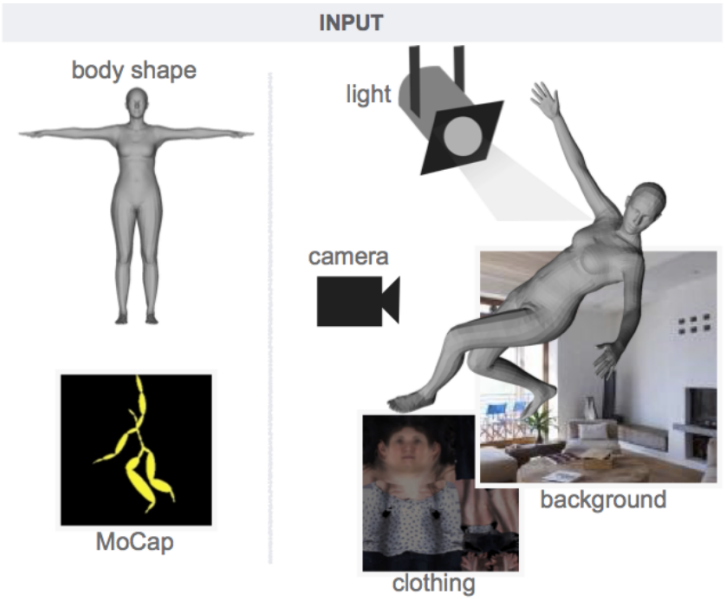

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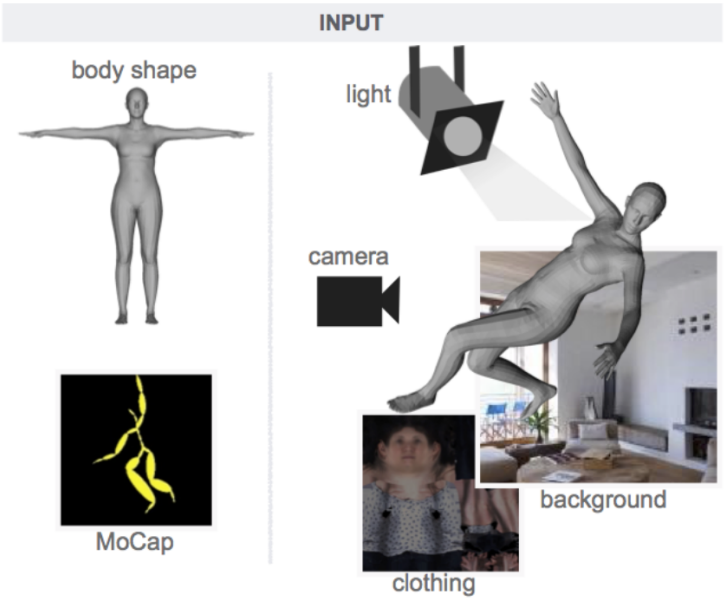

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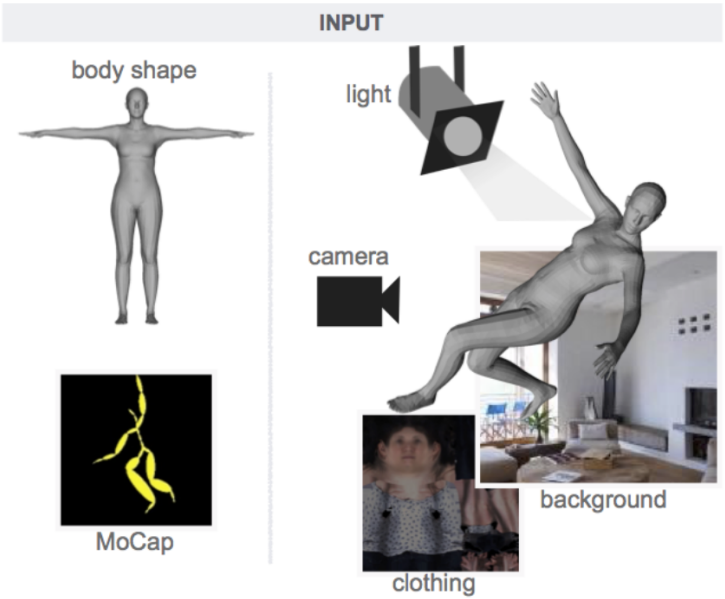

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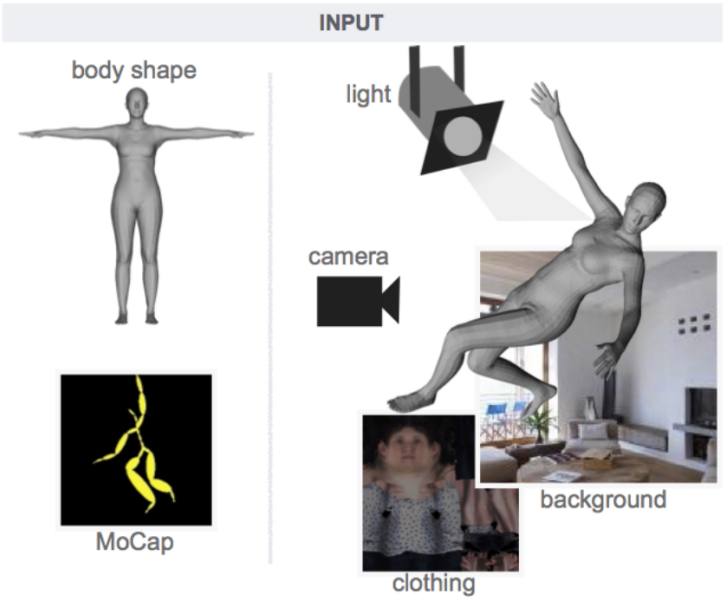

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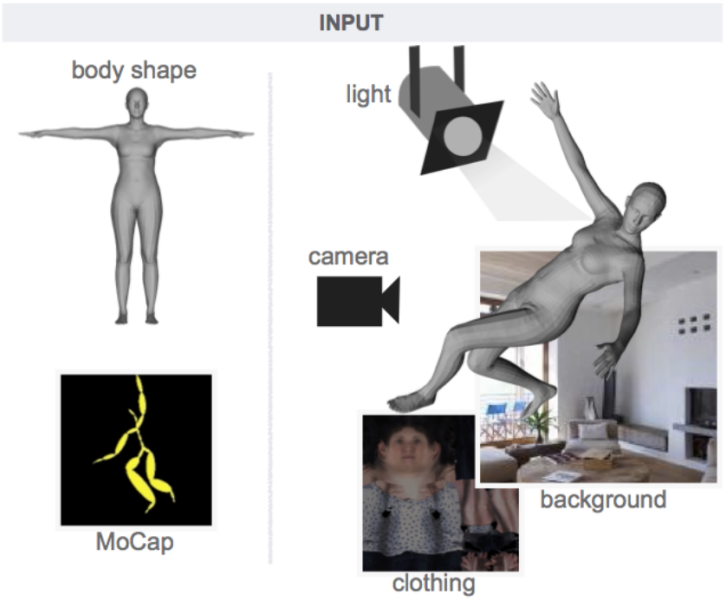

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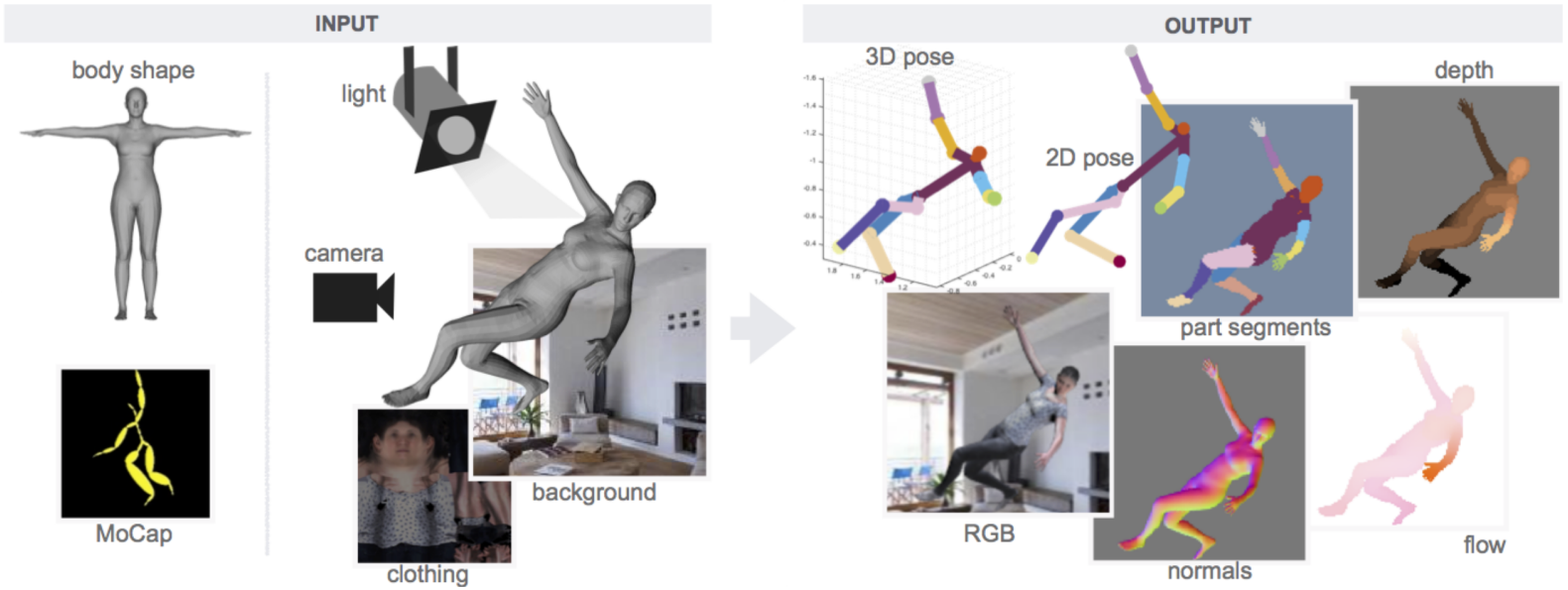

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Iterative Error Feedback

Carreira et al., 2016

- a generic framework for modeling rich structure in both input and output space
- standard ConvNet with a simple feedback connection
- focus on the correction the network should make on the estimation and not the estimation itself

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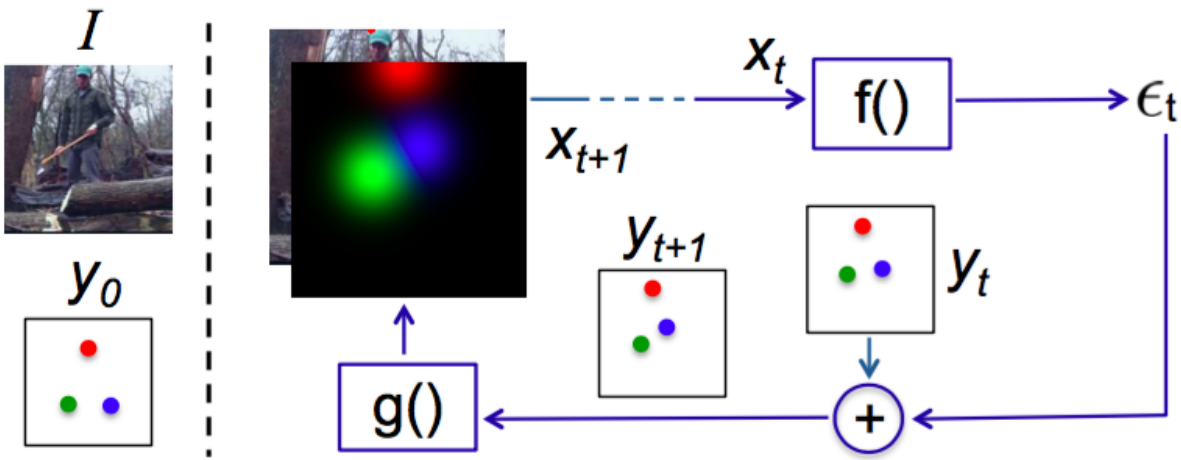
Iterative Error Feedback

Architecture



- $\epsilon_t = f(x_t)$ predicted error
- $y_{t+1} = y_t + \epsilon_t$ corrected estimation
- $x_{t+1} = I \oplus g(y_{t+1})$

Human Mesh Recovery

Kanazawa et al., 2018

Task

reconstruct a full 3D mesh of a human body from a single RGB image

Problems

- *in-the-wild* images with 2D annotations but not 3D
- depth ambiguity : same 2D projection for different 3D configurations
- regression rotation matrices is a challenge

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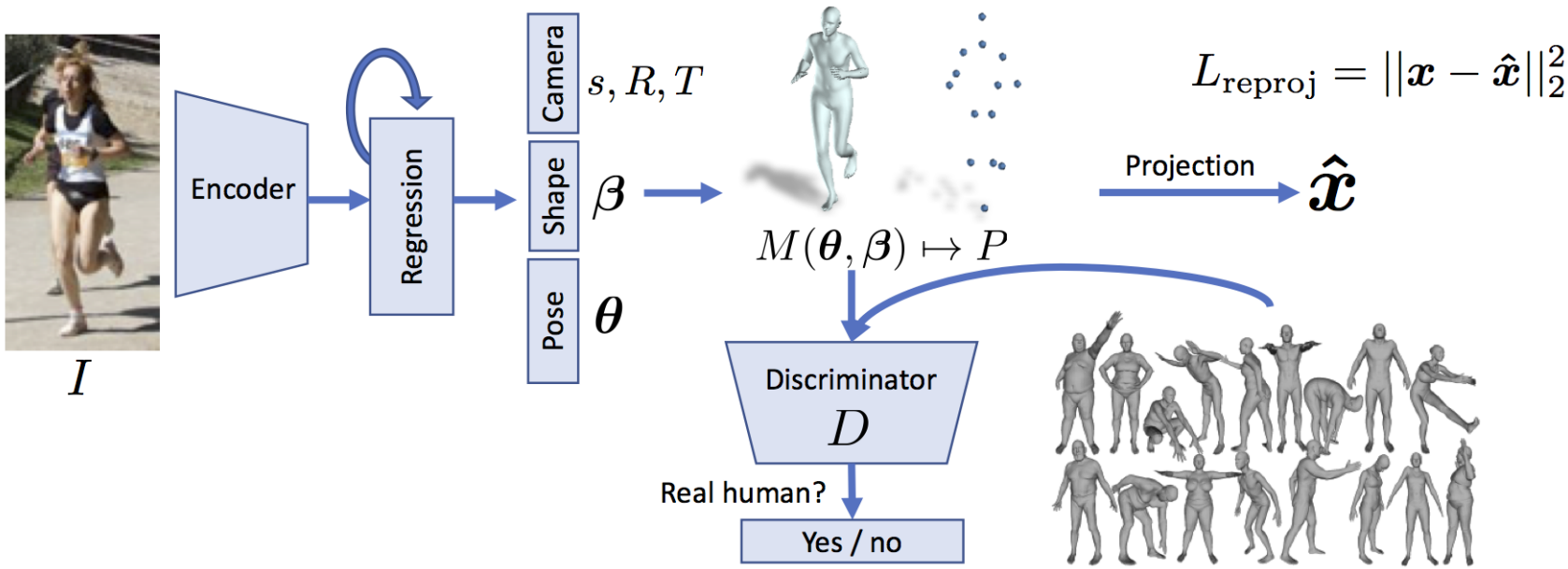

Human Mesh Recovery

Kanazawa et al., 2018

- real time
- no prior assumption (on angle joint limit for example)
- adapted to *in-the-wild* images with only 2D annotations

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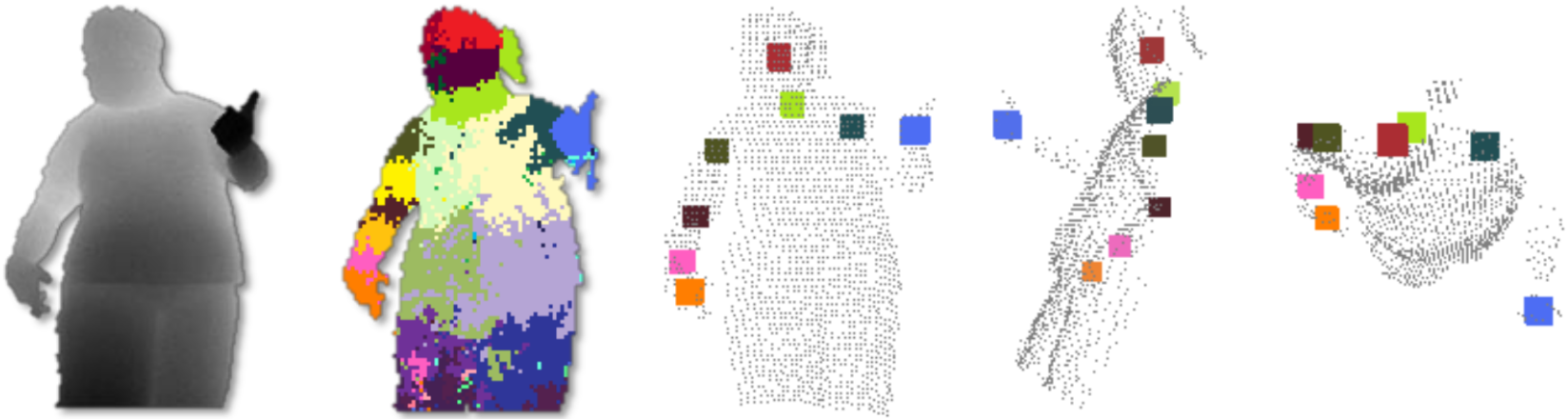

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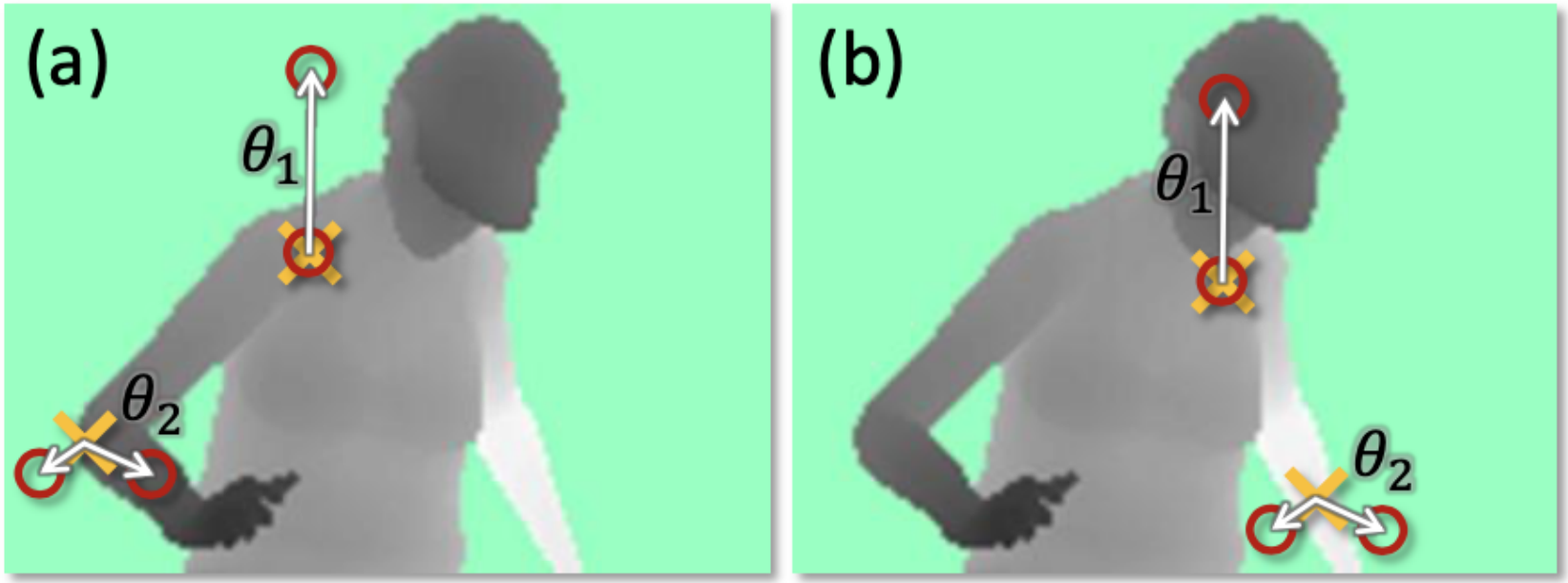

Pose Recognition from Single Depth Images

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$$f_\theta(I, \mathbf{x}) = d_I\left(\mathbf{x} + \frac{\mathbf{u}}{d_I(\mathbf{x})}\right) - d_I\left(\mathbf{x} + \frac{\mathbf{v}}{d_I(\mathbf{x})}\right) , \quad (1)$$

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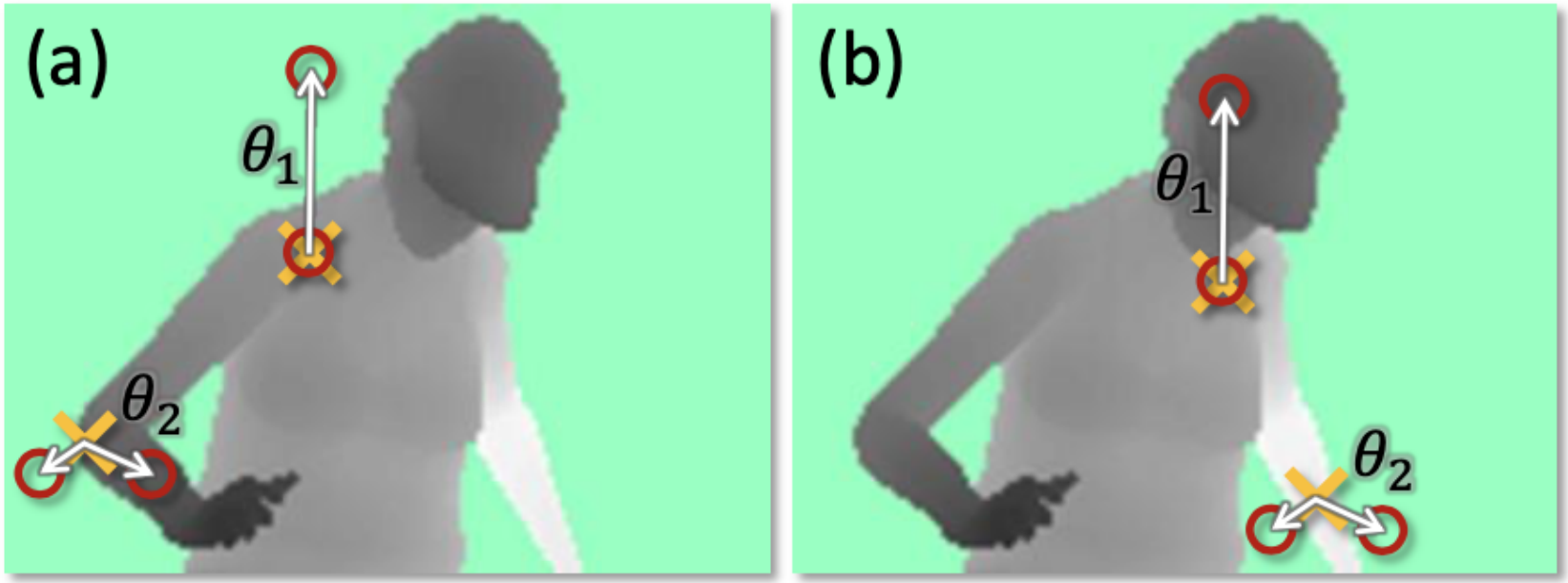

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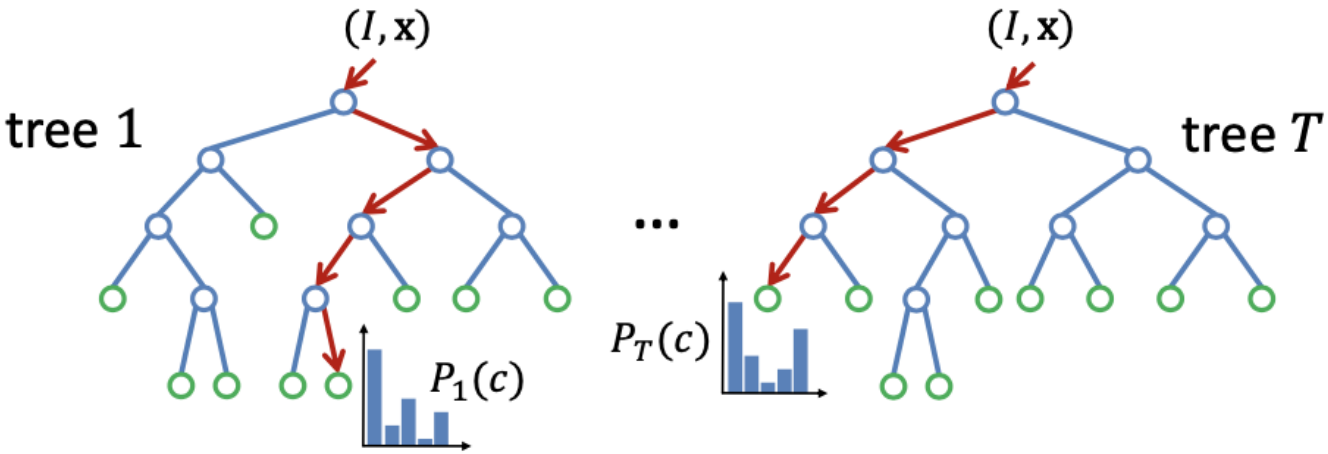

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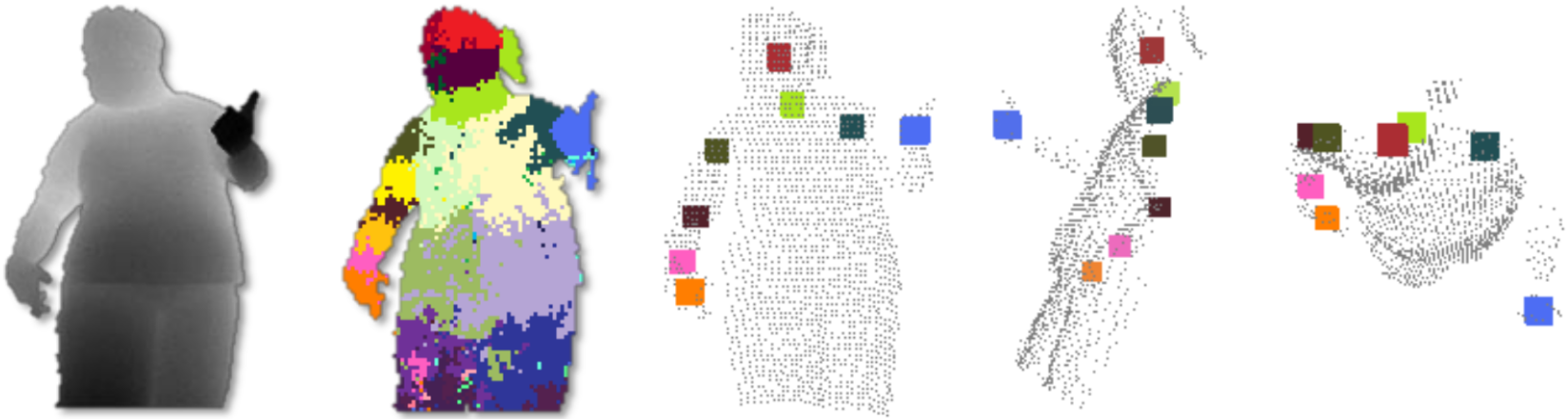

Pose Recognition from Single Depth Images

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$$f_c(\hat{\mathbf{x}}) \propto \sum_{i=1}^{N} w_{ic} \exp\left(-\left\|\frac{\hat{\mathbf{x}} - \hat{\mathbf{x}}_i}{b_c}\right\|^2\right), \qquad (7)$$

Pose Recognition from Single Depth Images

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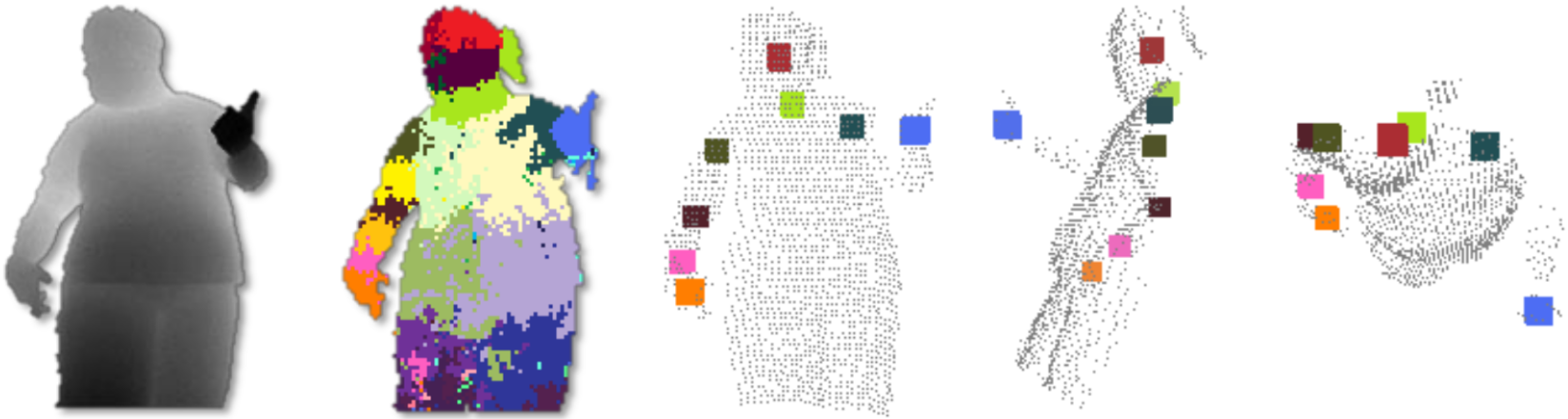

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