IEEE Computer Graphics and Applications

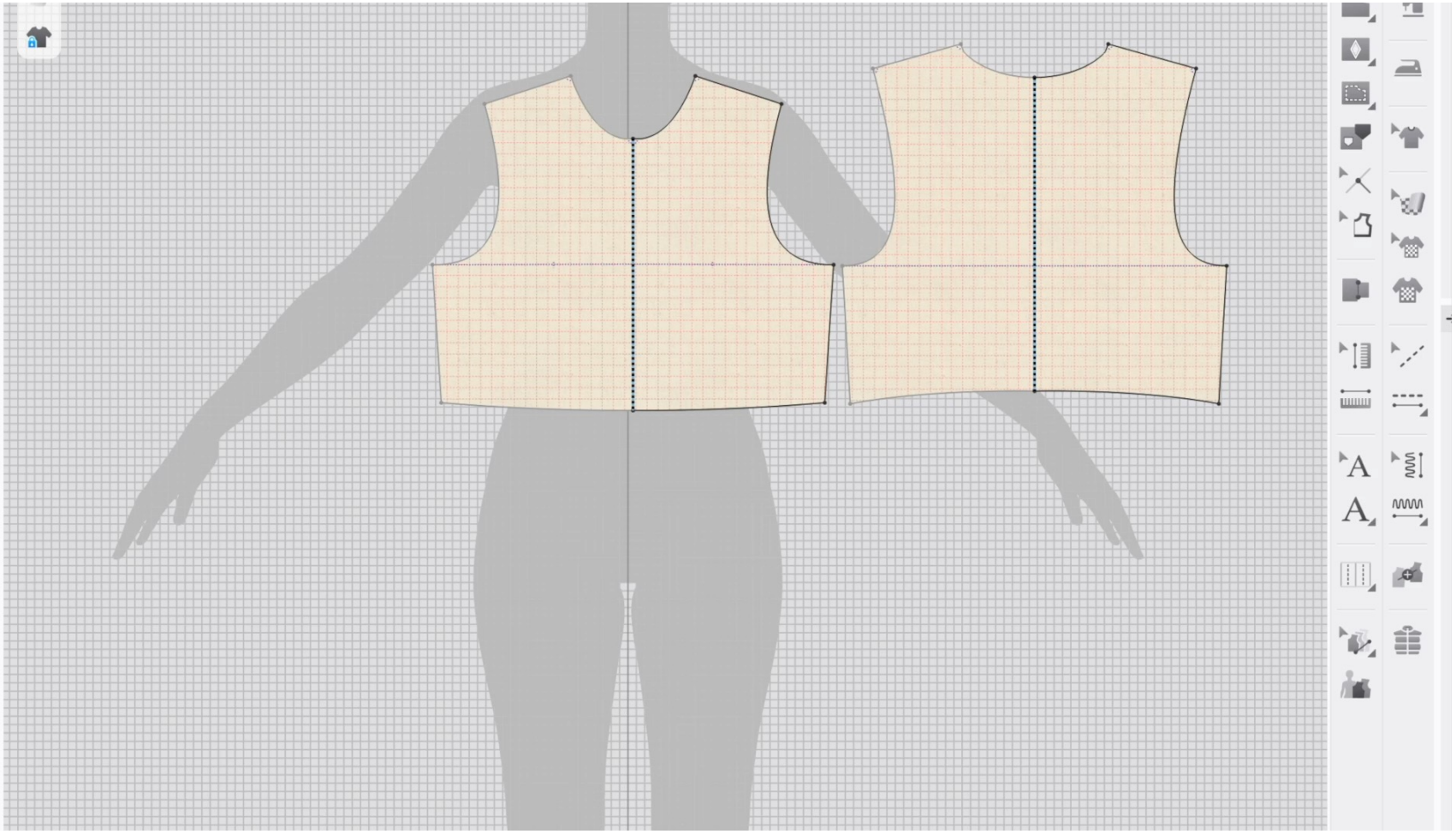
PerfectTailor: Scale-Preserving 2D Pattern Adjustment Driven by 3D Garment Editing

Anran Qi, Takeo Igarashi

The University of Tokyo

This project was sponsored by SHIMA SEIKI

Traditional Garment Editing Workflow



Pattern: ©CLO Brasil

"Edit 2D pattern, and then run simulation to see 3D."

Problems of Traditional 2D-to-3D Workflow

Must mentally convert target 3D shape to 2D pattern. (inverse mapping)

It requires expertise, which is difficult for non-experts

Problems of Traditional 2D-to-3D Workflow

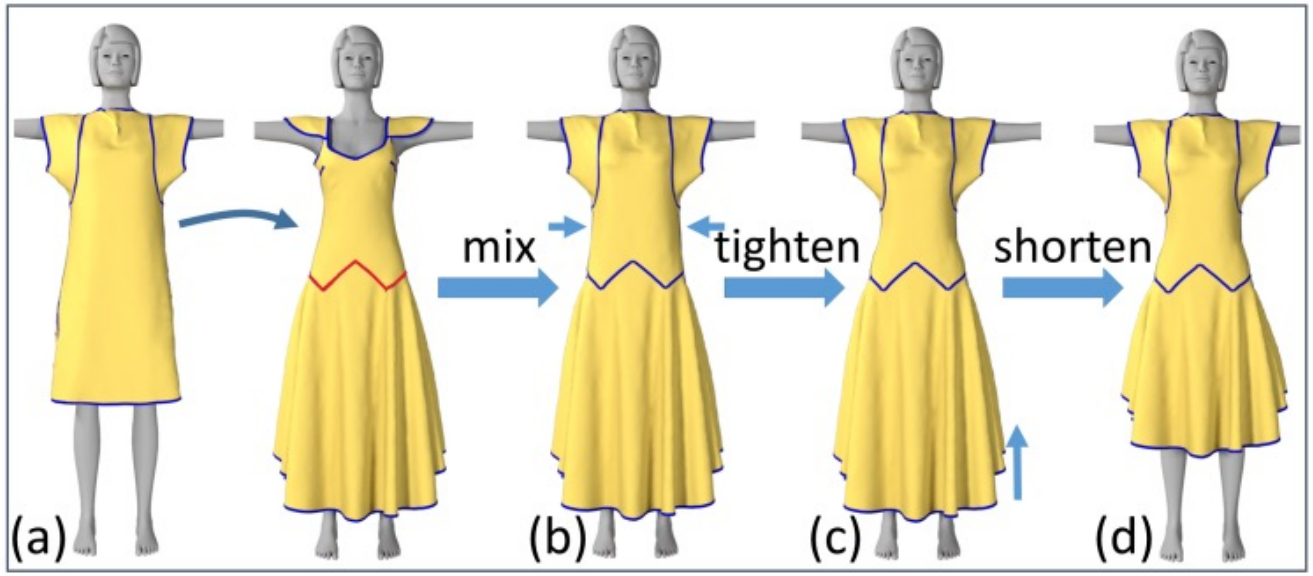
Must mentally convert target 3D shape to 2D pattern. (inverse mapping)

It requires expertise, which is difficult for non-experts

We want to let non-experts directly edit 3D (3D-to-2D)!

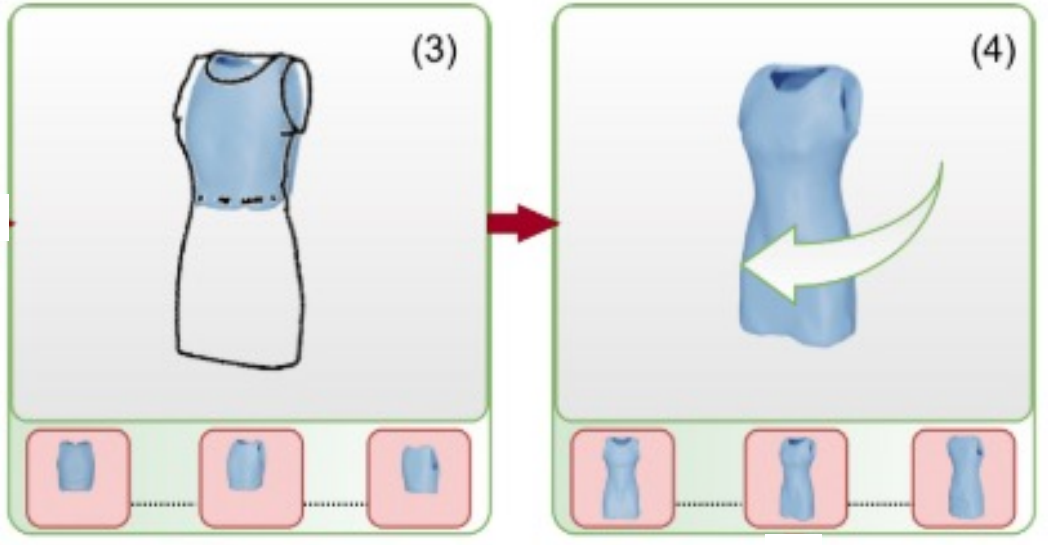
Previous Work in 3D-to-2D

Directly modify 3D garment



Bartle, et al. TOG, 2016

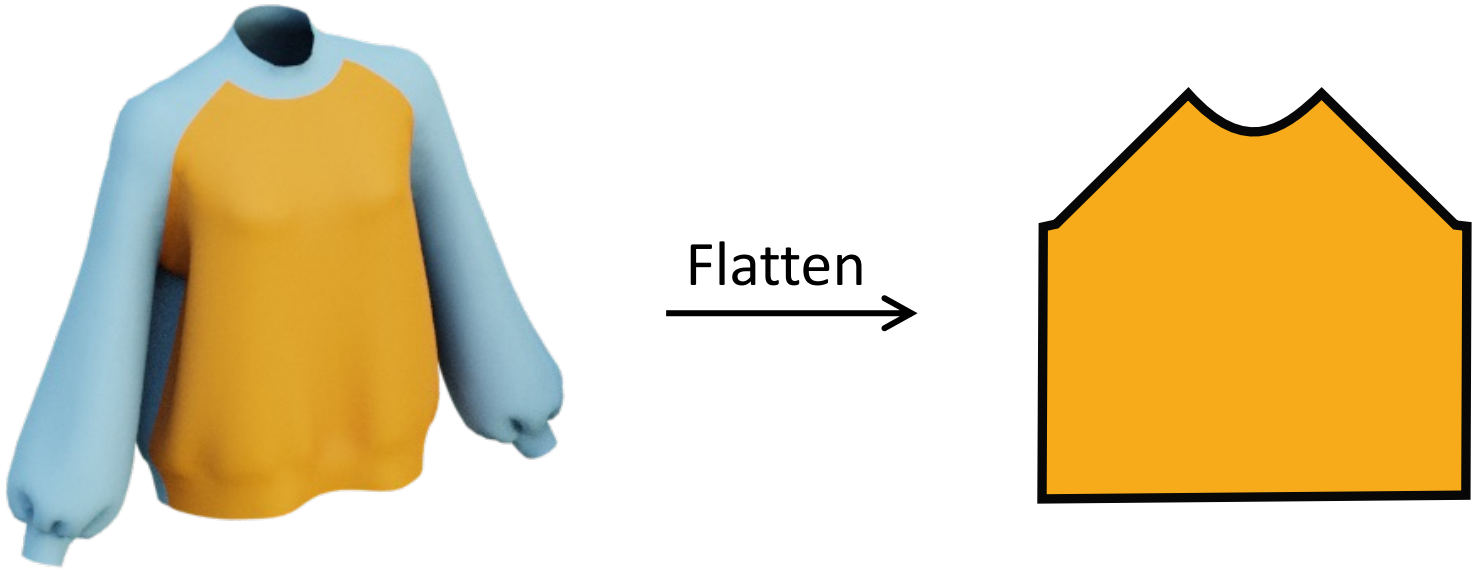
3D garment from sketch



Chowdhury, et al. 3DV, 2022.

Both convert 3D garment into 2D pattern by “flattening”.

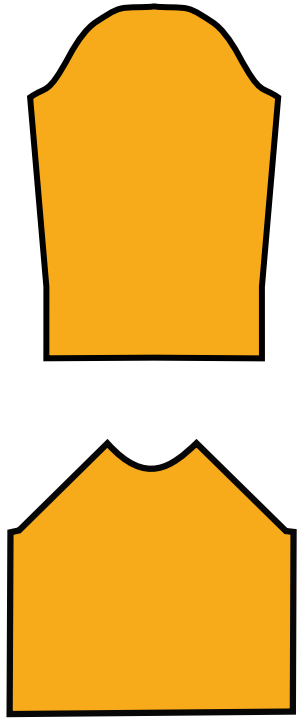
Converting 3D garment into 2D pattern by “flattening” (geometric surface parametrization).



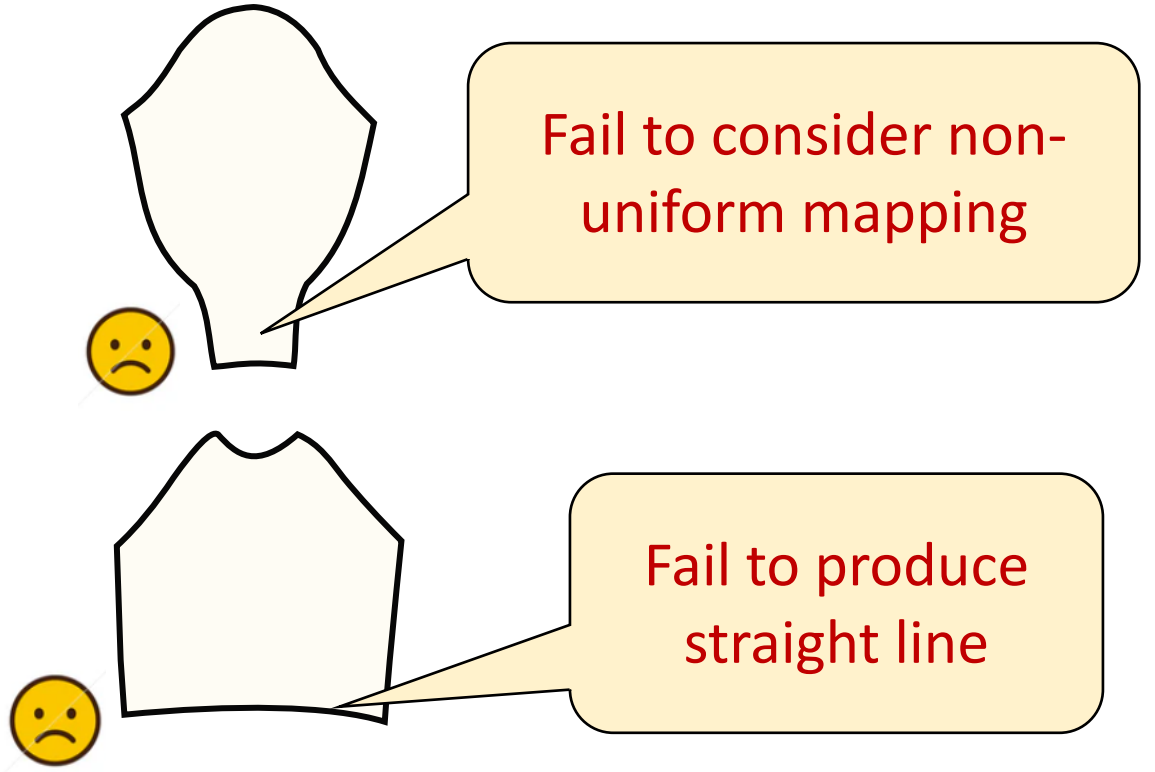
Pattern: ©SHIMA SEIKI

Limitations of standard (uniform) flattening

(a) 3D garment



(b) Original panel design

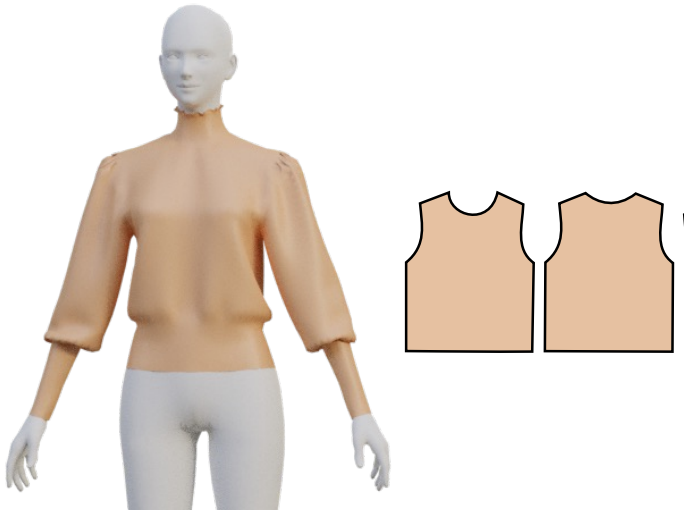


Standard flattening [ABF++ 2005]

Fail to consider **domain specific constraints**

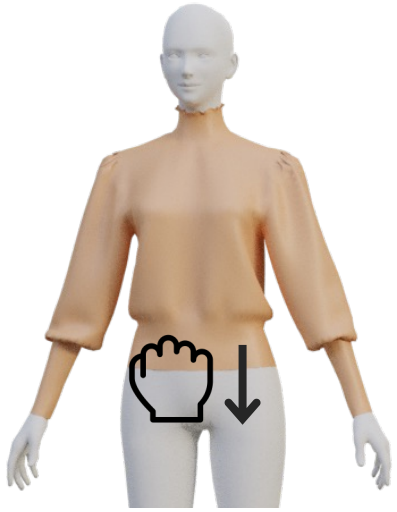
Goal

- Propose 3D-to-2D respecting **domain specific constraints.**
- Specifically for **adjusting** a manually-designed 2D pattern according to the user's edits in 3D.



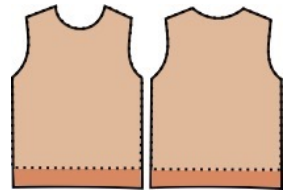
Initial 3D garment + 2D pattern

User edits 3D



Modified 3D garment

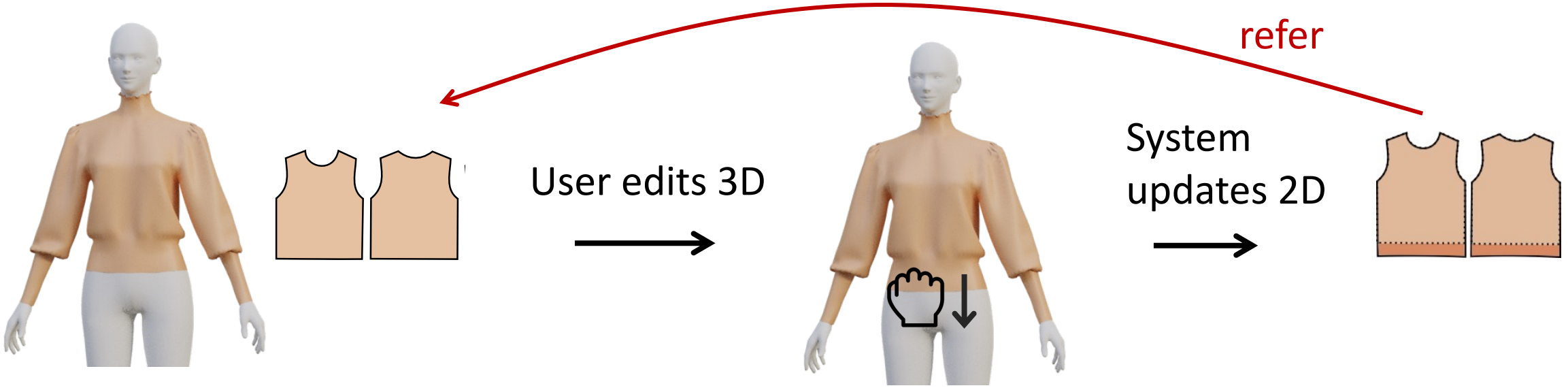
System updates 2D



updated 2D pattern

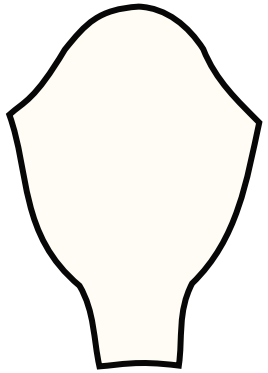
Goal

- Propose 3D-to-2D respecting **domain specific constraints.**
- Specifically for **adjusting** a manually-designed 2D pattern according to the user's edits in 3D.

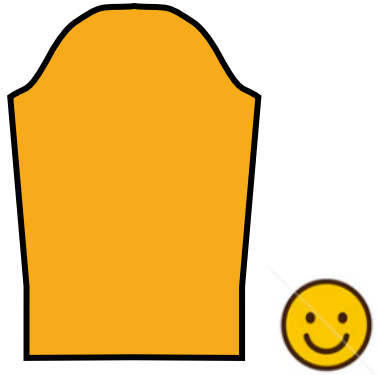


Proposed Method

1) Preserve non-uniform scaling

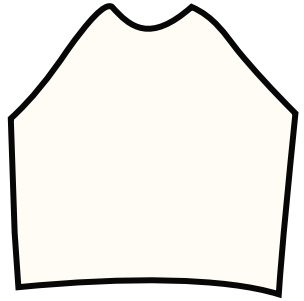


Uniform
(standard)

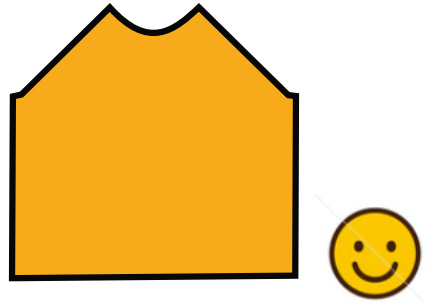


Non-uniform
(ours)

2) Boundary shape perservation

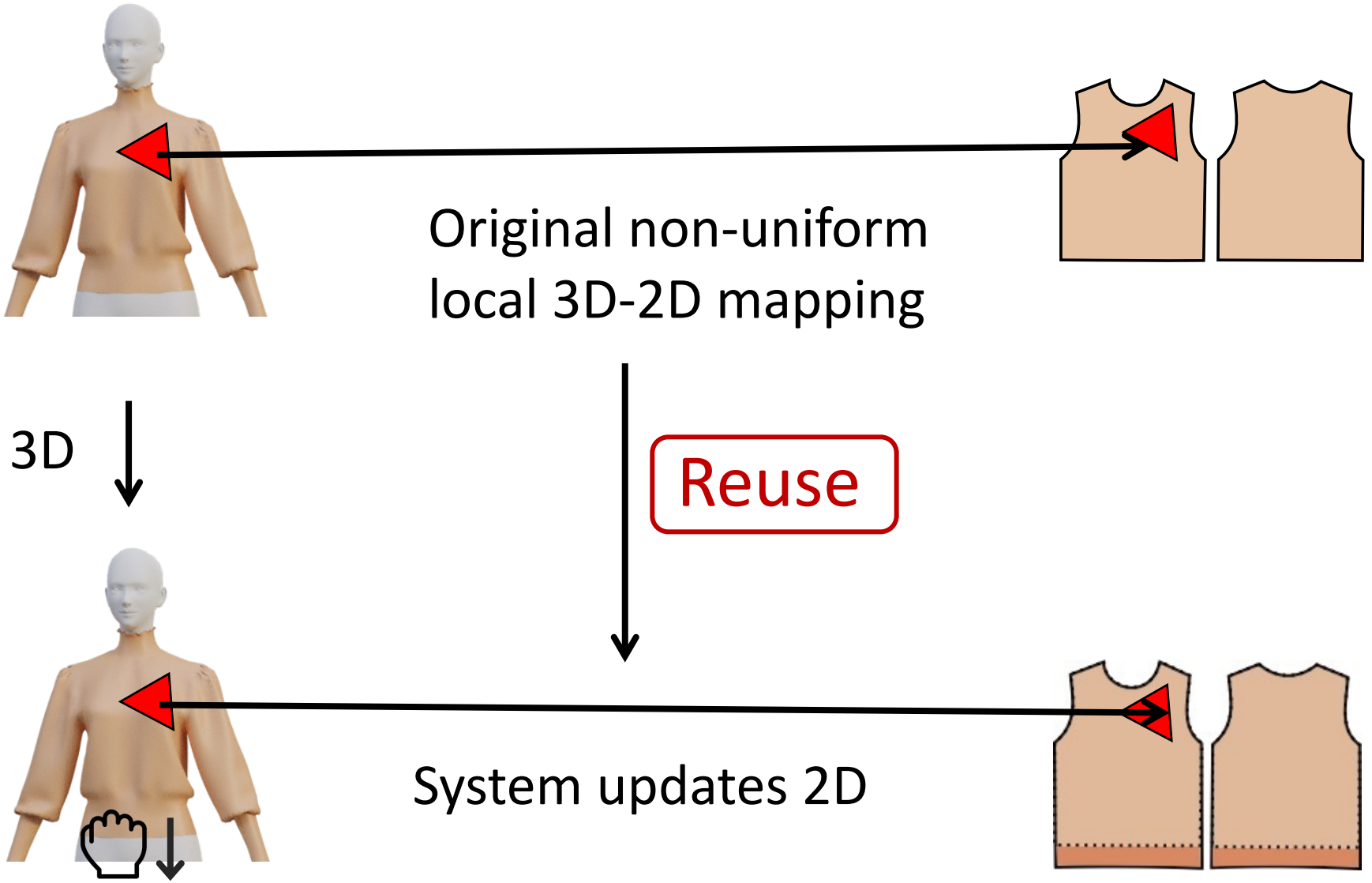


Distorted
(standard)



Straight
(ours)

1) Preserve non-uniform scaling: Core Idea

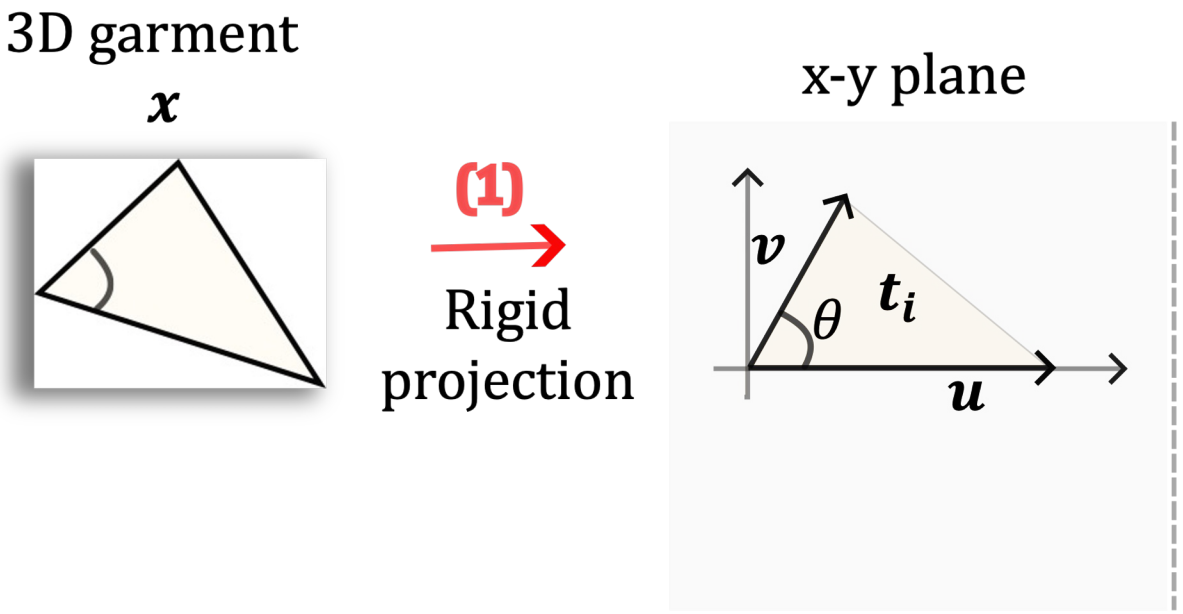


Q) Why don’t you use inverse physical simulation?

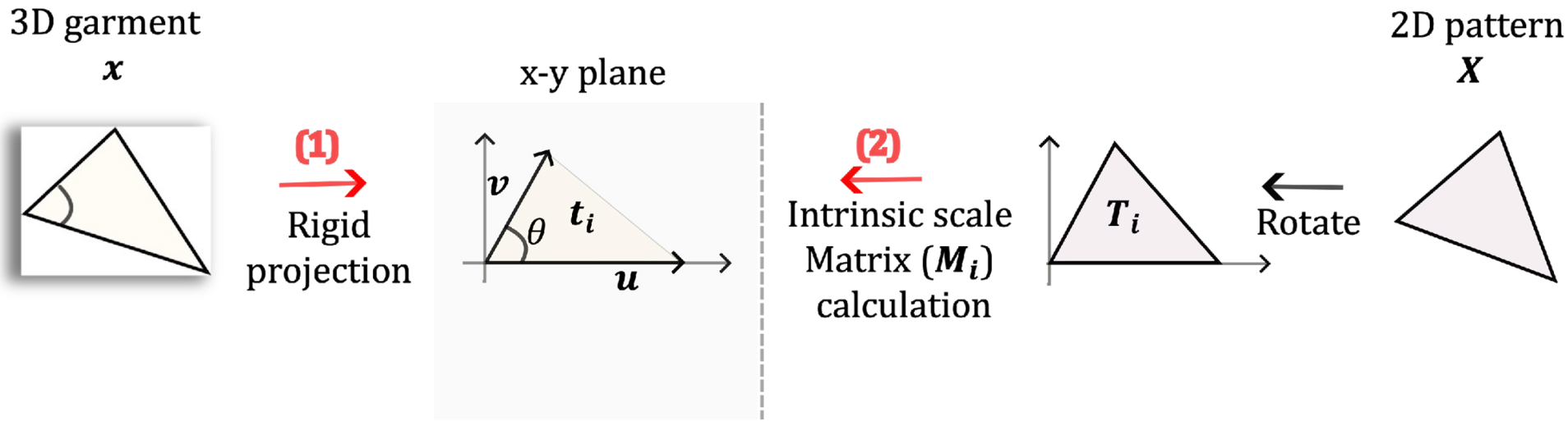
A) Industrial workflow constraints.

- Physical simulation is a black box in their workflow.
- Parameters are often not immediately available.
- They wanted a simple and fast solution

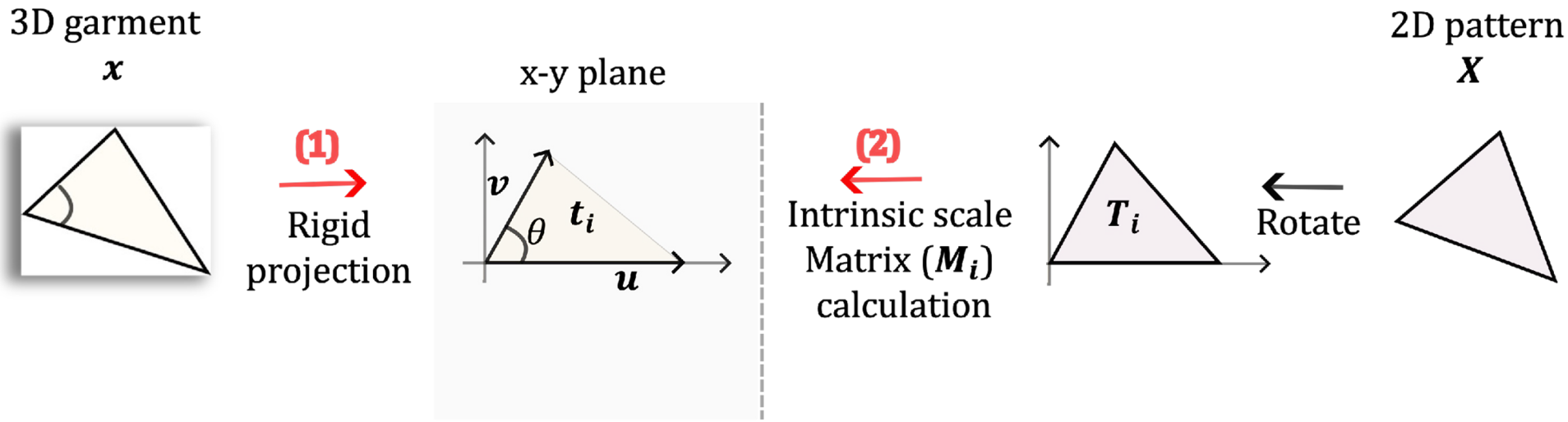
1) Preserve non-uniform scaling



1) Preserve non-uniform scaling

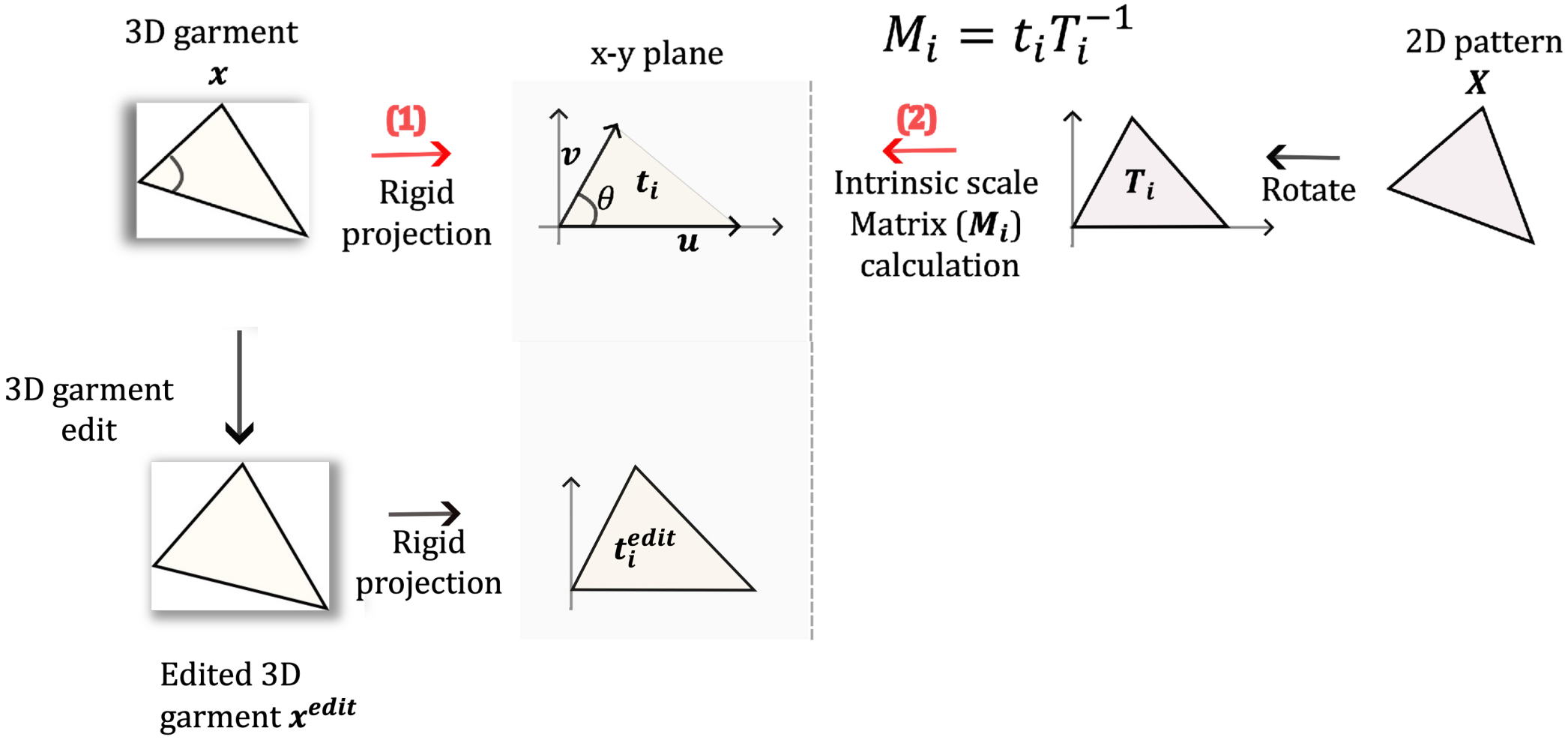


1) Preserve non-uniform scaling

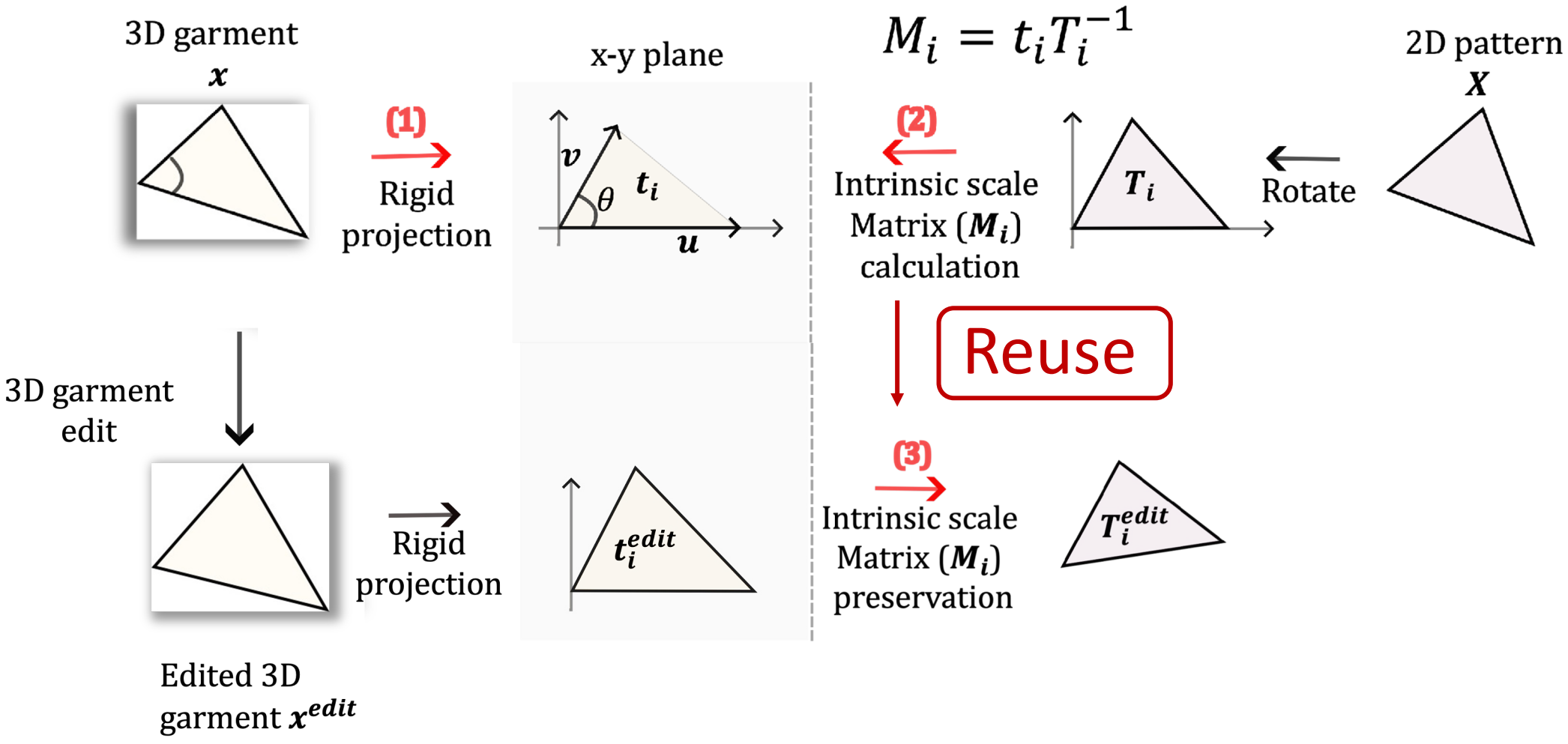


$$M_i = t_i T_i^{-1}$$

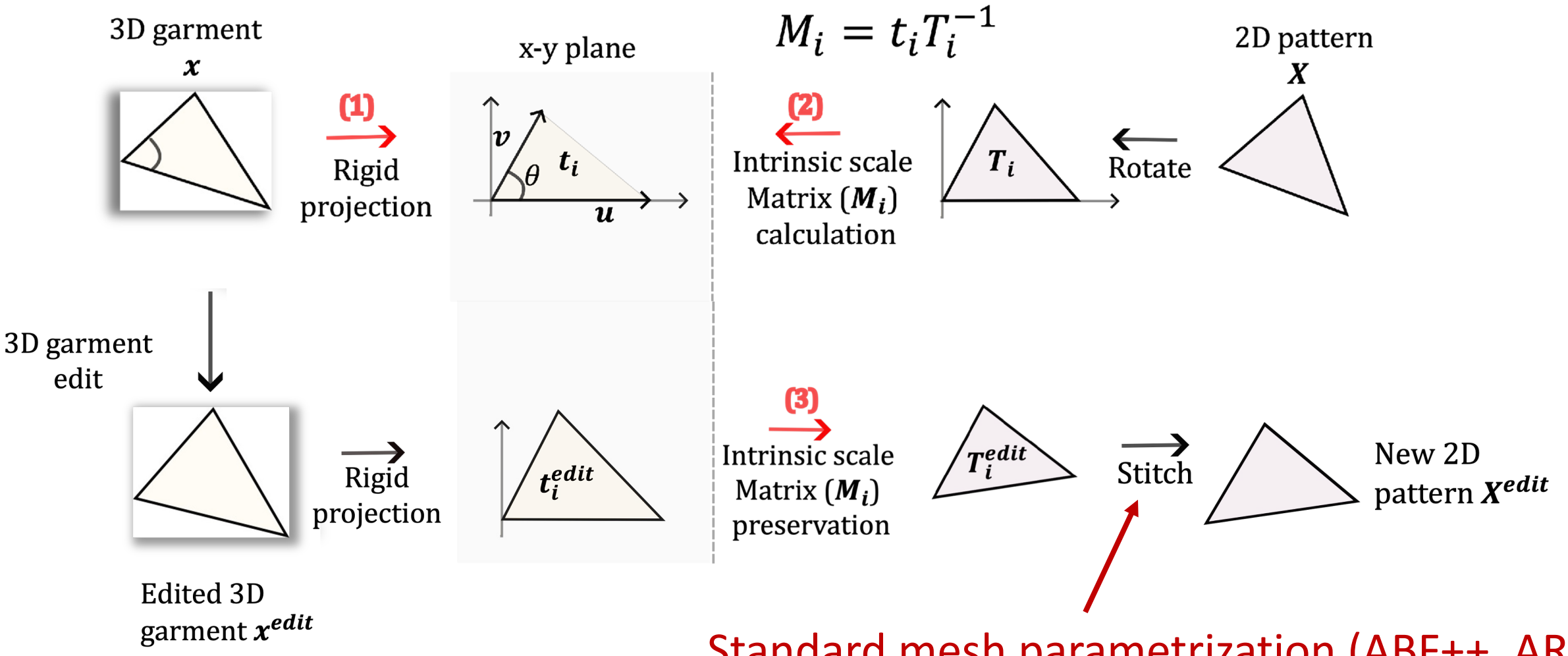
1) Preserve non-uniform scaling



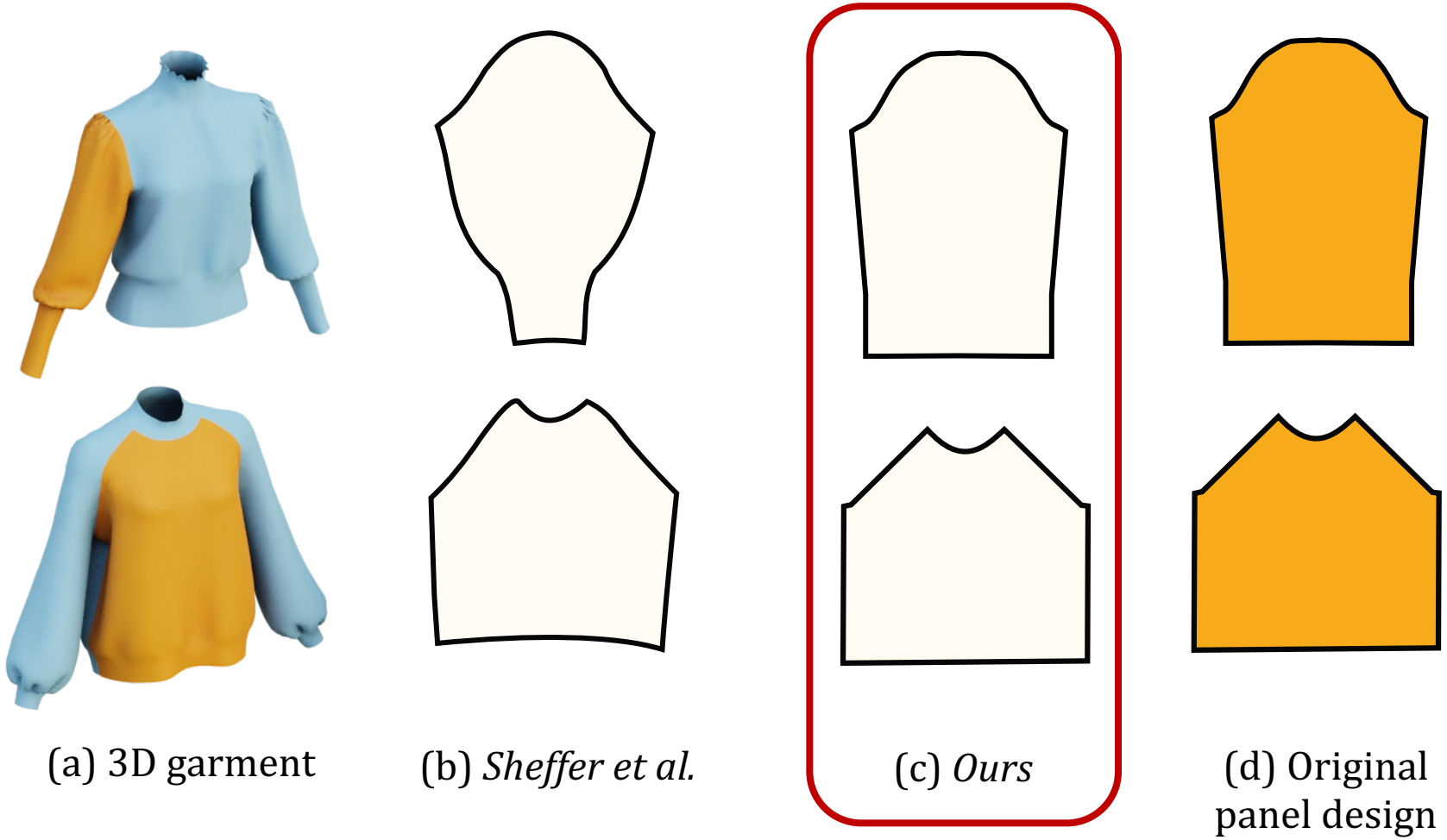
1) Preserve non-uniform scaling



1) Preserve non-uniform scaling



1) Preserve non-uniform scaling: Results



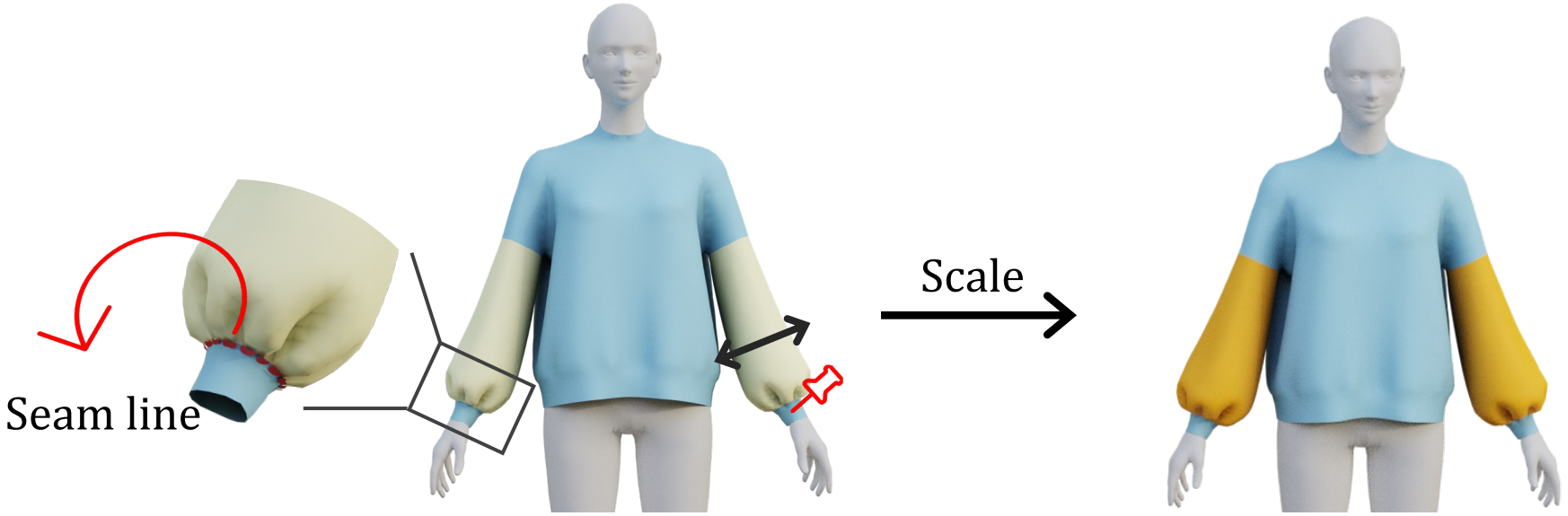
(a) 3D garment

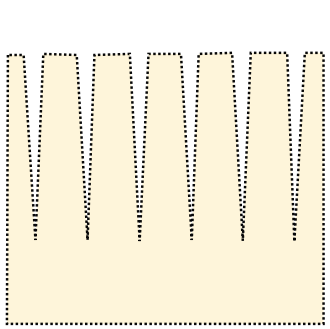
(b) *Sheffer et al.*

(c) *Ours*

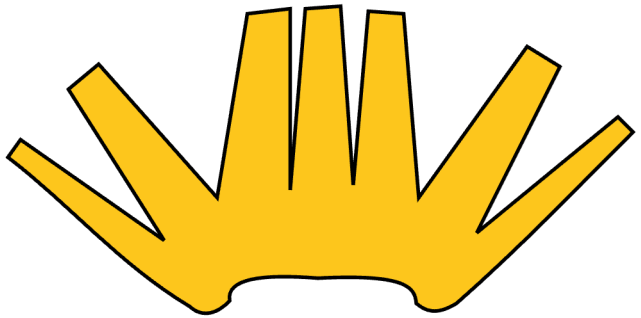
(d) Original panel design

1) Preserve non-uniform scaling: Results

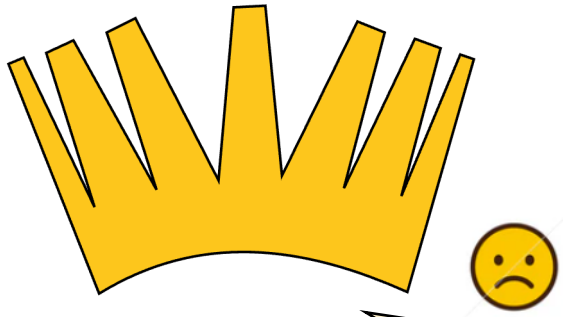




(a) Original panel



Uniform
(standard)



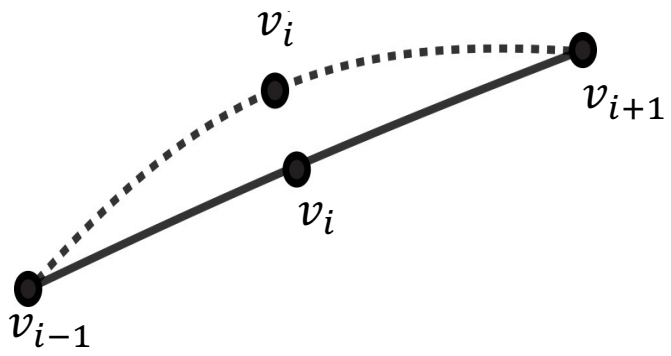
(c)Ours

Fail to produce straight line

2) Boundary shape perservation

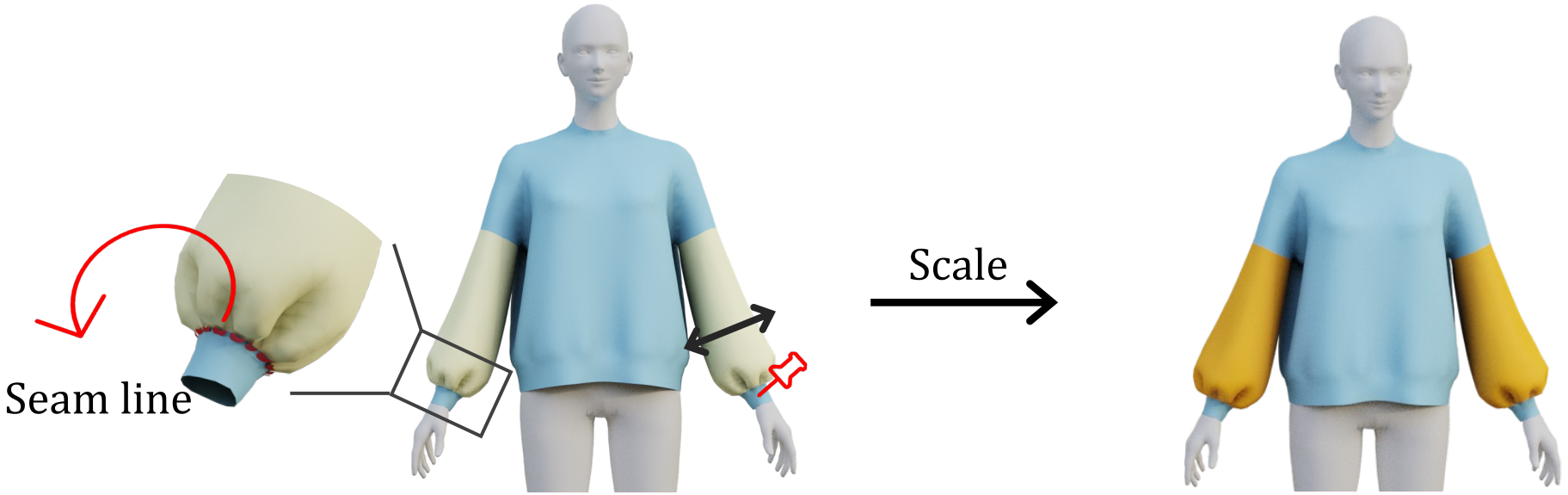
$$\arg\min_{v' \in V} \sum_{(i,j) \in E} \left((v'_j - v'_i) - (v_j - v_i) \right)^2 + w_1 \sum_{i \in C} (v'_i - C_i)^2 + w_2 \sum_{i \in Boundary} \left(v_i^{\tan'} - v_i^{\tan} \right)^2$$

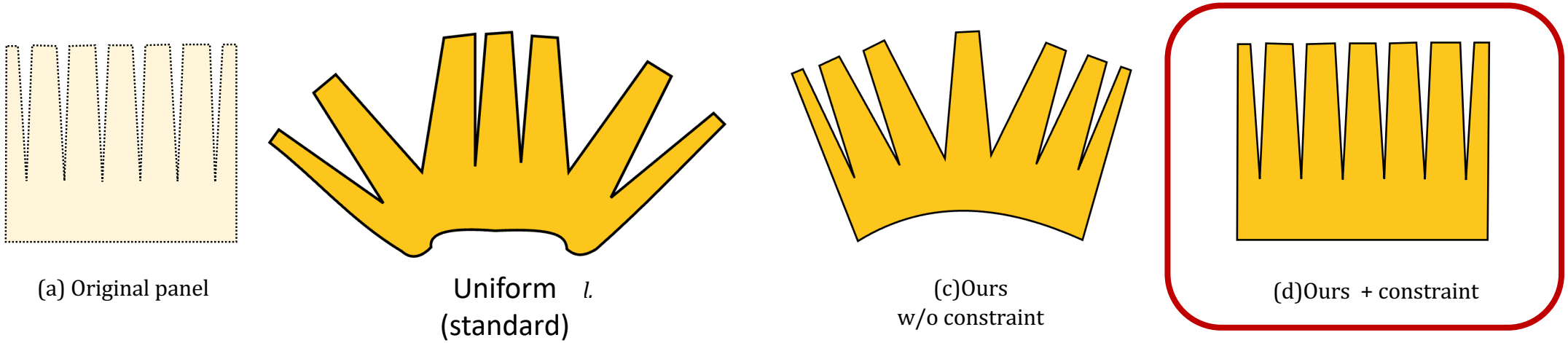
$$v_i^{\tan'} \approx v'_{i+1} + v'_{i-1} - 2v'_i$$



As-original-as-possible constraint

2) Boundary shape preservation: Results





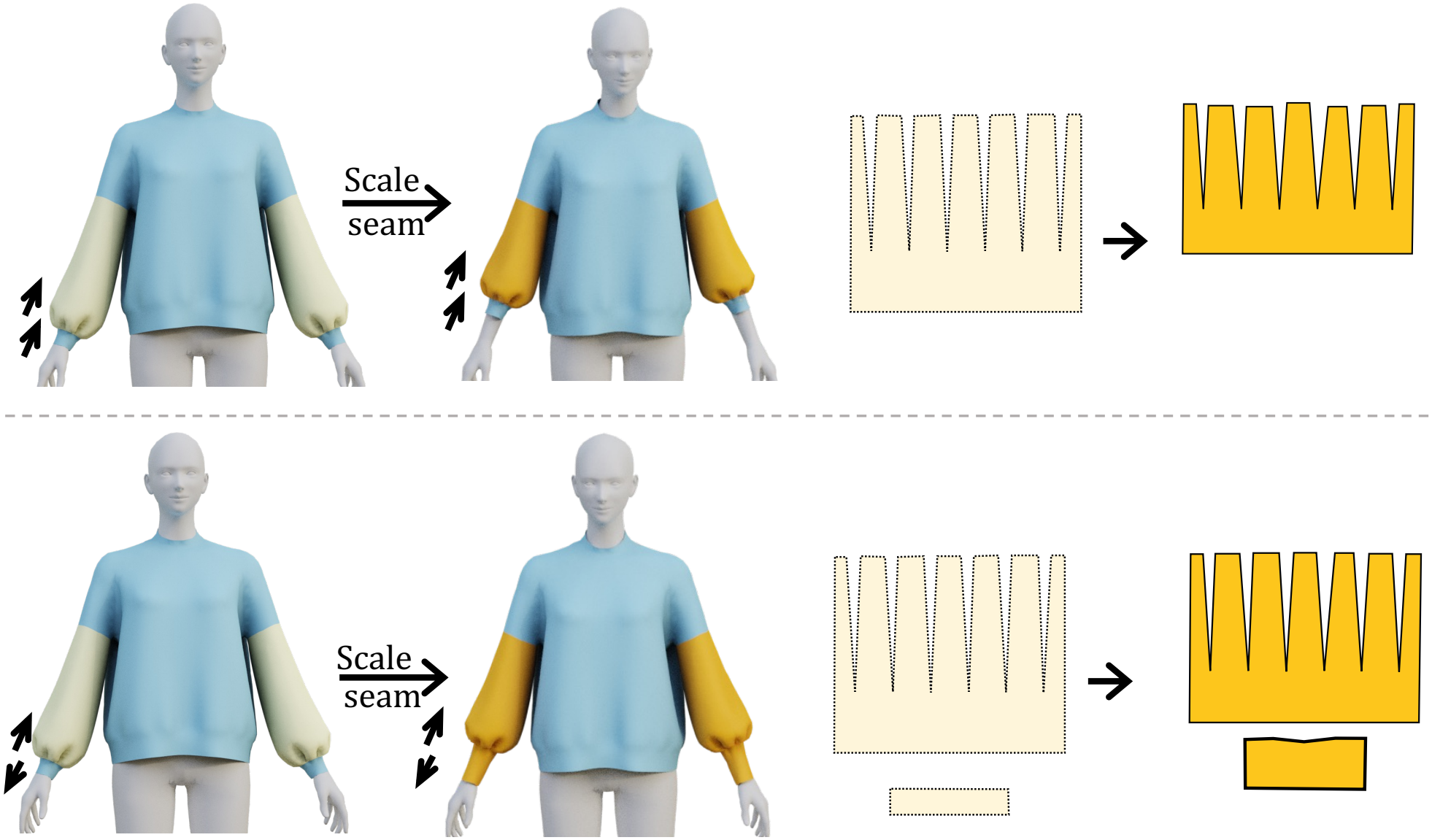
(a) Original panel

Uniform l.
(standard)

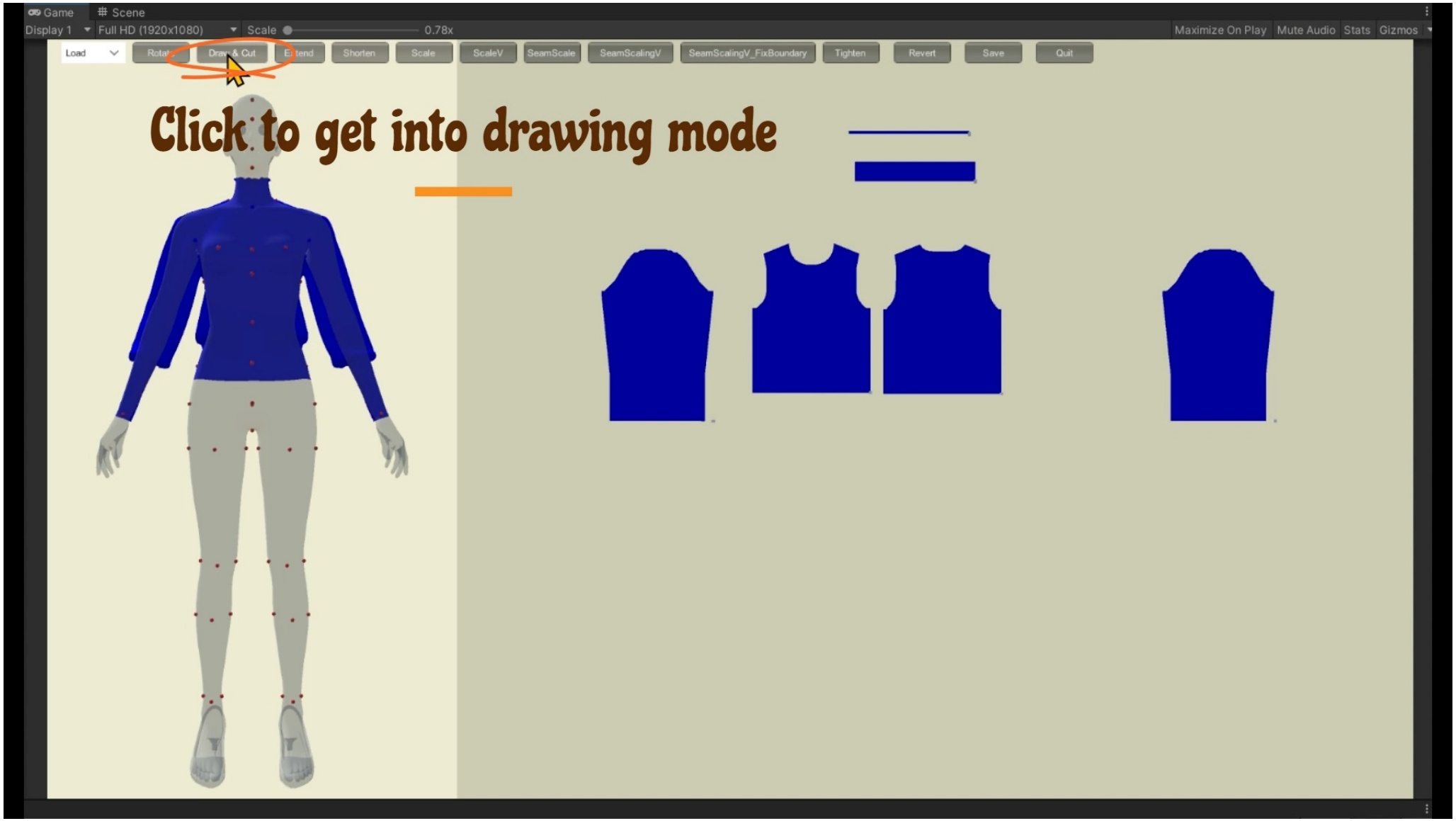
(c)Ours
w/o constraint

(d)Ours + constraint

2) Boundary shape preservation: Results



Operations: sketch2cut, extend, shorten, tighten and scale



Limitations

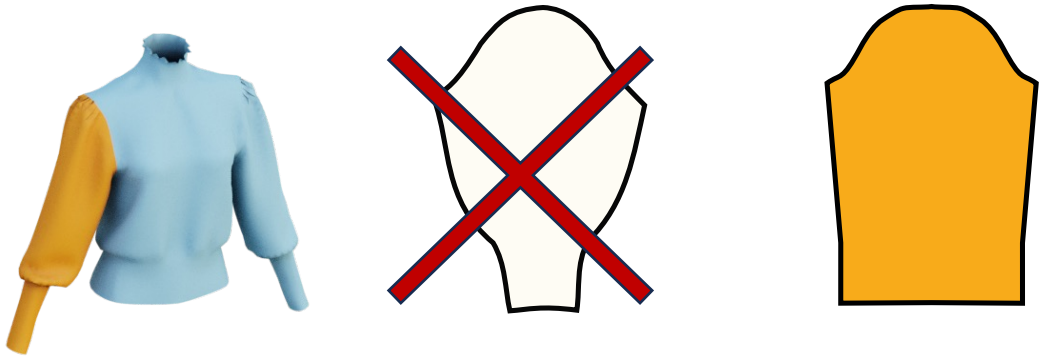
- Our method is geometric and physically not accurate.
  Good for quick preview, but needs simulation for accuracy.

- Our method requires manually designed 2D patterns.
  Not applicable to pattern design from scratch.

Conclusion

We present a 3D-to2D pattern **adjustment** method that

- preserves the non-uniform local scaling



- preserves the pattern boundary shape

Thank you!