Learning-Based Animation of Clothing for Virtual Try-On

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~80% of clothing is purchased at brick-and-mortar stores

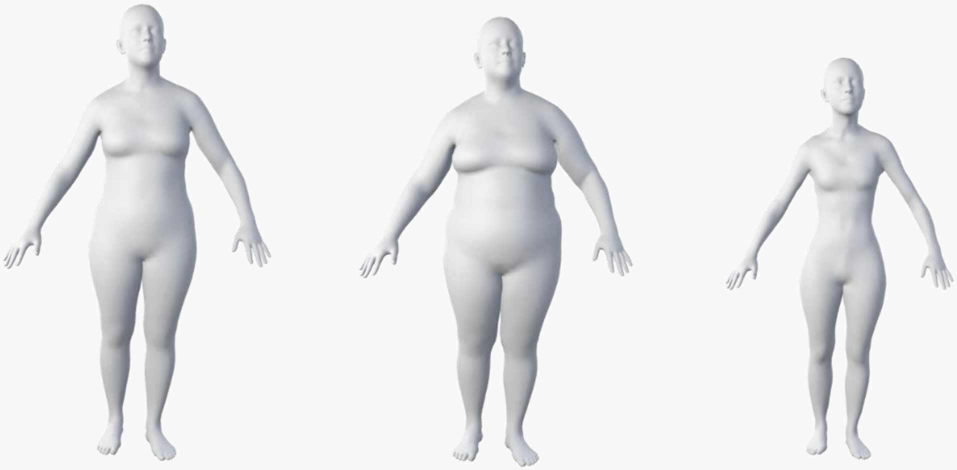
Images from Wikimedia Commons

Virtual try-on

Garment

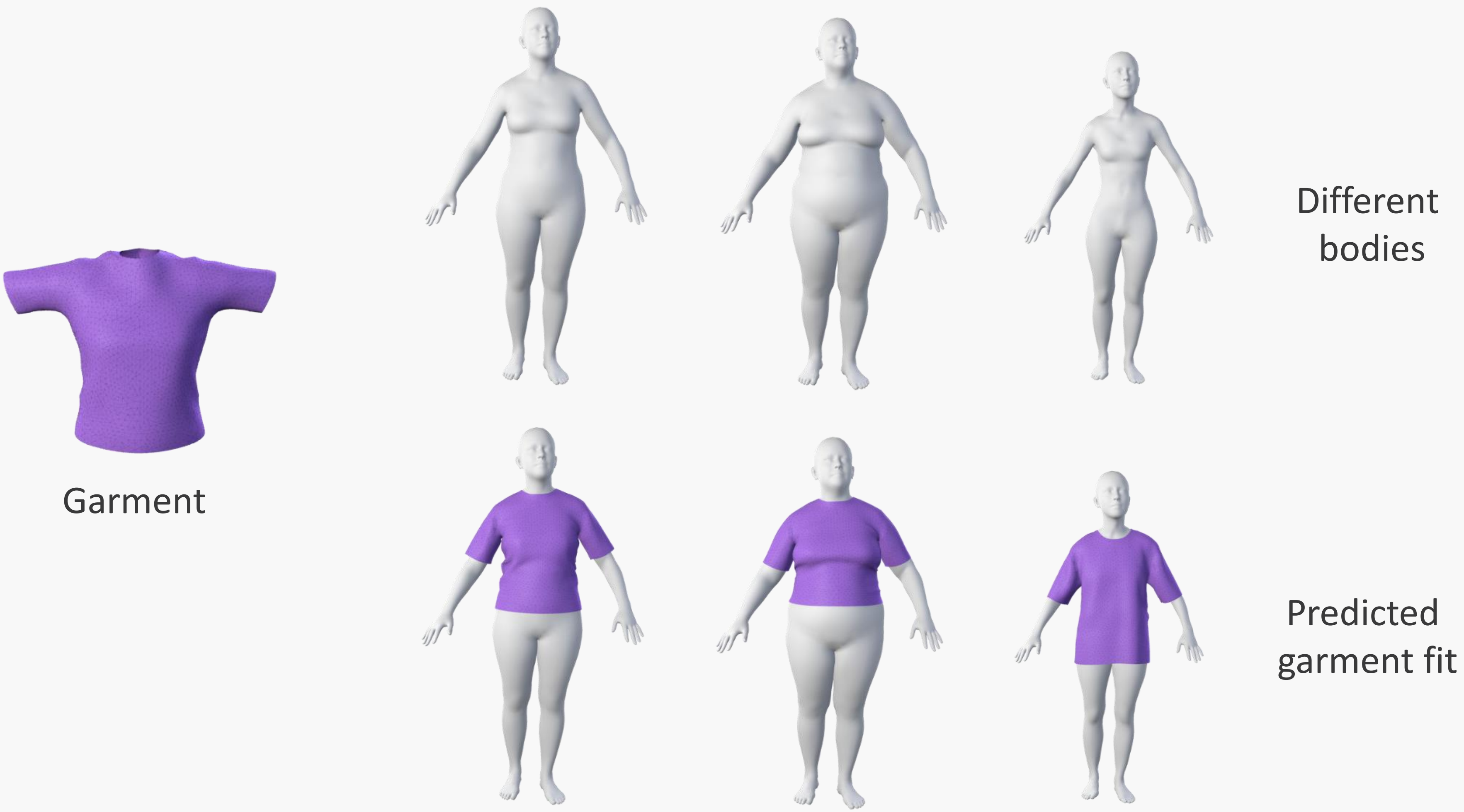
Virtual try-on

Garment

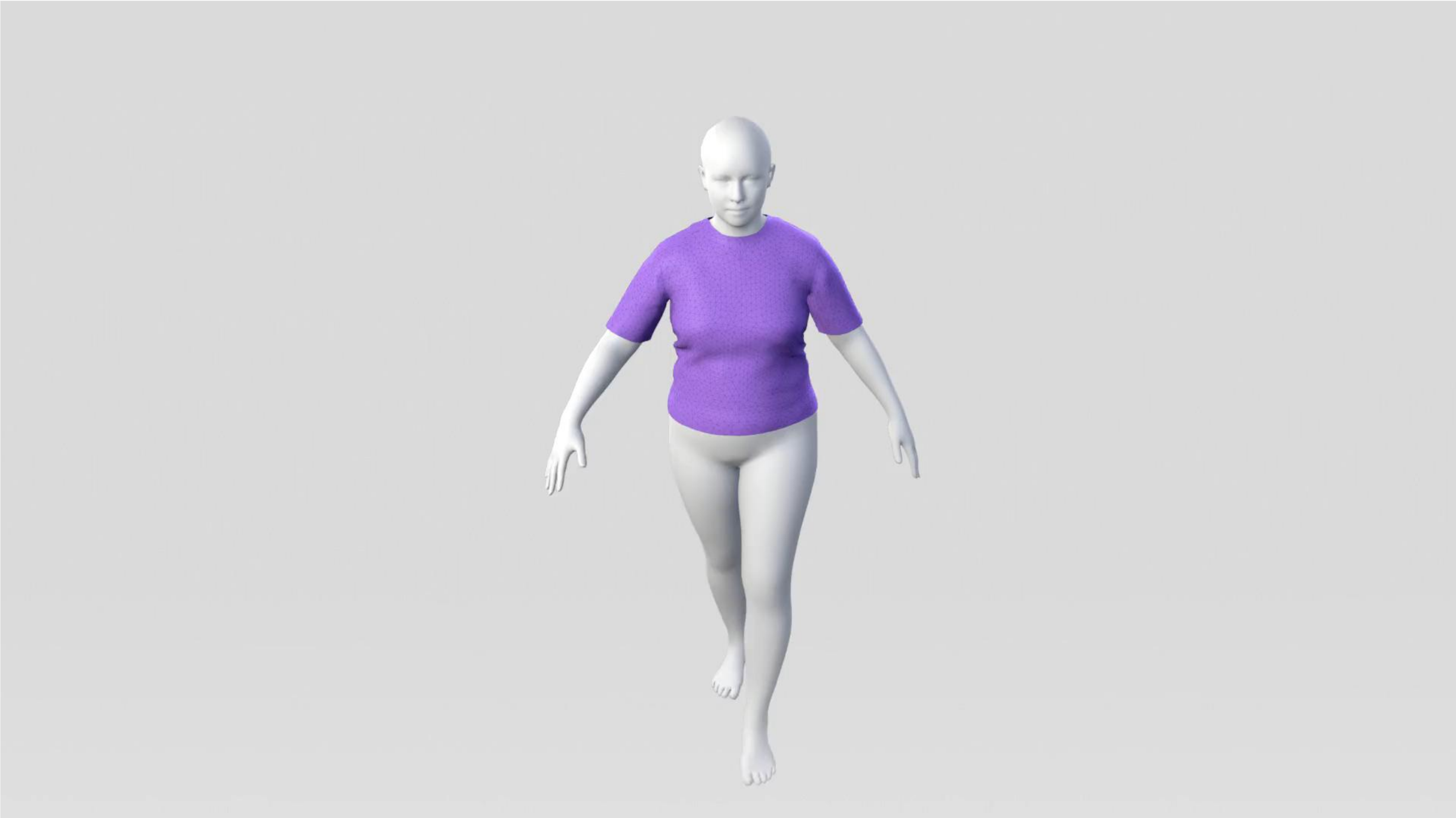


Different bodies

Virtual try-on



Virtual try-on

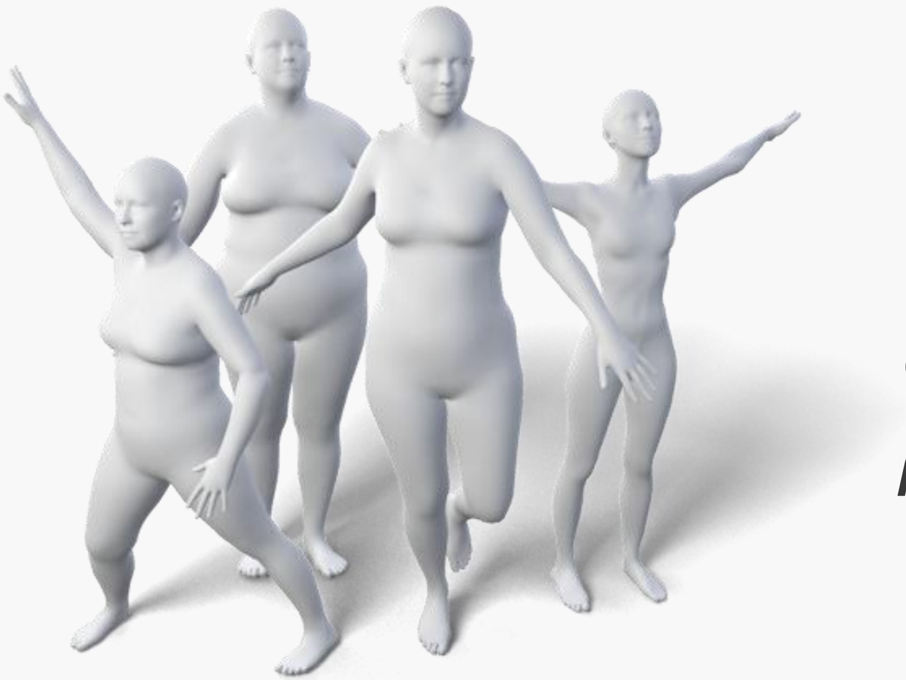


Virtual try-on

Key insights

- Cloth deformations are **highly nonlinear**
  - Physics-based models
  - Data-driven models (e.g., neural networks)
- Clothing deformations are **strongly correlated** with body shape and motion
- The human body can take a **wide ranges of shapes**

Human model

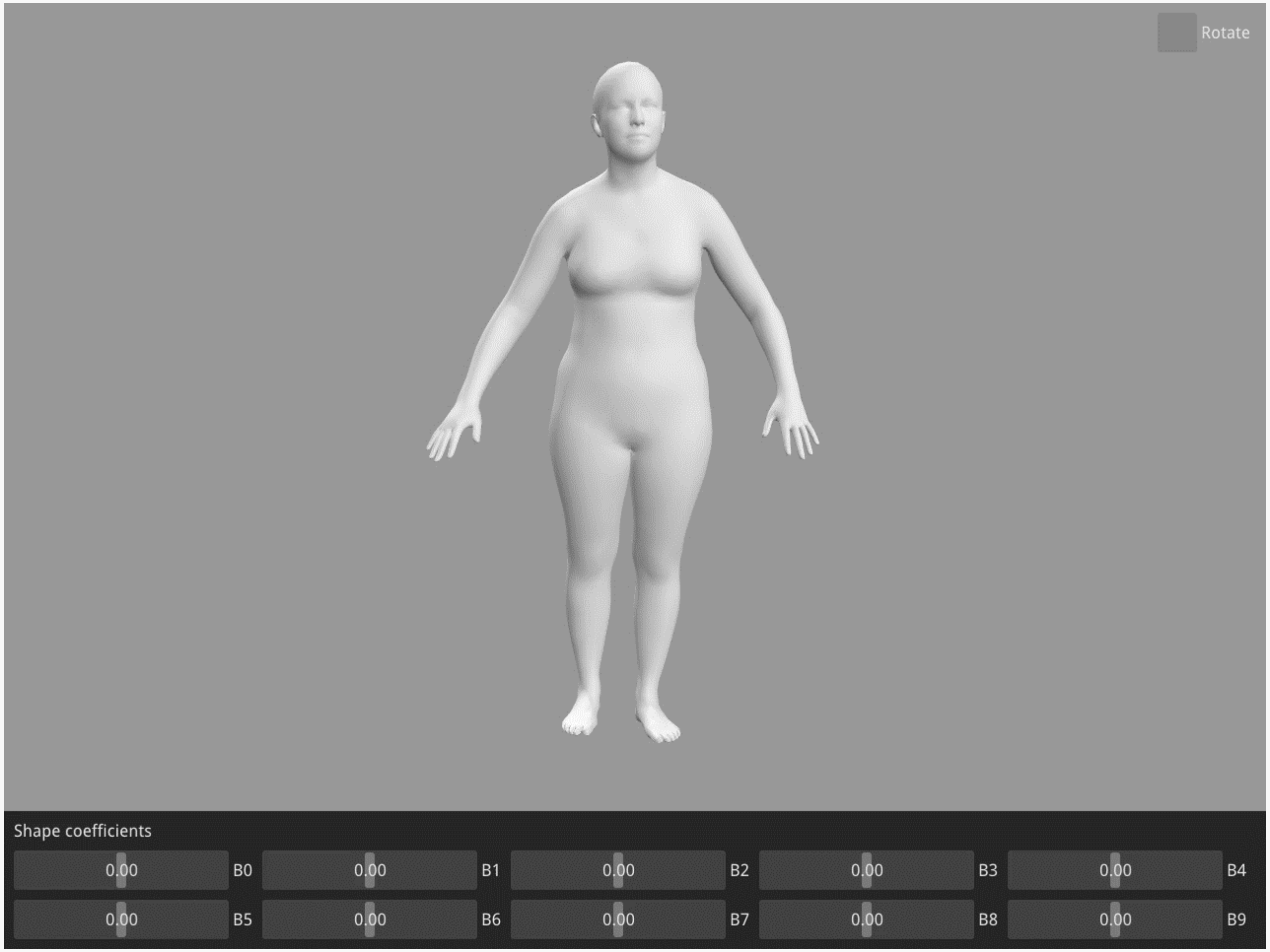


SMPL
[Loper et al. 2015]

$\boldsymbol{\theta} \in \mathbb{R}^{69}$ (Pose coefficients)

$\boldsymbol{\beta} \in \mathbb{R}^{10}$ (Shape coefficients)

Human model



$\leftarrow \boldsymbol{\beta}$

Physics-based models

Cirio et al. 2015

Narain et al. 2012

Tang et al. 2018

Physics-based models

Cirio et al. 2015

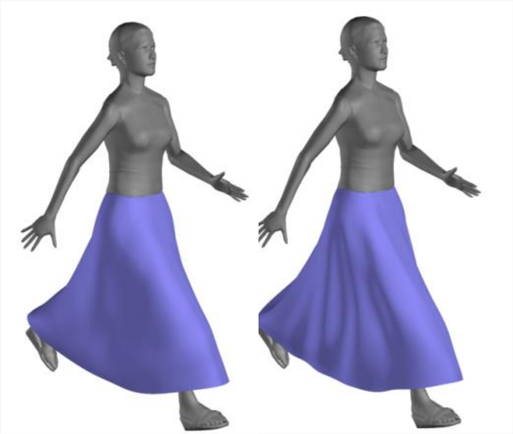
Narain et al. 2012

Tang et al. 2018

Data-driven models

Wang et al. 2010

De Aguiar et al. 2010



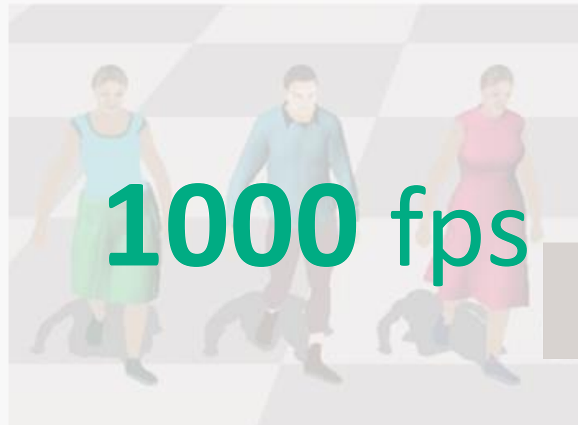
Kavan et al. 2011

Hahn et al. 2014

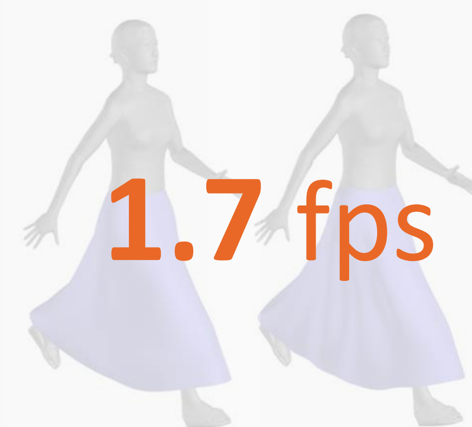
Guan et al. 2012

Data-driven models

Wang et al. 2010



De Aguiar et al. 2010



Kavan et al. 2011

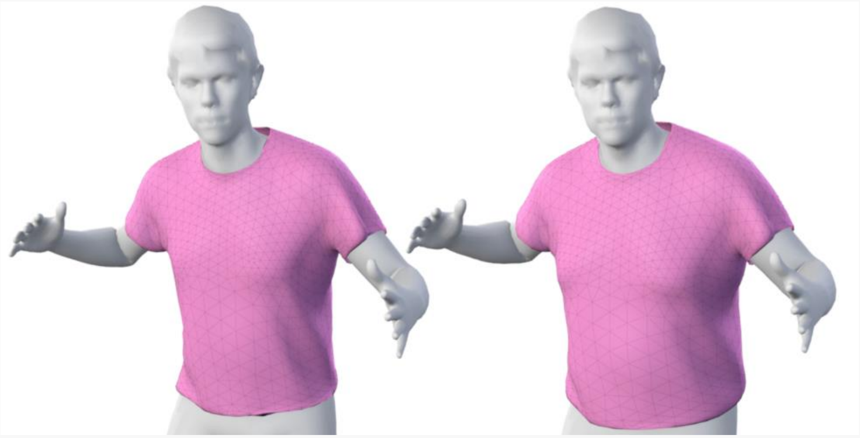
Hahn et al. 2014

Guan et al. 2012

Data-driven models

DRAPE
Guan et al. 2012

- Preserves the style across different body shapes
- The size of the garment changes

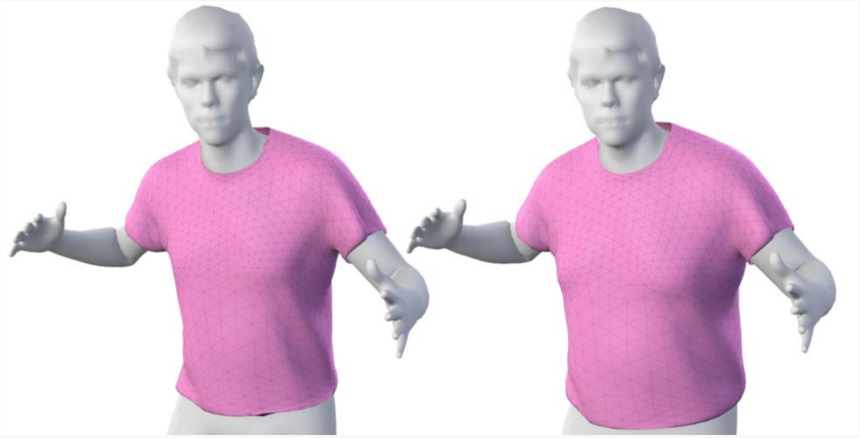


ClothCap
Pons-Moll et al. 2017

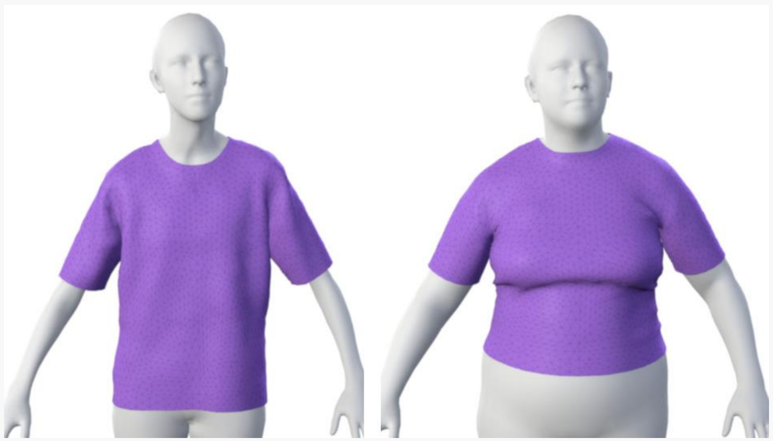
- Uses retargeting
- The wrinkles are copied from one shape to another

Data-driven models

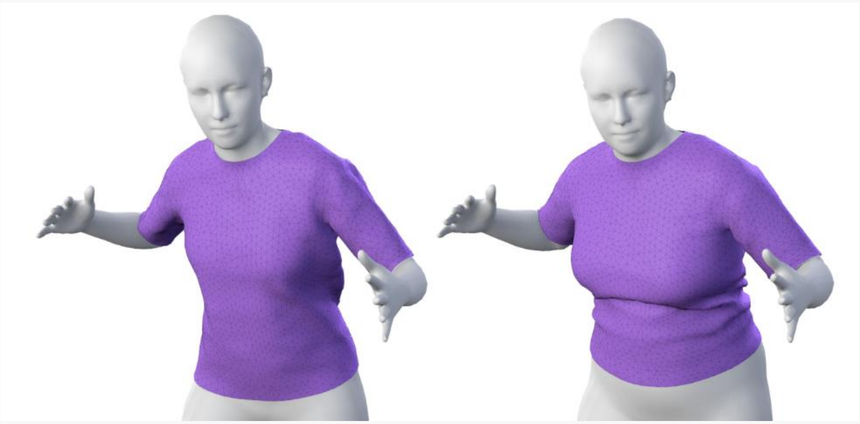
DRAPE
Guan et al. 2012



ClothCap
Pons-Moll et al. 2017



Our method



Our method

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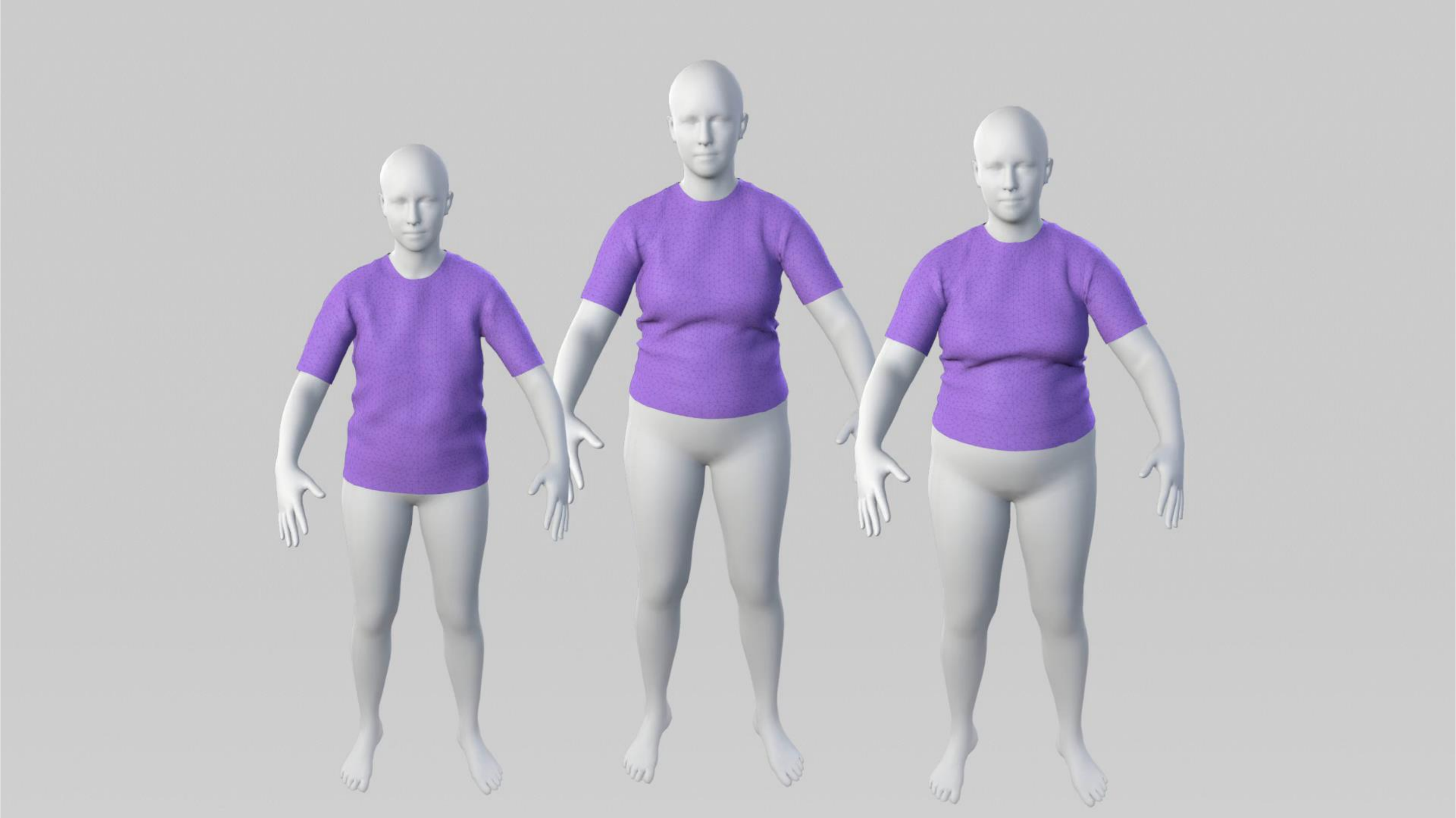


250 fps

Our method

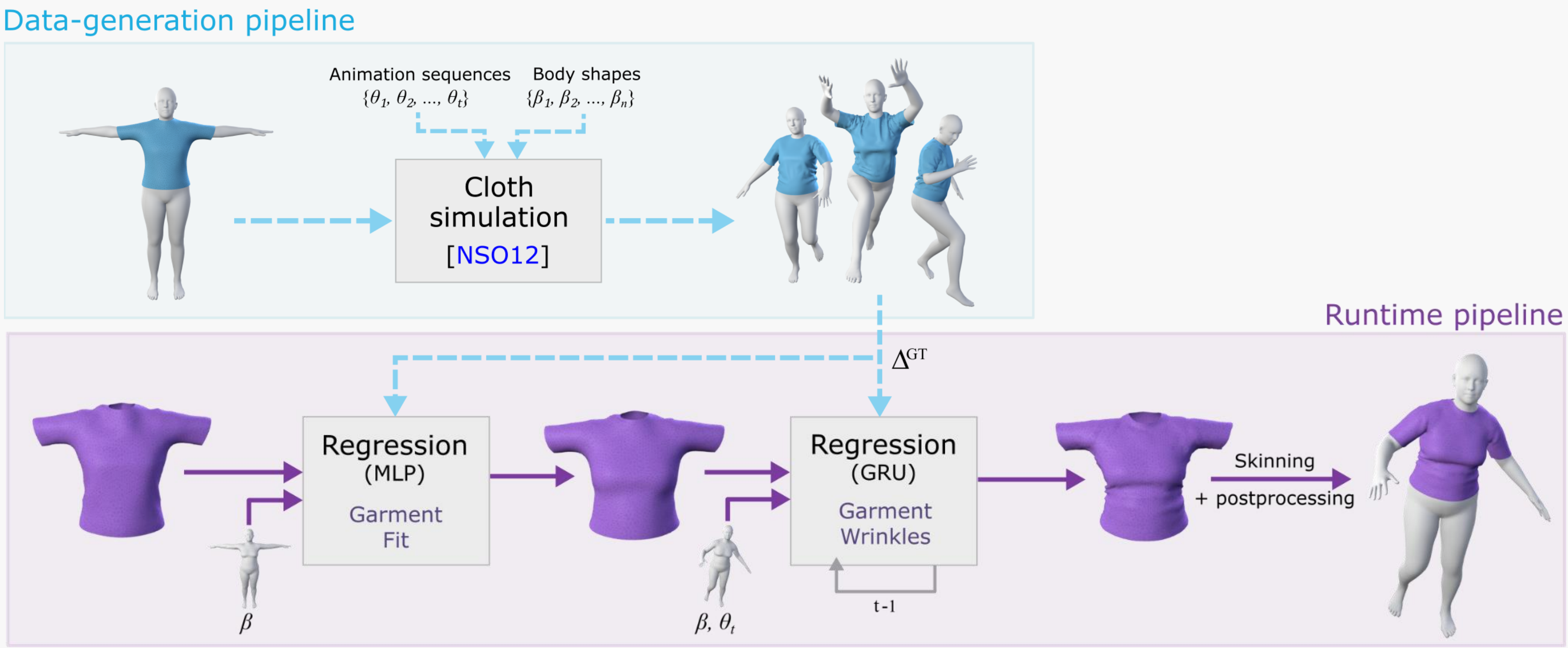
Key ideas

1. Build a rich dataset of dressed character simulations

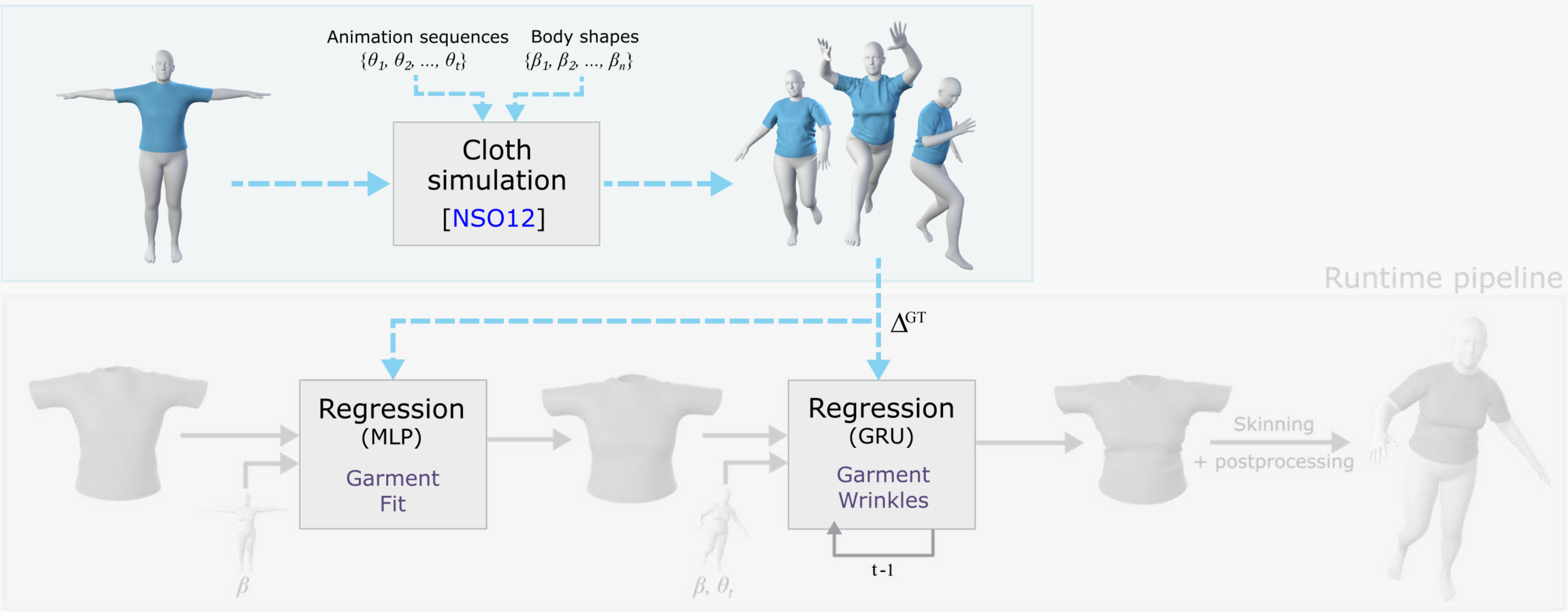
2. Learn deformations in pose-space

3. Disentangle two sources of deformation:
   - Static fit deformations (shape dependent)
   - Dynamic wrinkle deformations (shape and motion dependent)

4. Capture temporal dependencies

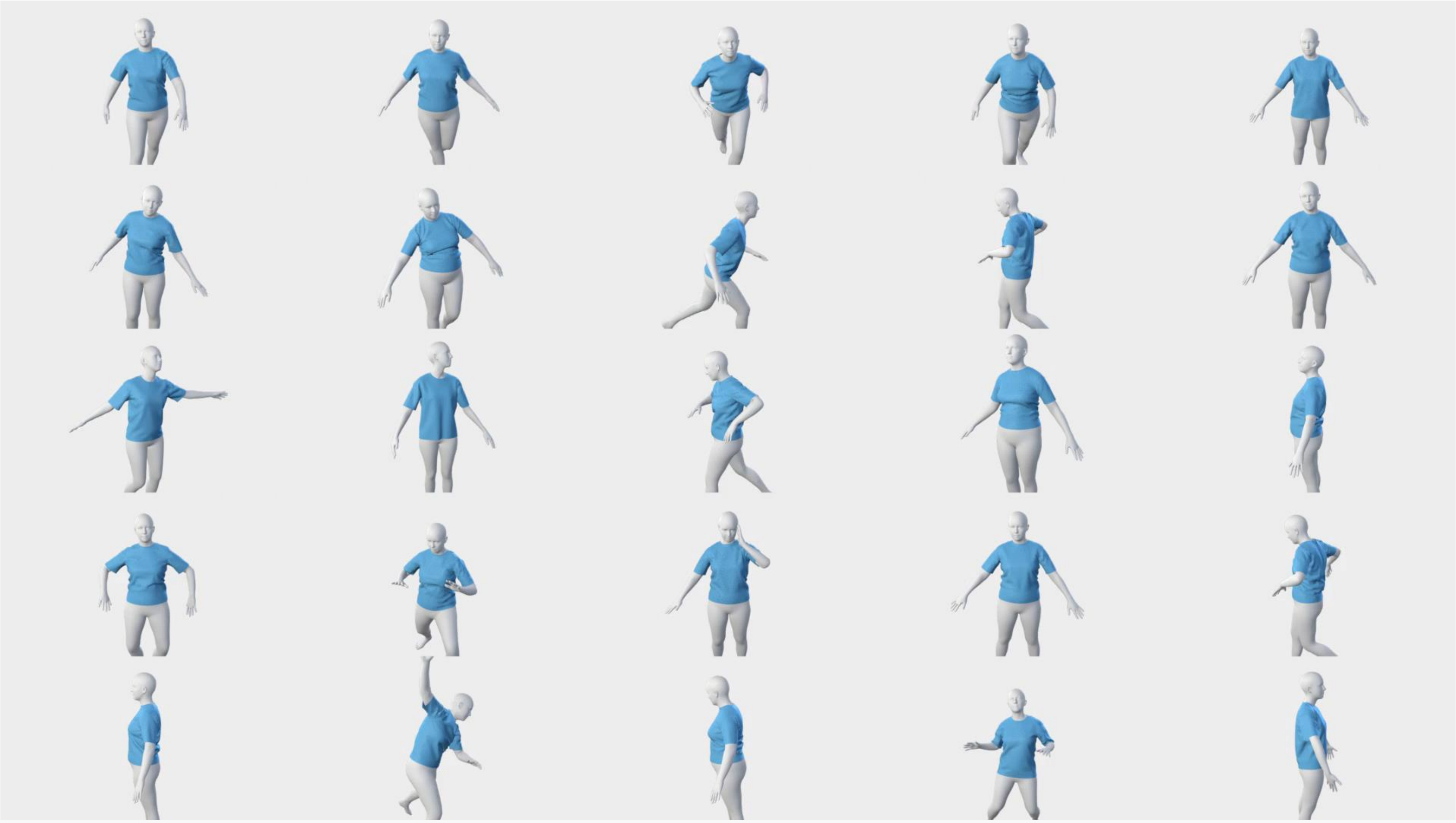

Data-generation pipeline
Animation sequences
$\{\theta_1, \theta_2, ..., \theta_t\}$
Body shapes
$\{\beta_1, \beta_2, ..., \beta_n\}$
Cloth simulation
[NSO12]
Runtime pipeline
Δ^{GT}
Regression
(MLP)
Garment Fit
β
Regression
(GRU)
Garment Wrinkles
t-1
β, θ_t
Skinning
+ postprocessing

Data-generation pipeline



Dataset

56 sequences × 17 shapes



ARCSim

[Narain et al. 2012]

Data preprocessing

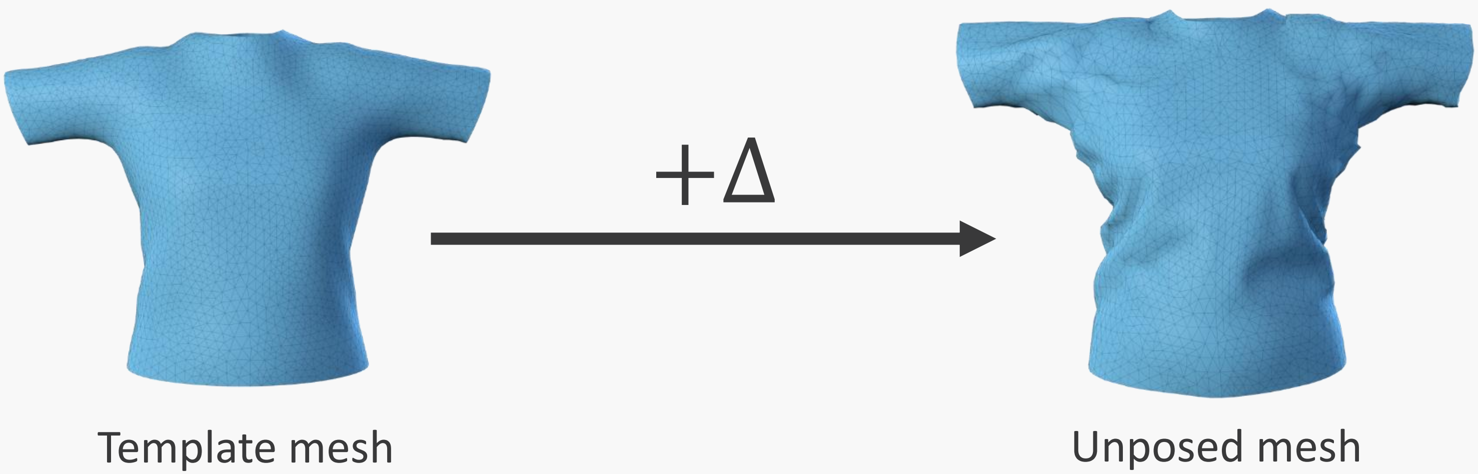
Simulated mesh

Data preprocessing

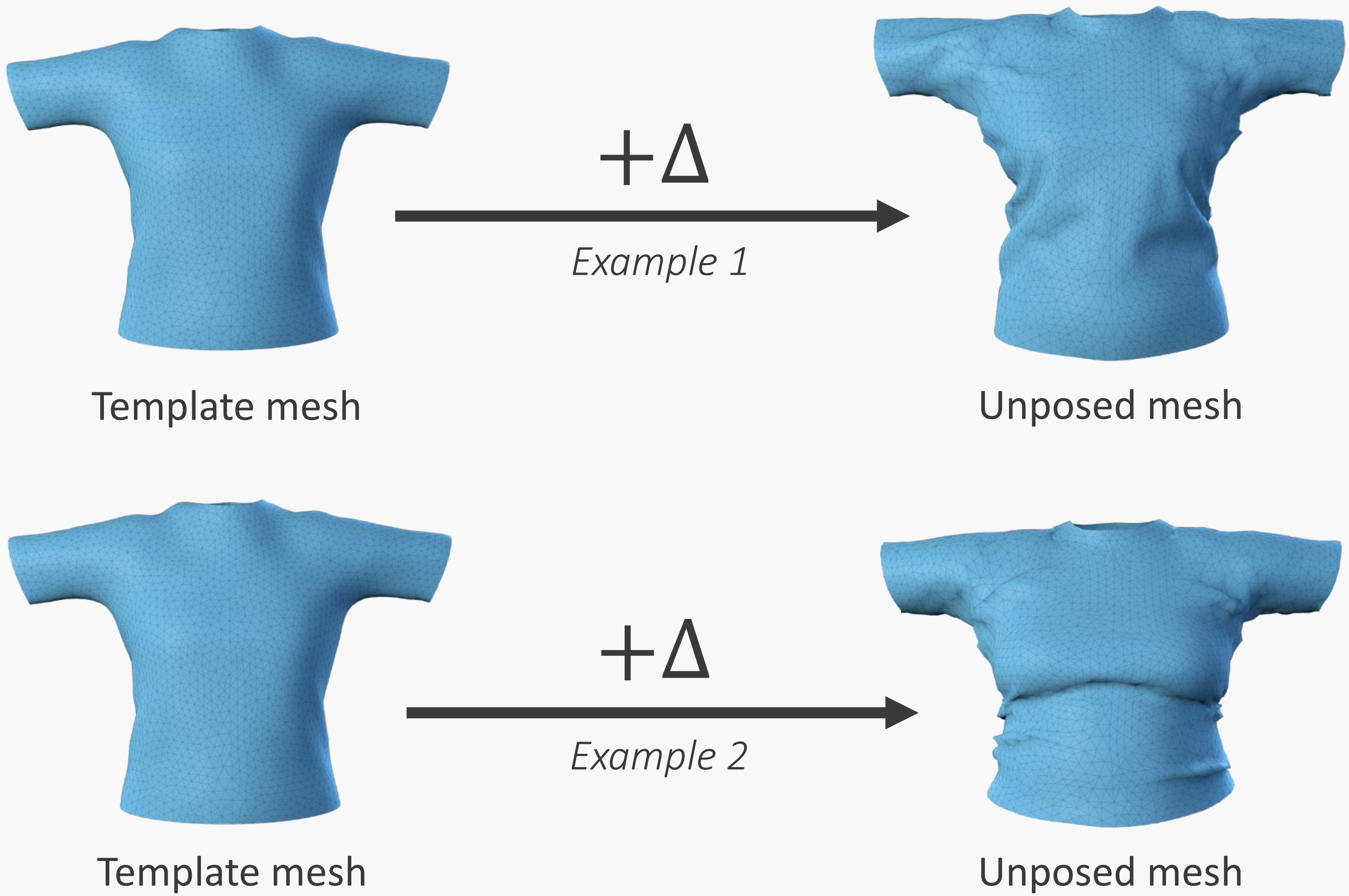
$LBS^{-1}\Big($  $\Big) =$ 

Unposed mesh

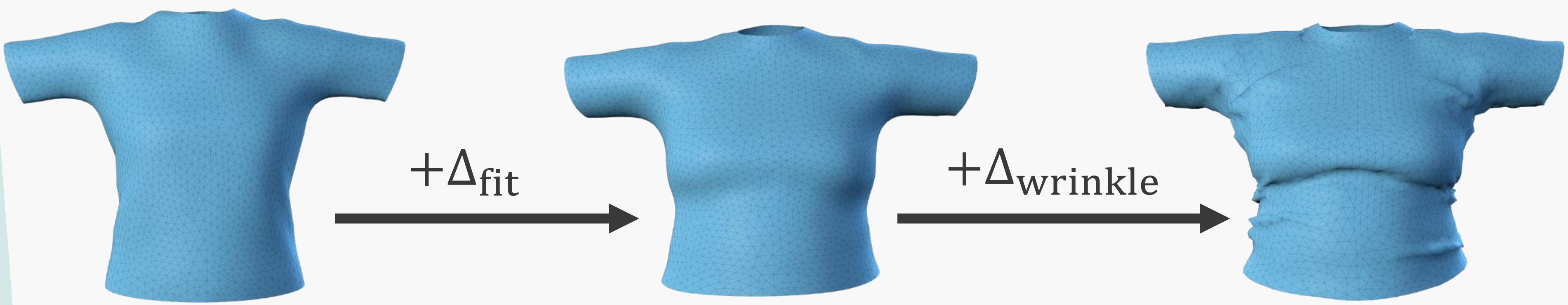
Data preprocessing



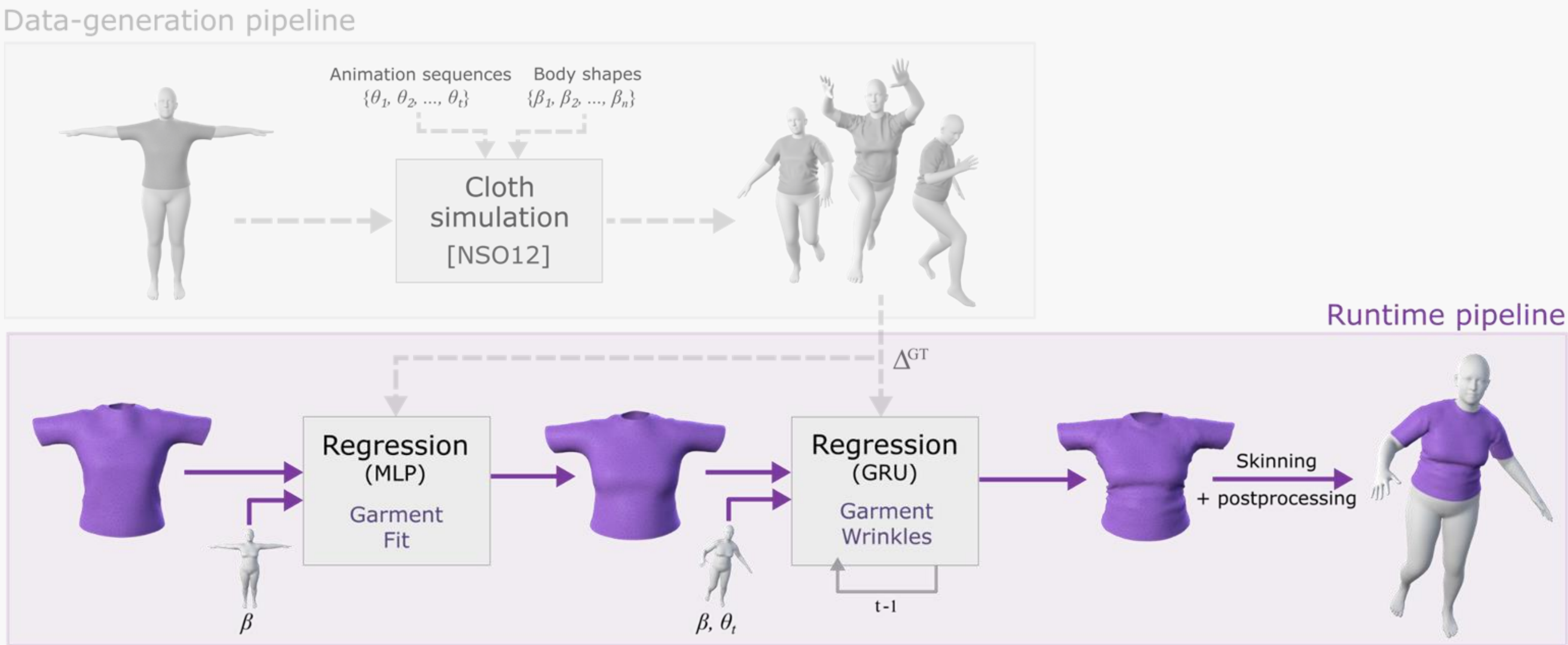
Data preprocessing



Data preprocessing

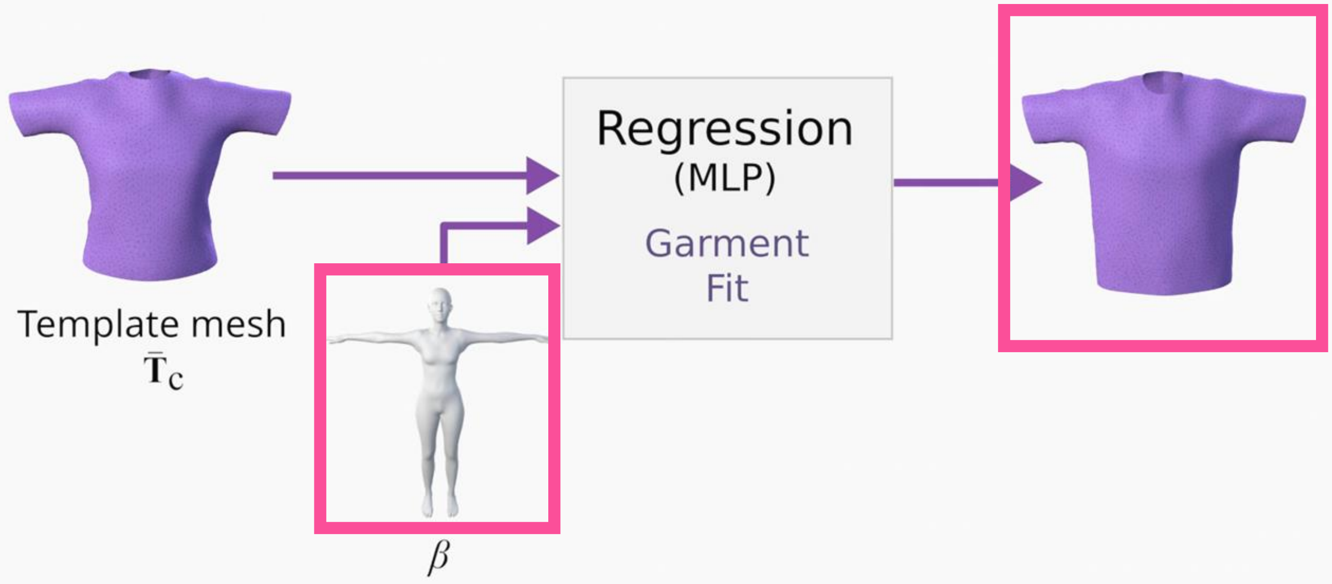


Template mesh | Fitted mesh | Unposed mesh

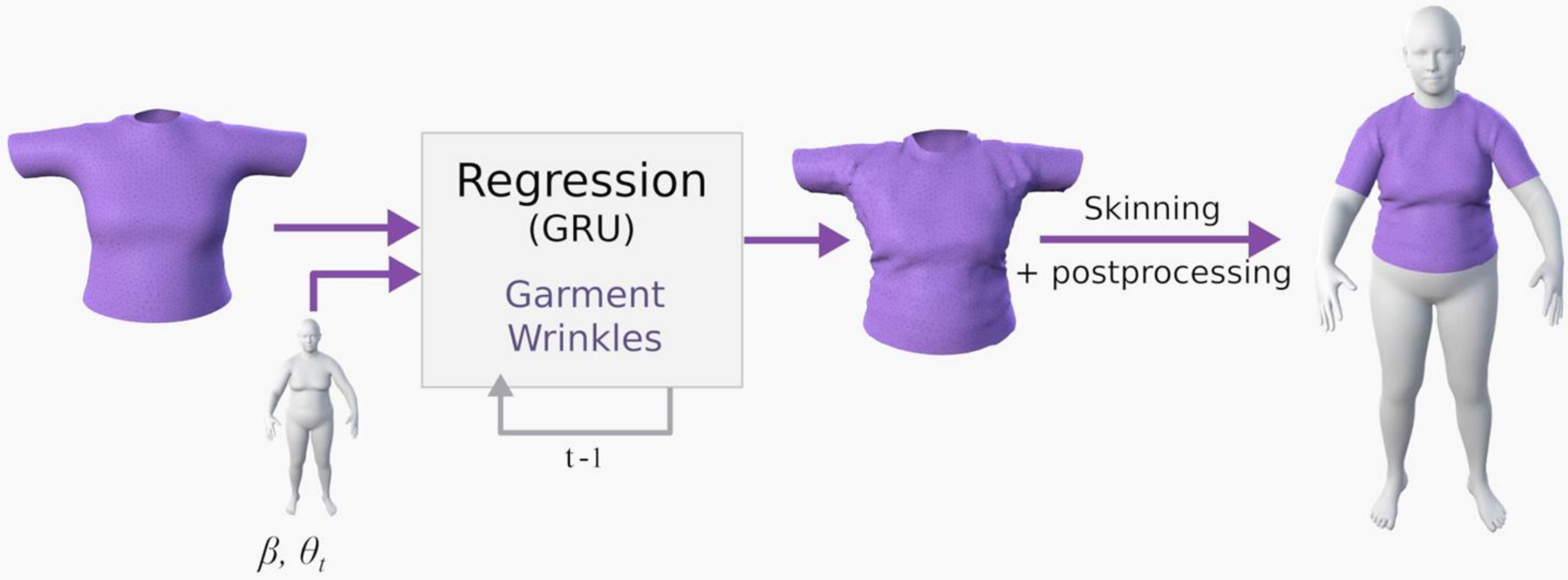


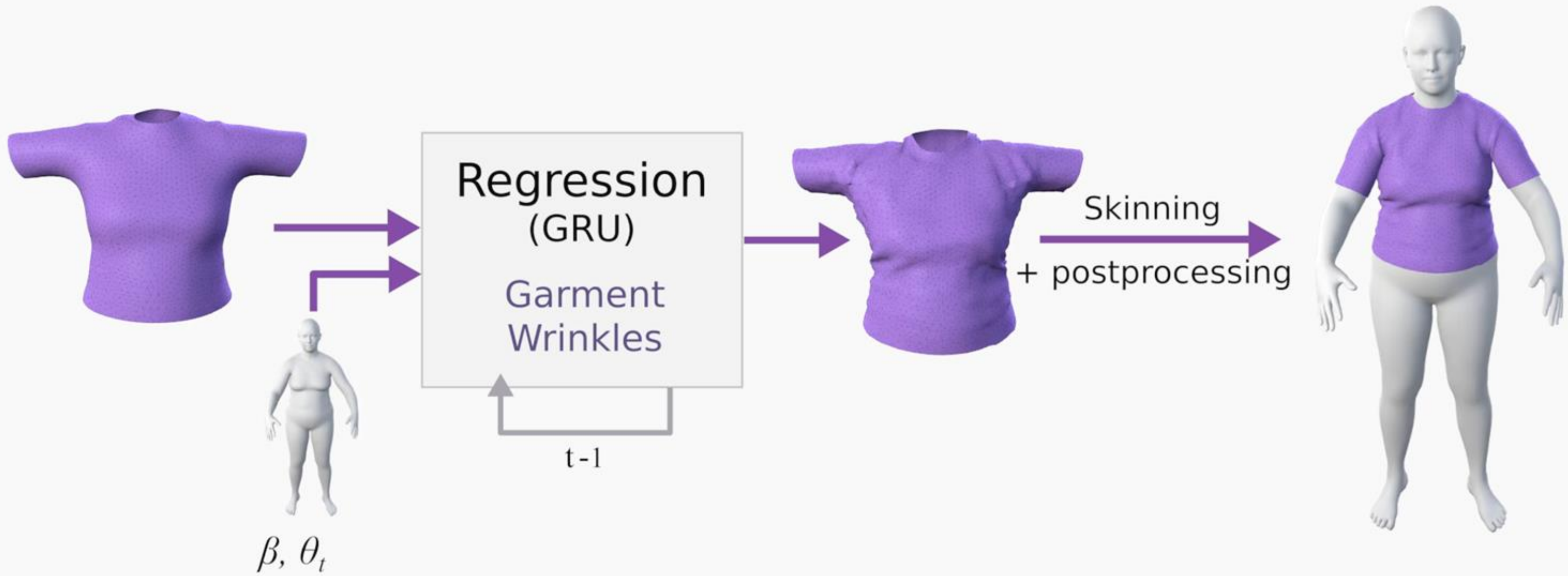
Δ_{fit} Δ_{wrinkle}

Step 1: Δ_{fit}



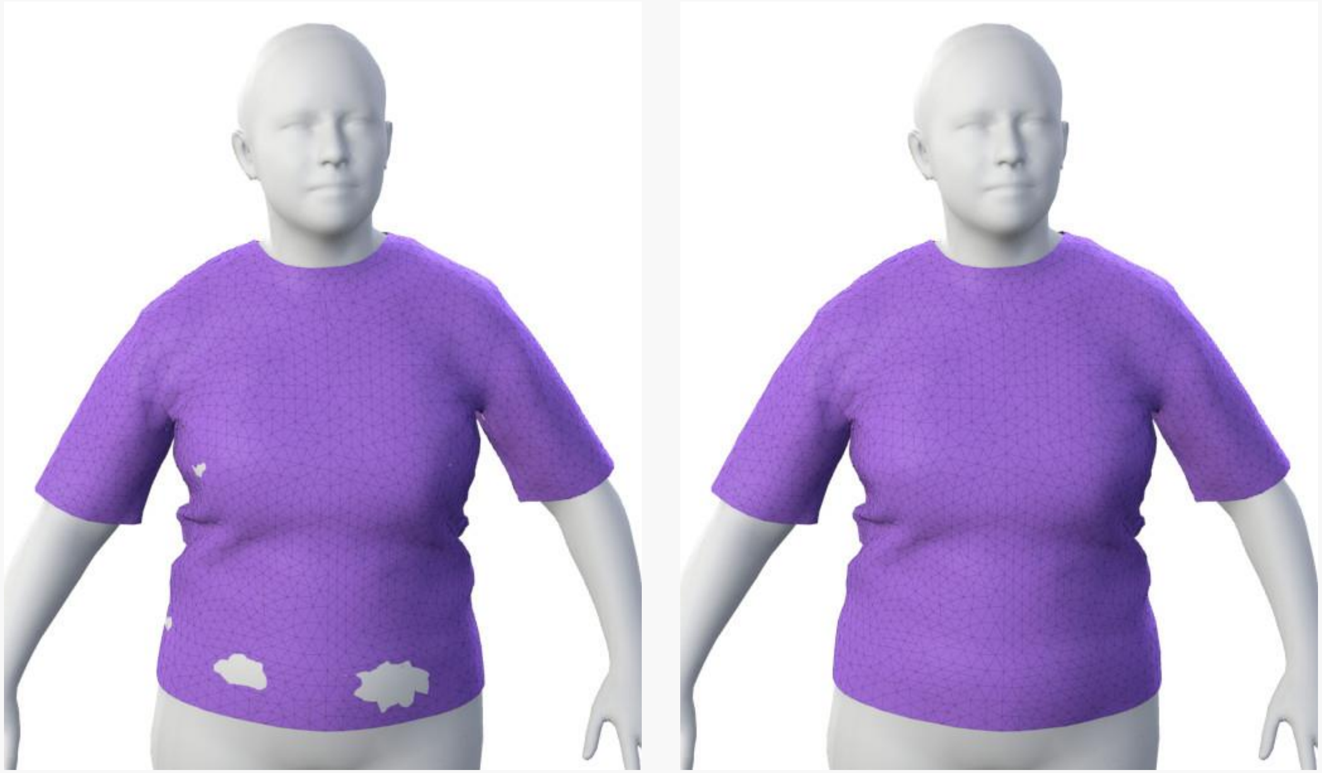
Step 2: Δ_{wrinkle}





- Modelling temporal dependencies:
  - Add the output of the previous frame as input
    (e.g., De Aguiar et al. SIGGRAPH 2011, Casas et al. i3D 2018)
  - Recurrent neural networks
    (e.g., RNN, GRU, LSTM)

Postprocessing



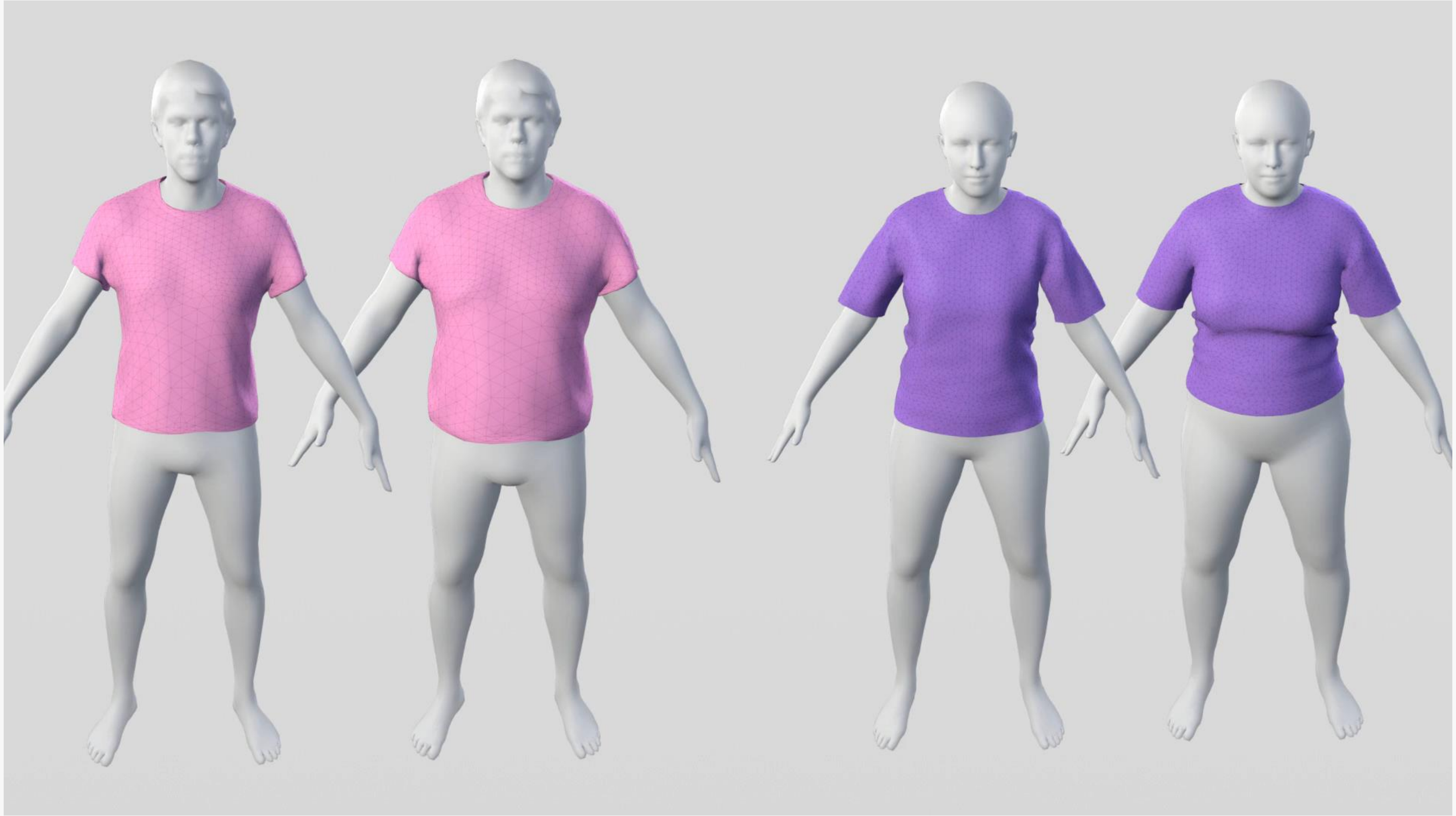
Before
After

Qualitative evaluation

Shape generalization

Cloth simulation — Retargeting — Our method

Qualitative comparison



ClothCap (Retargeting)
[Pons-Moll et al. 2017]

Our method

Qualitative comparison

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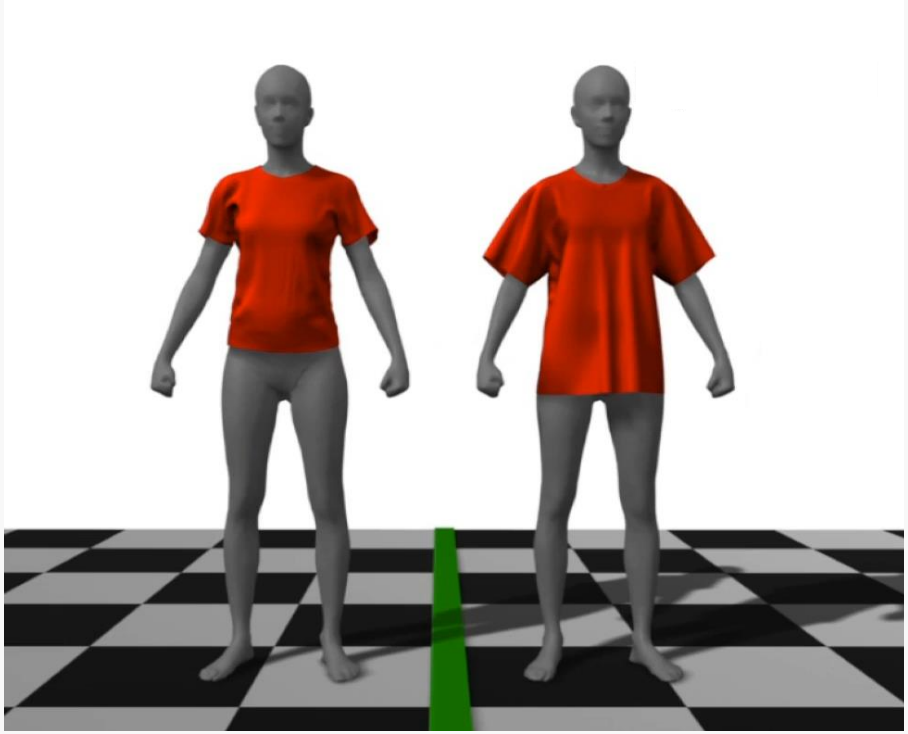
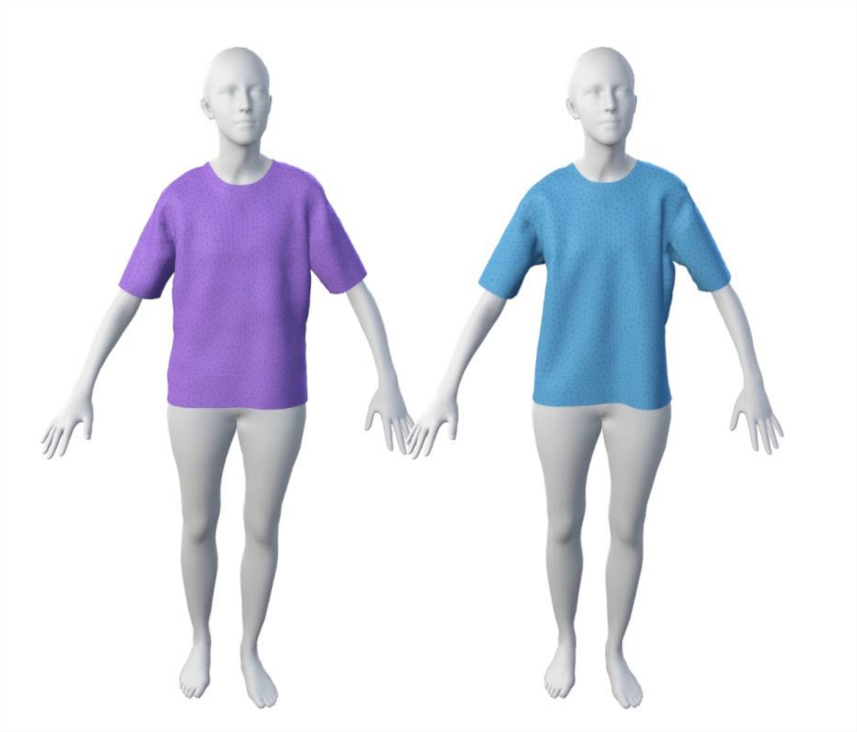
Qualitative comparison



DRAPE
[Guan et al. 2012]

Physics based

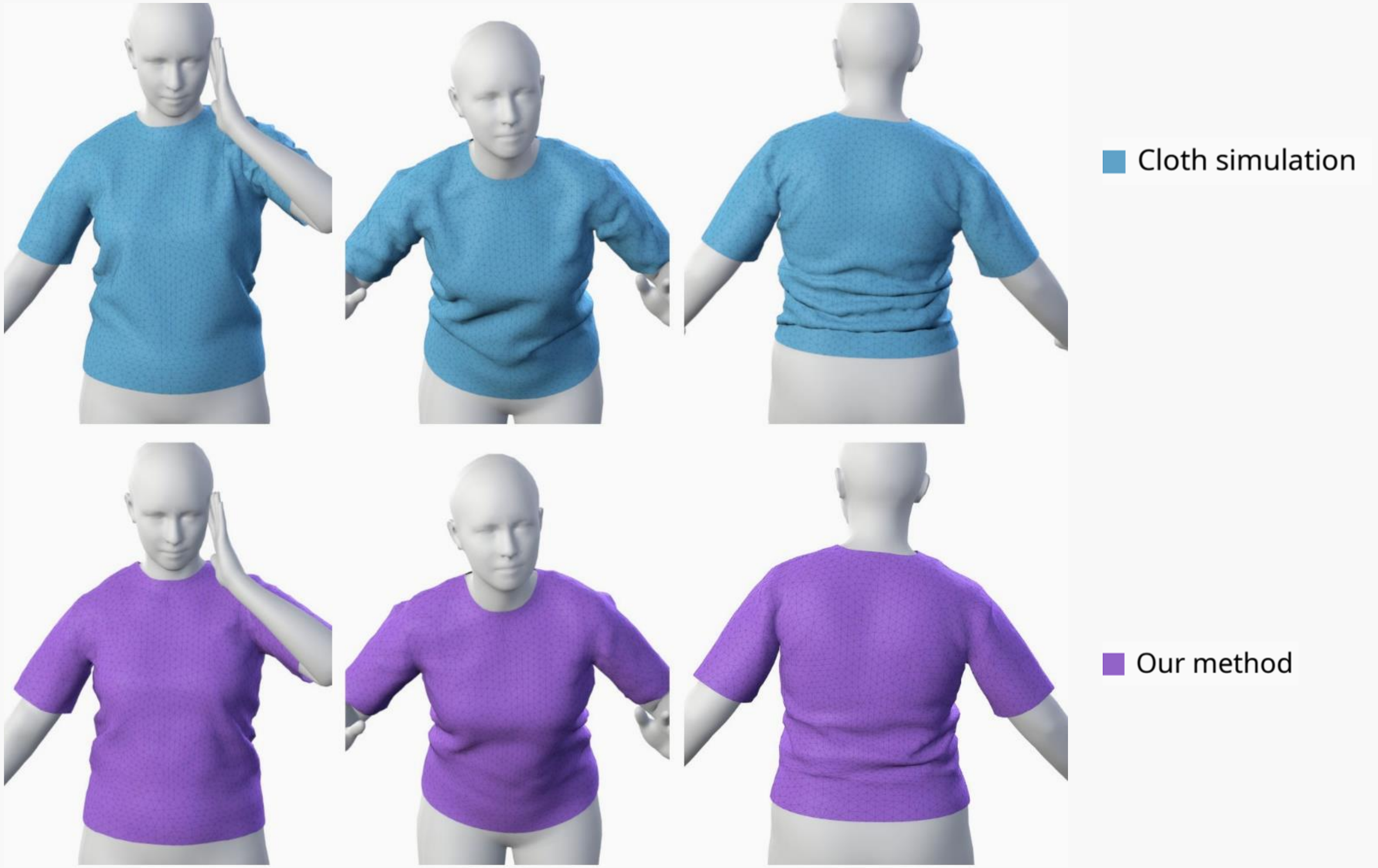


Our method

Physics based

Qualitative evaluation

Pose generalization



Contributions

- Clothing deformations as a function of **body shape** and **motion**
- Captures highly **nonlinear effects**
- Very fast clothing animations: **250 fps!**

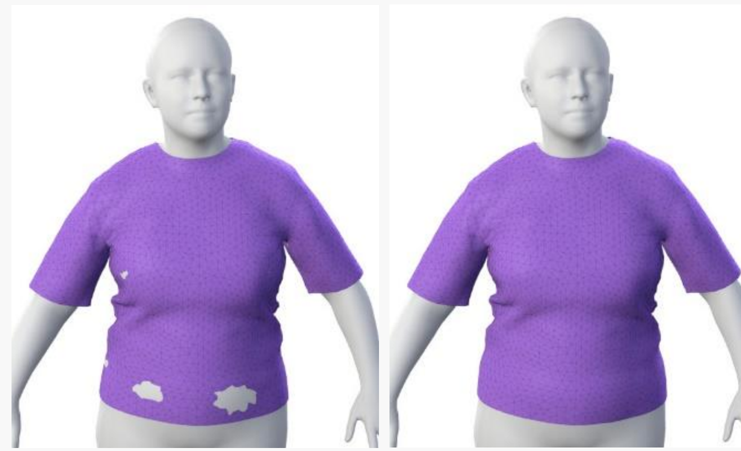
Future work

Generalize to multiple garments

Future work

Generalize to multiple garments

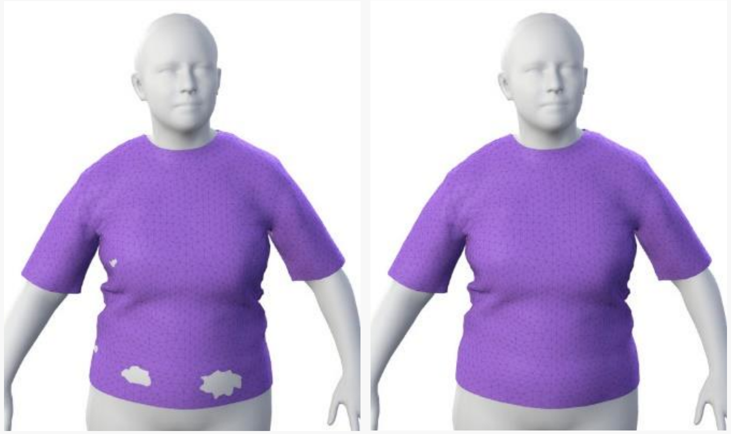
Collisions



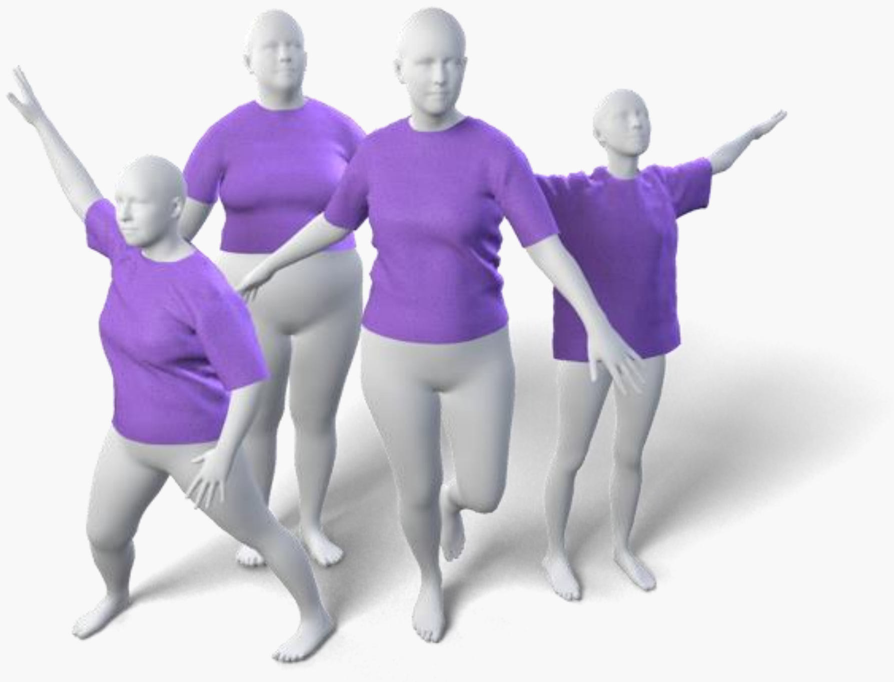
Future work

Generalize to multiple garments

Collisions



Loose garments



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