Introduction

The Stitch Mesh

Interactive Modeling

Offline Relaxation

Results

Limitations and Future Directions

Q & A

Stitch Meshes for Modeling Knitted Clothing with Yarn-level Detail

Yuksel, Kaldor, James, Marschner
ACM TOG 31/4 - SIGGRAPH 2012.

presented by Sebastian Morr

Computer Graphics Lab
TU Braunschweig

2013-02-15

Outline

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2 The Stitch Mesh

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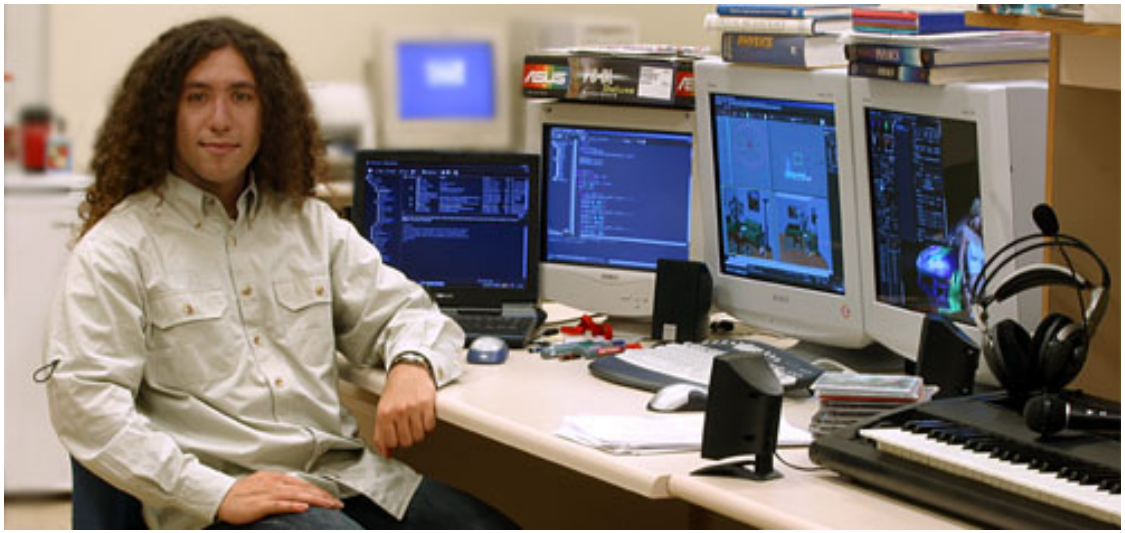

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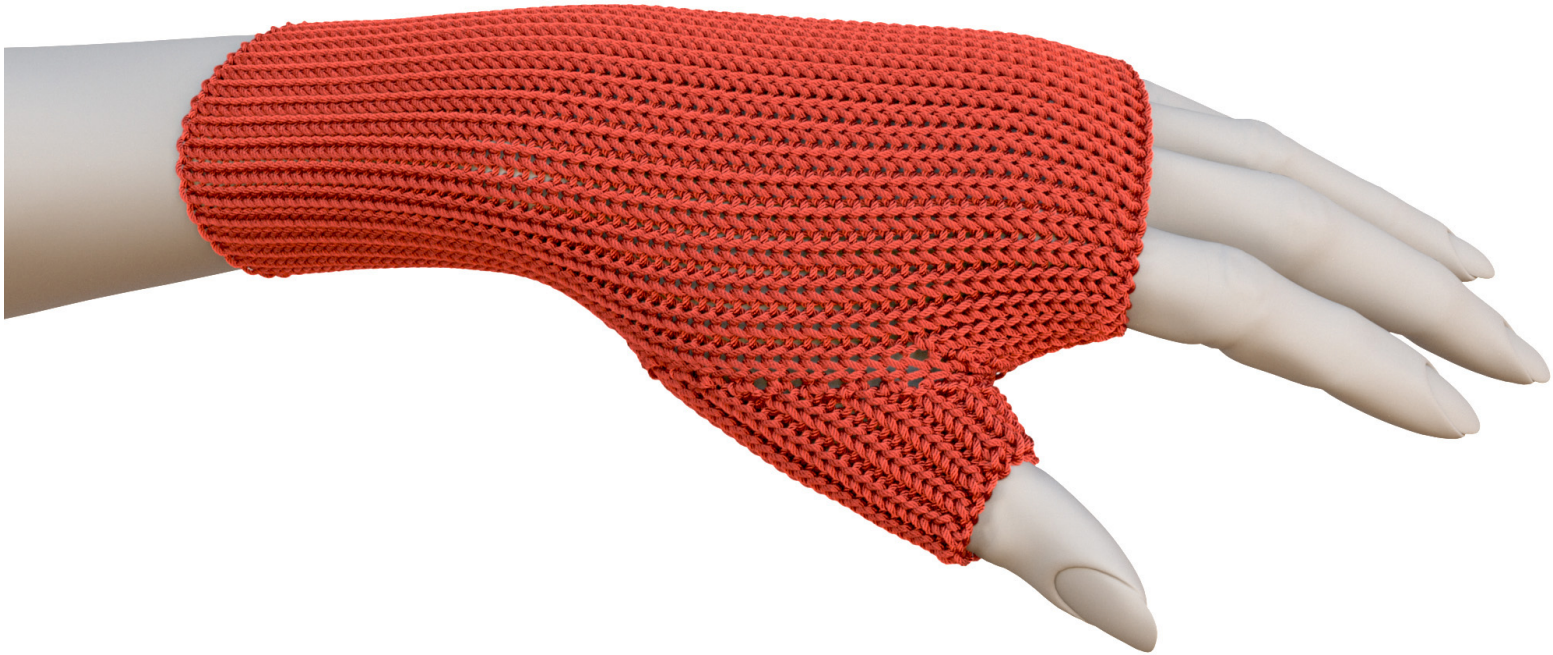

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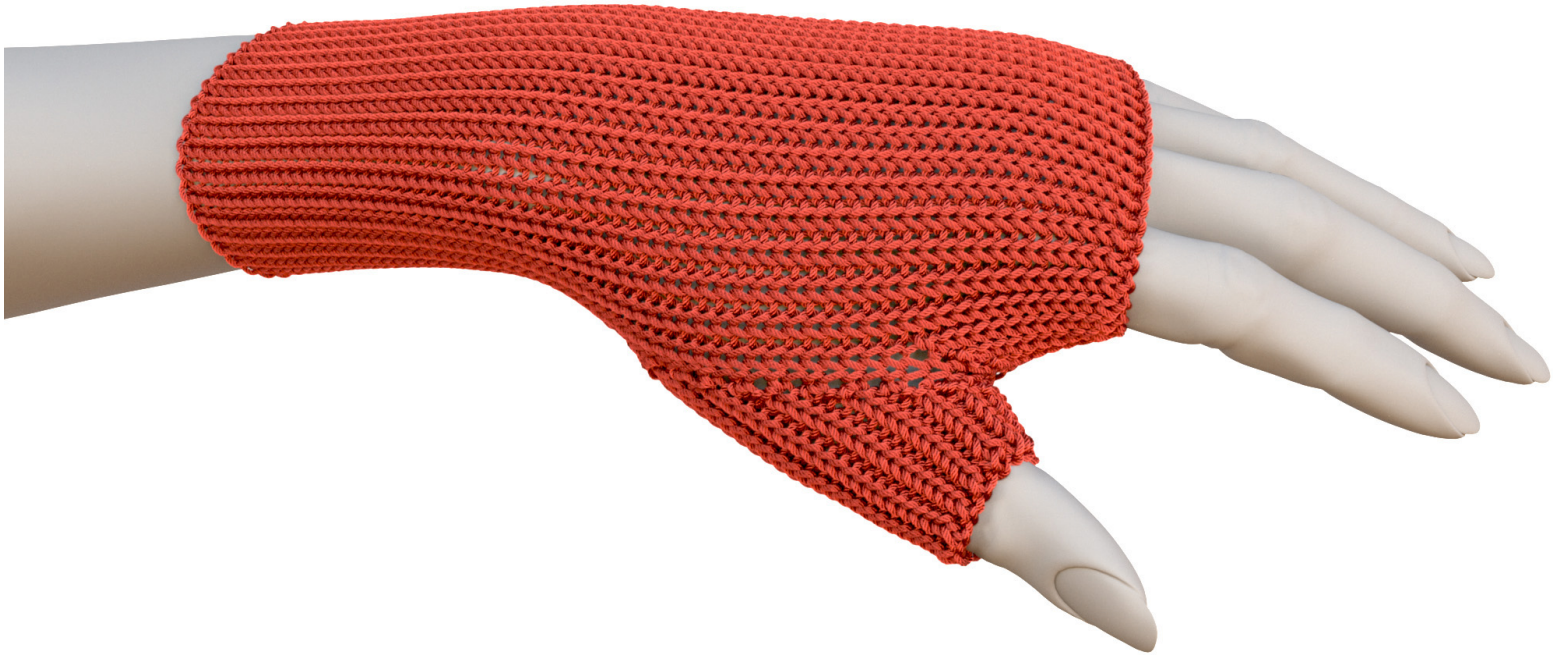

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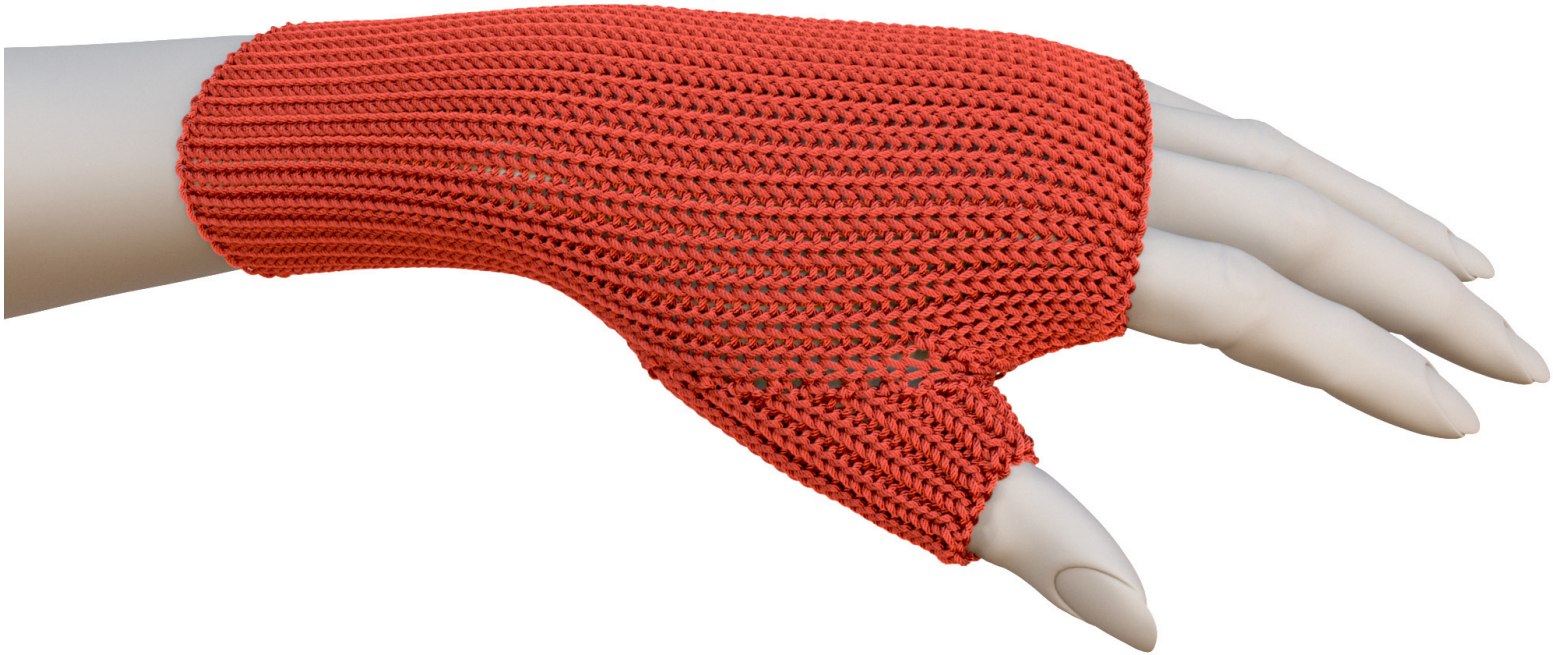

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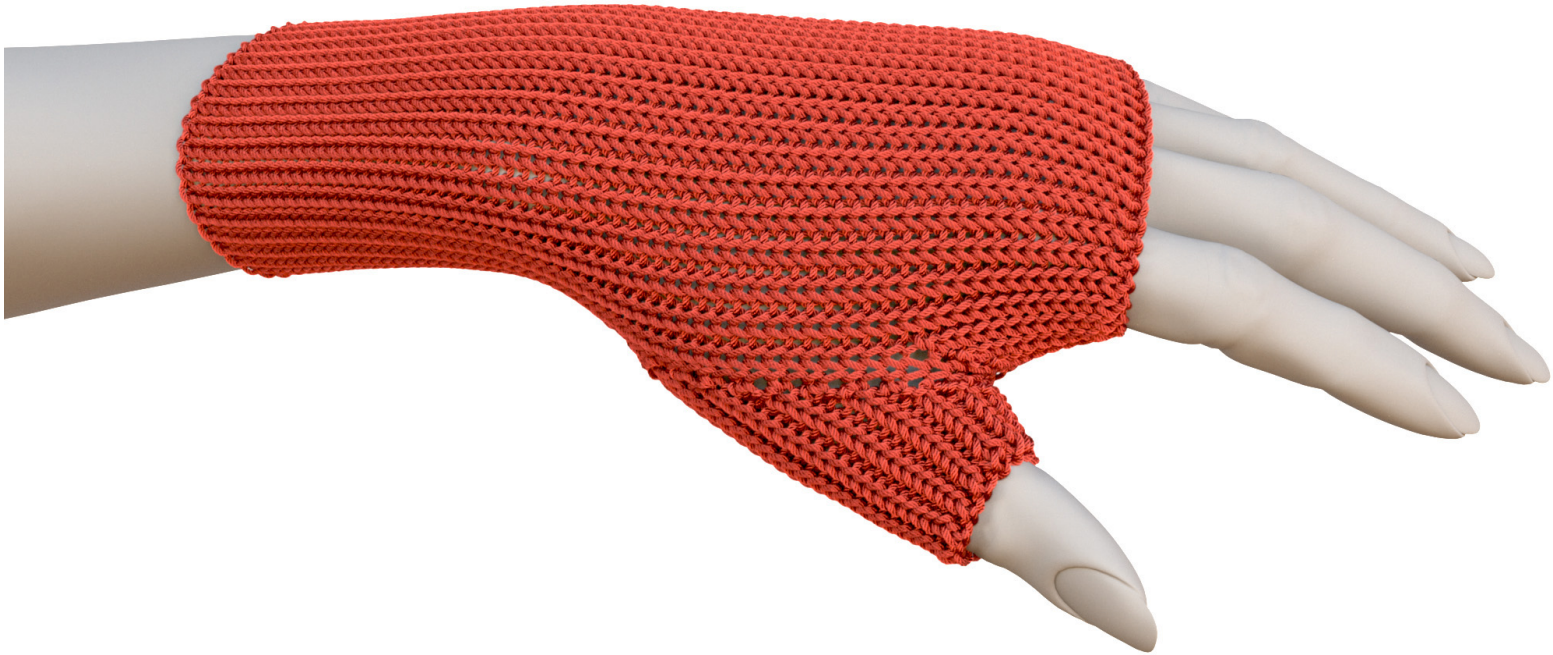

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The paper provides a tool, that ...

enables artists to create yarn-level models of knitted clothing very easily.

Why is this paper interesting?

(Why should you listen to this talk?)

Contains . . .

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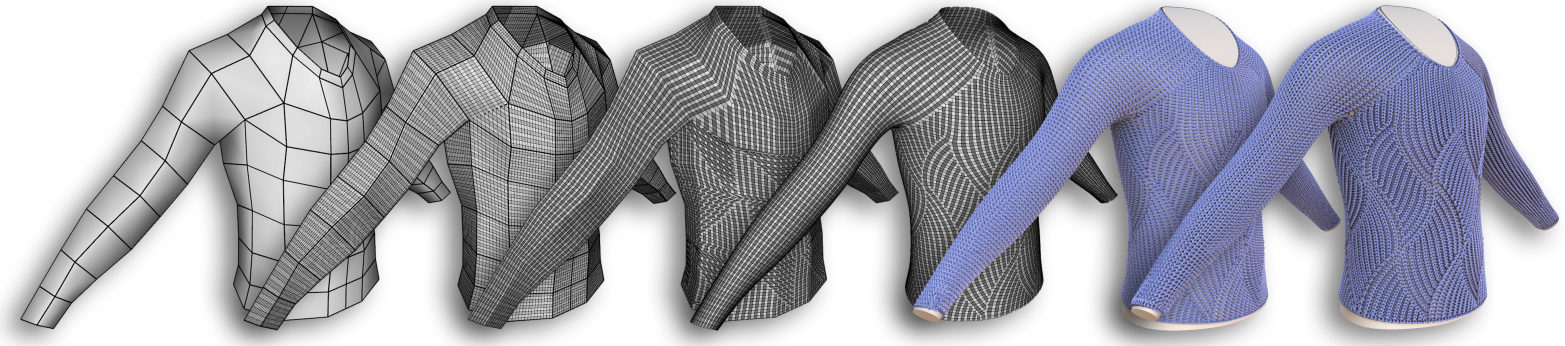
- new, clever idea to model knitted structures
- an interesting approach on simulating the yarn
- many nice pictures!

Overview of the Process



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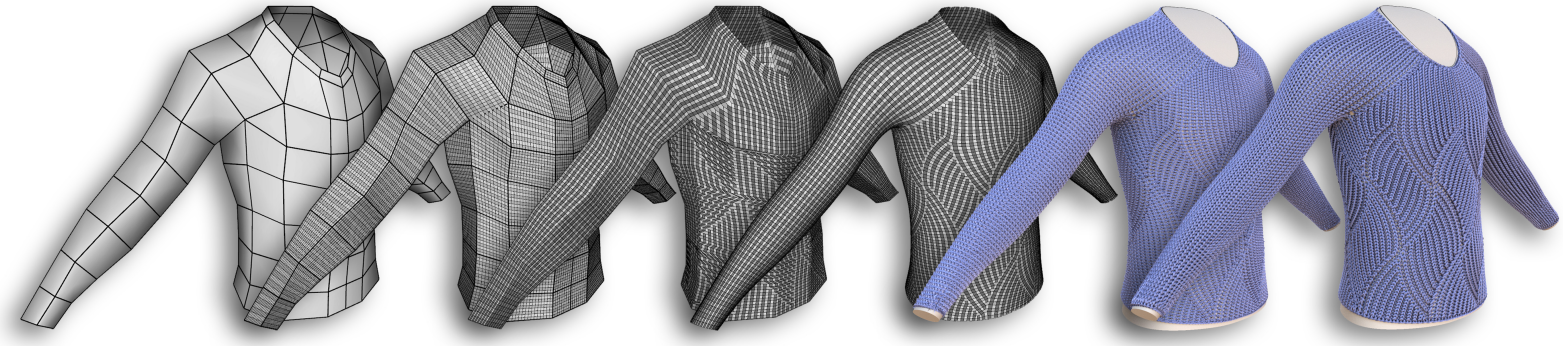

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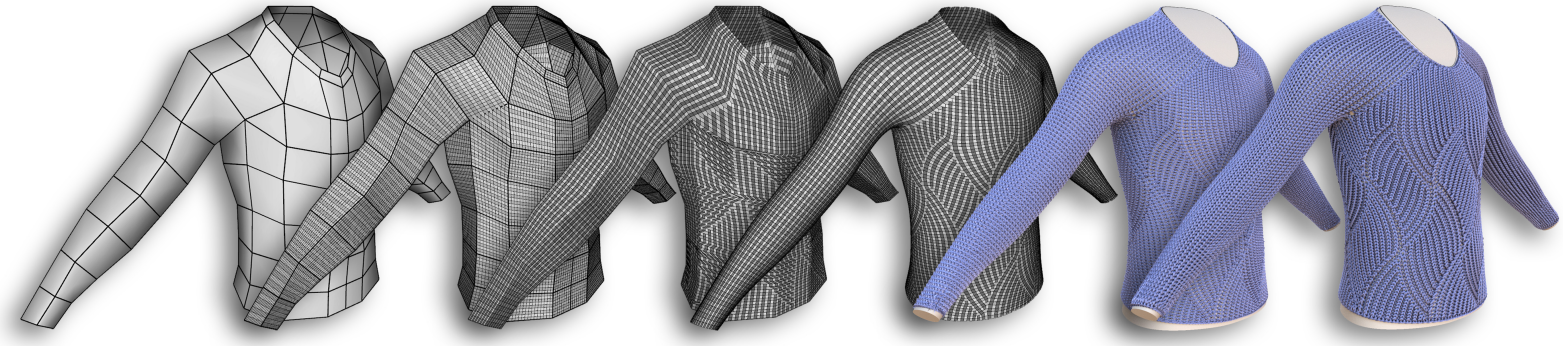

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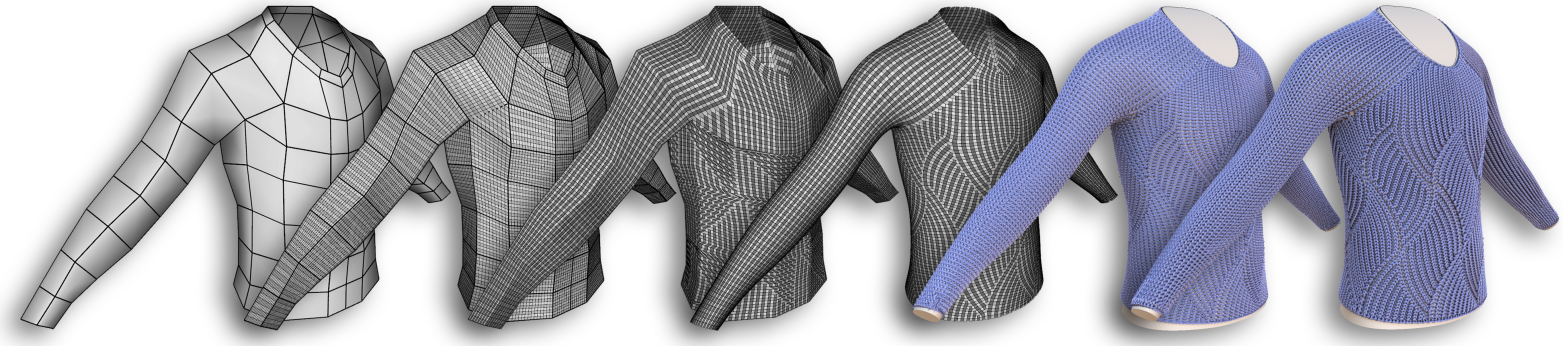

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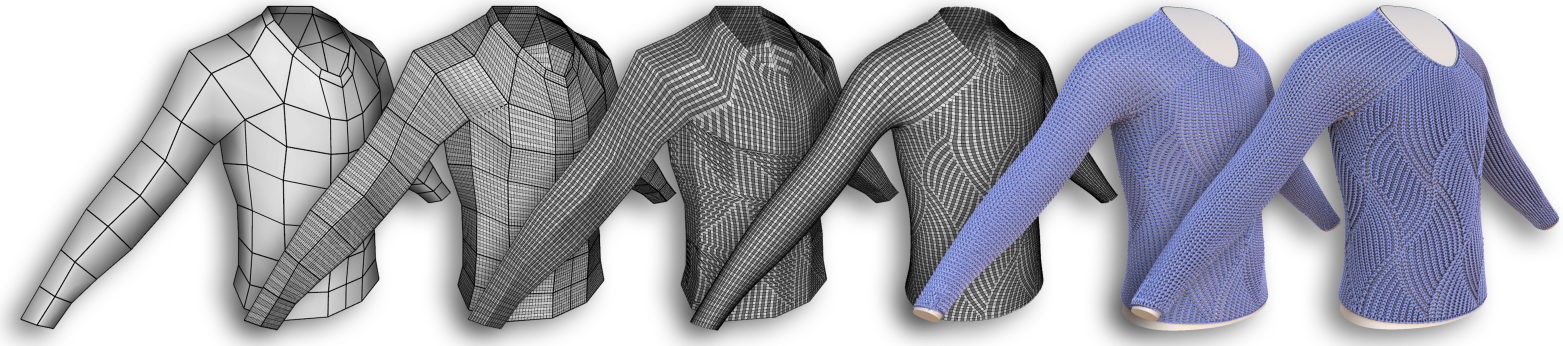

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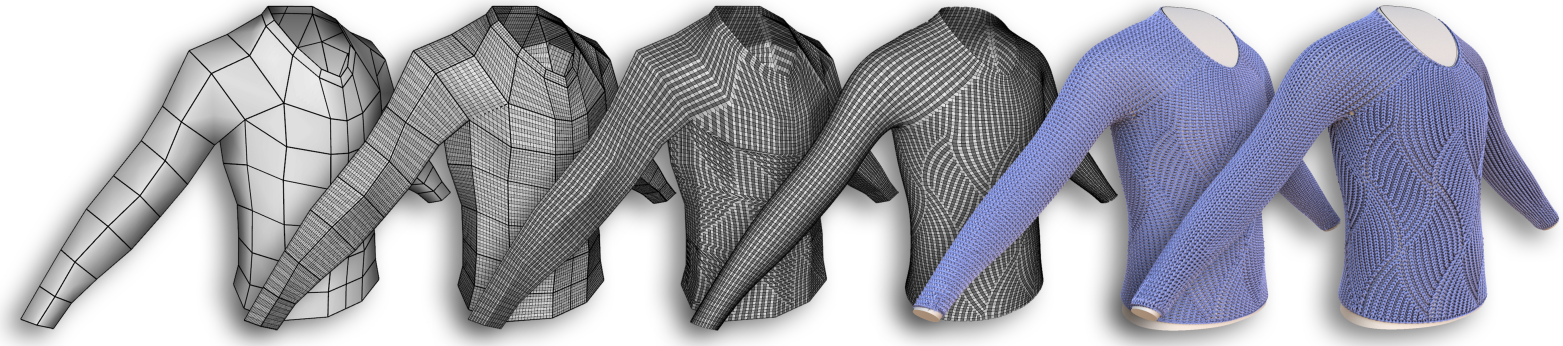

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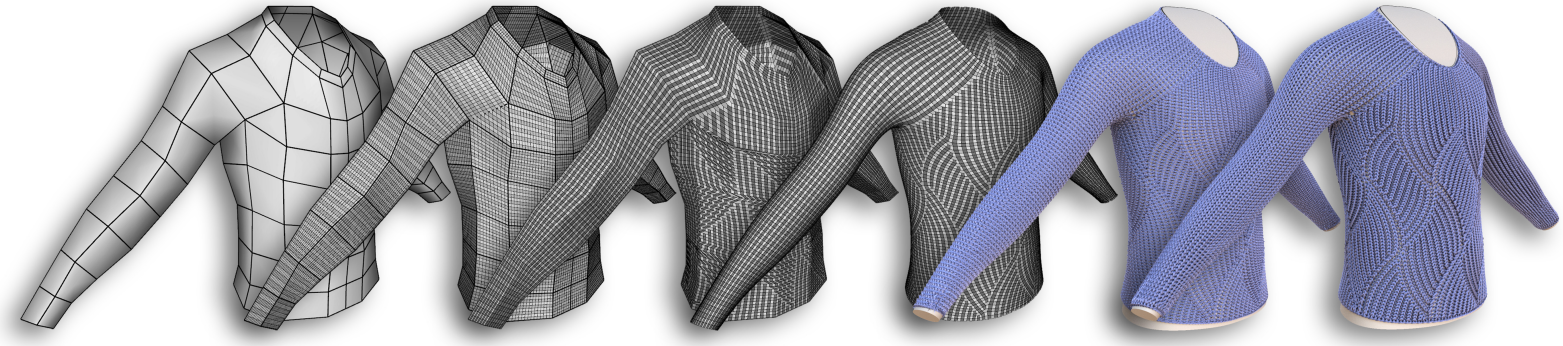

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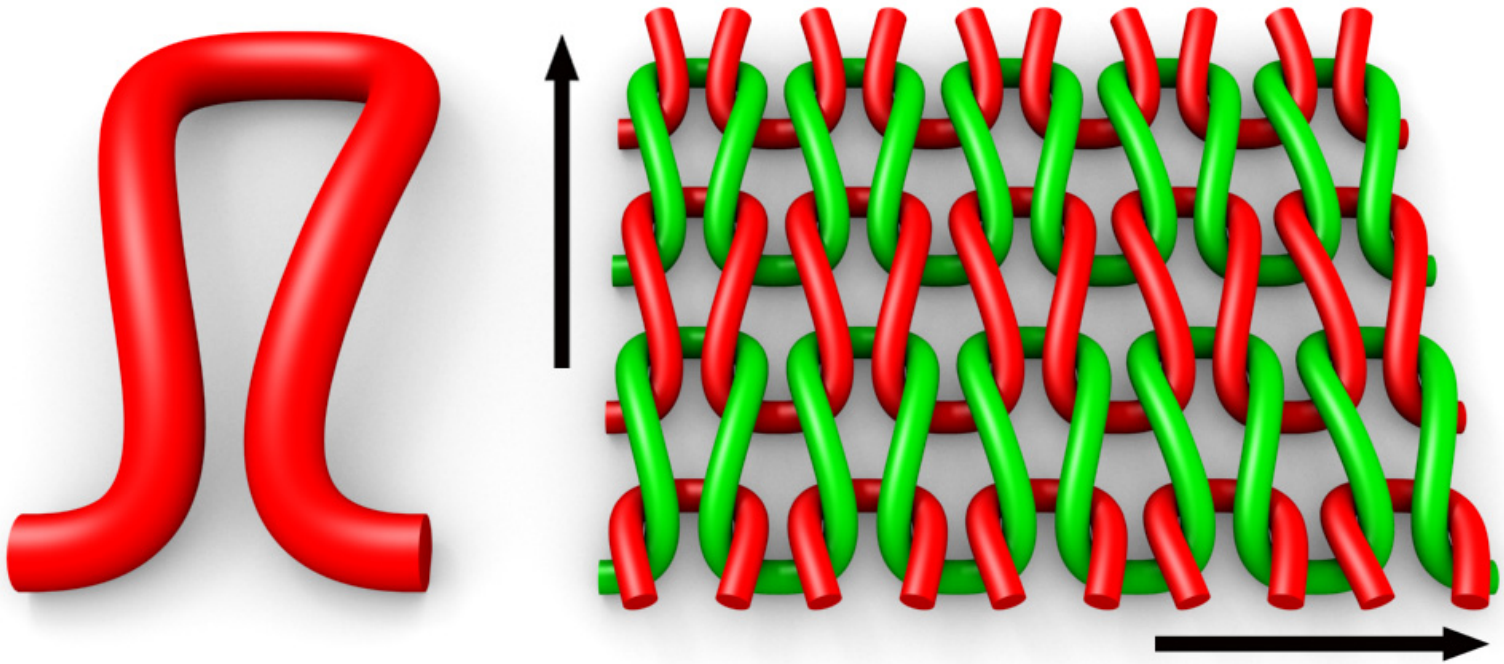

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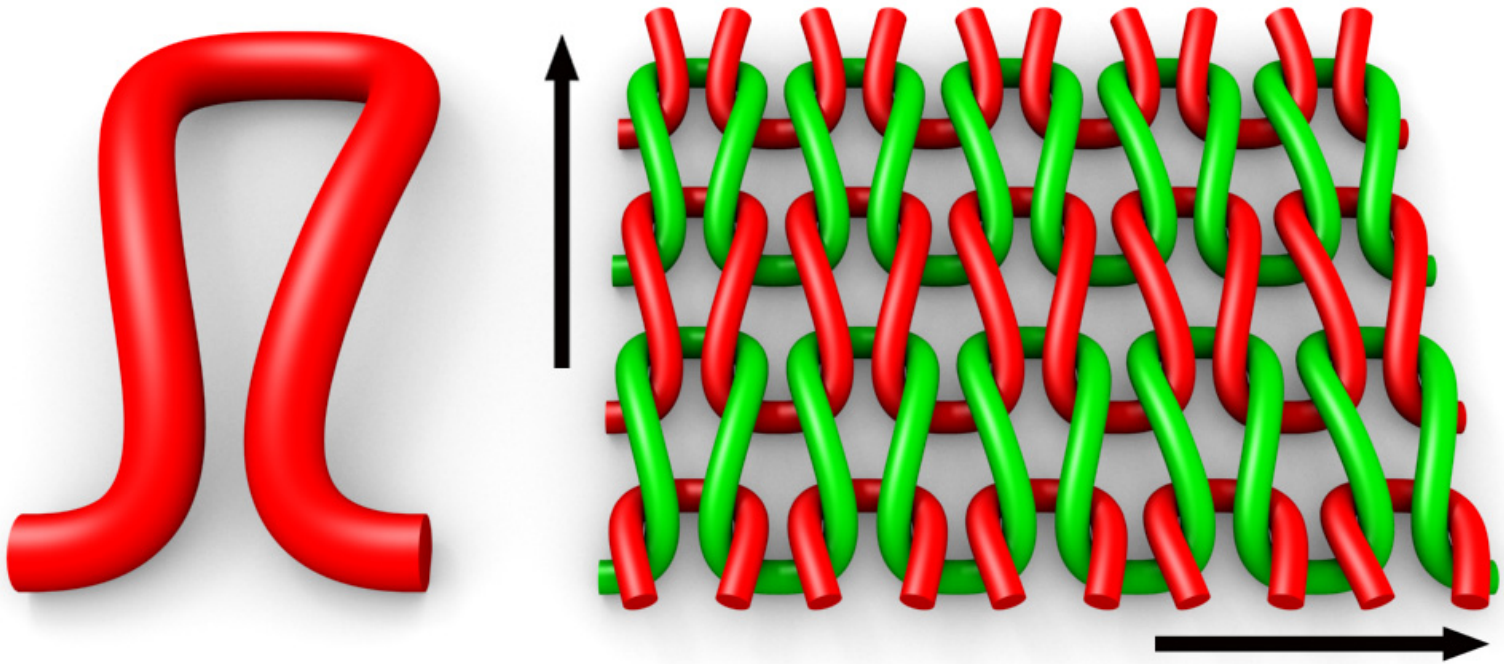

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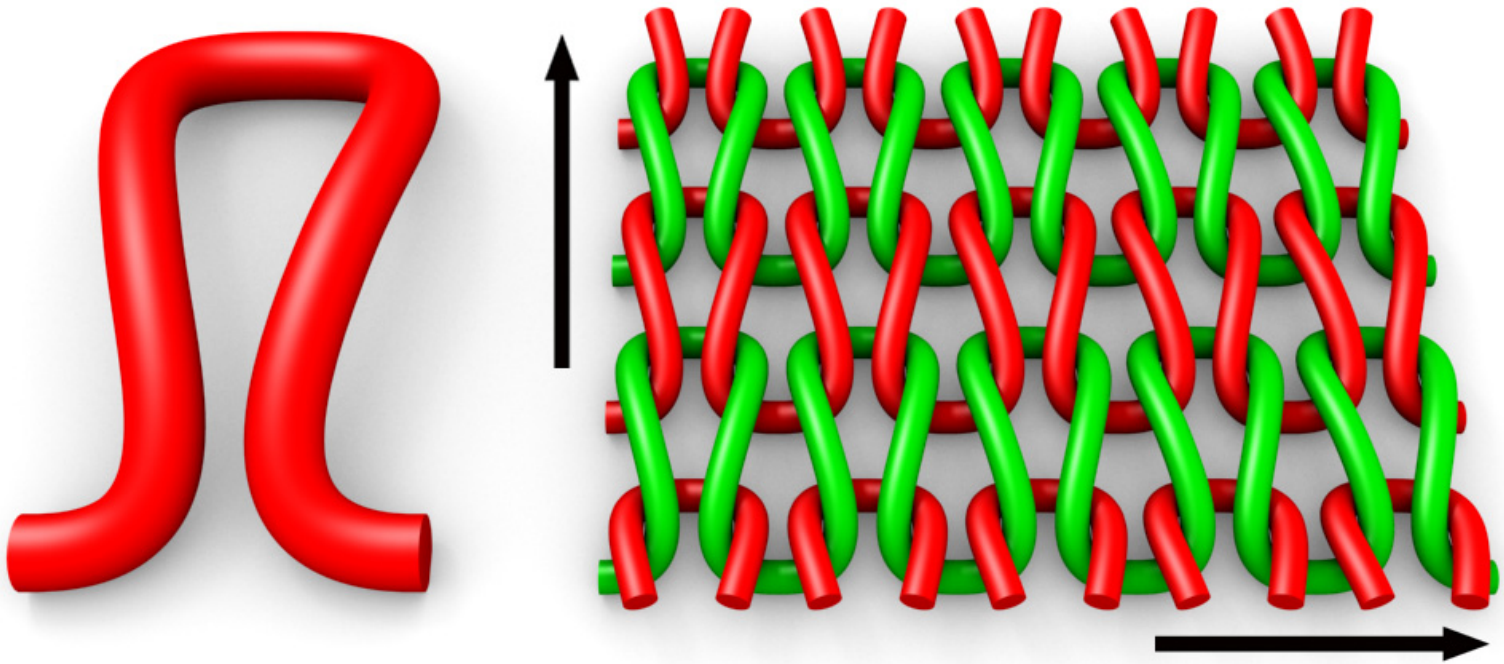

- Knitting = Pulling yarn through loops of previous row
- Several ways to create those loops ⇒ complexity

The Stitch Mesh

- Easy abstraction of the yarn geometry

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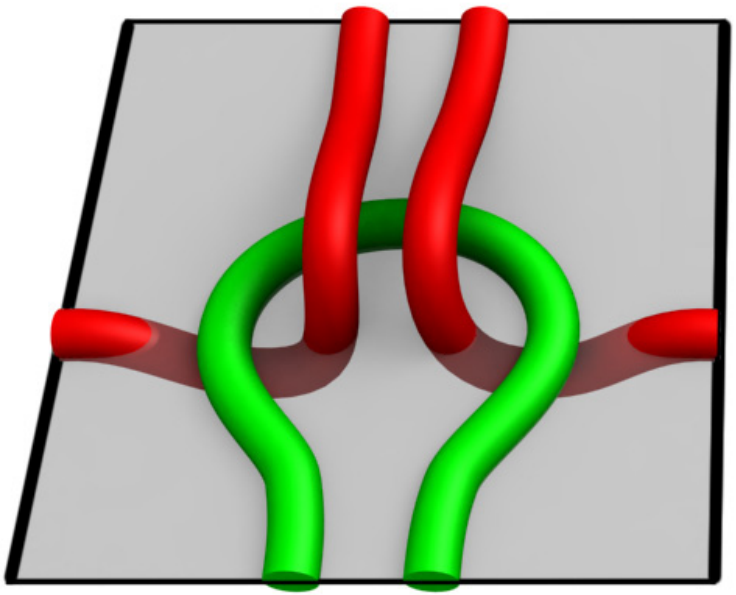

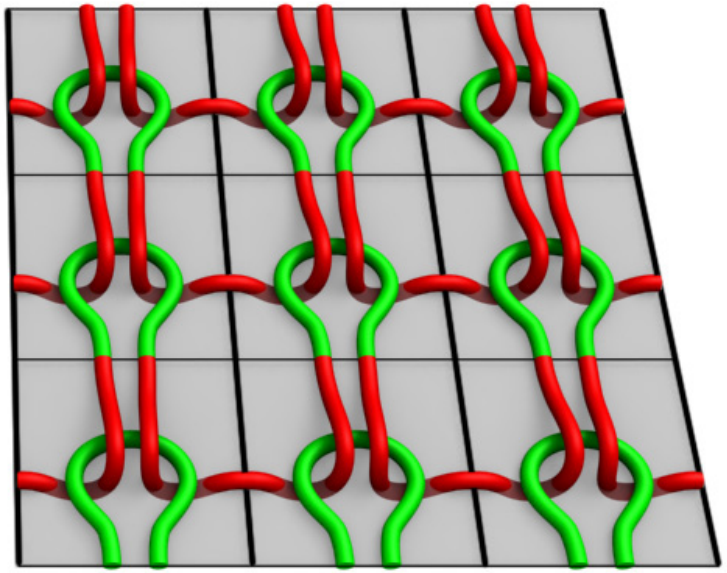

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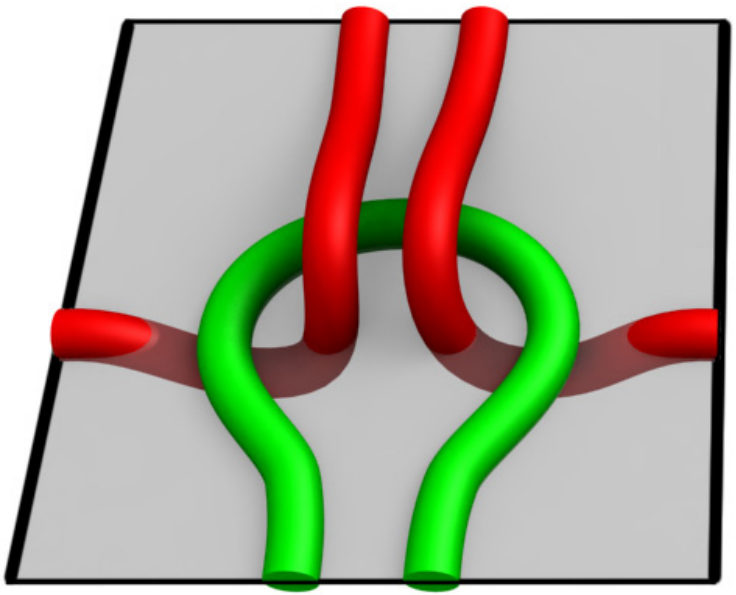

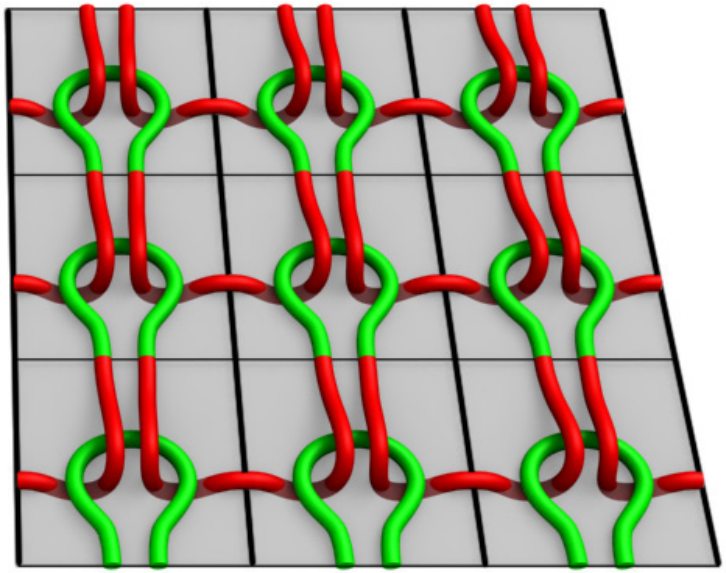

- Each face = certain yarn configuration

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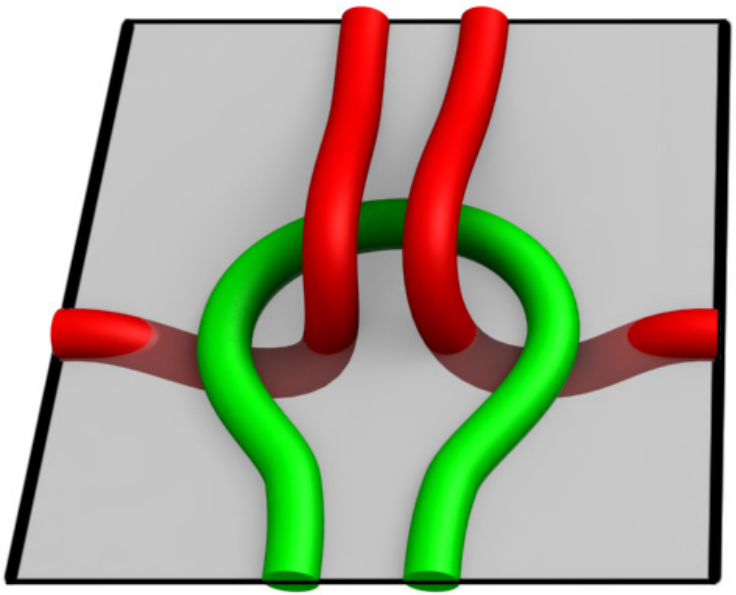

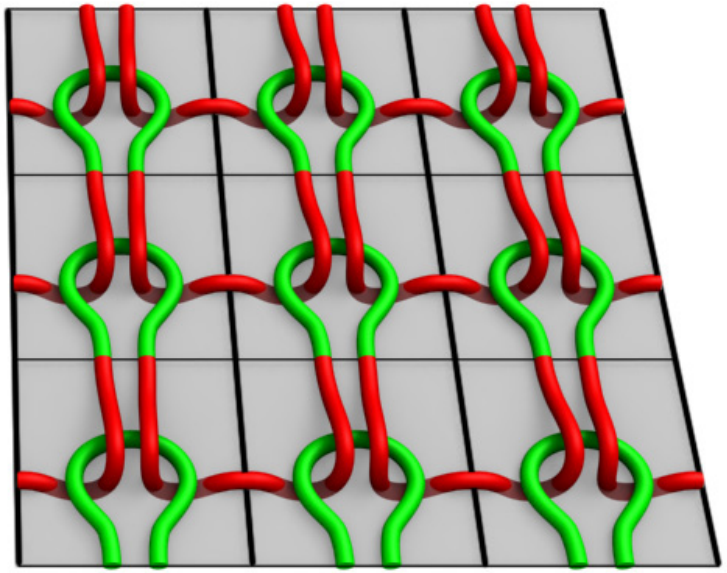

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- Centered around the top part of one loop

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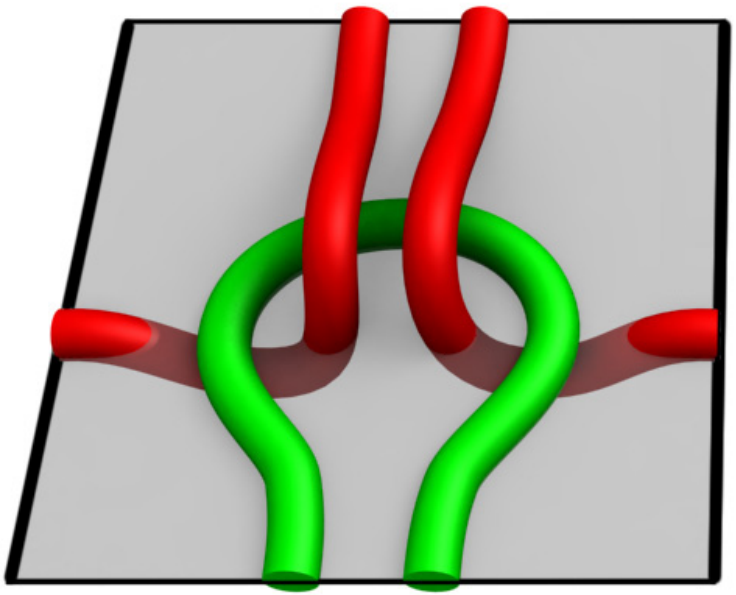

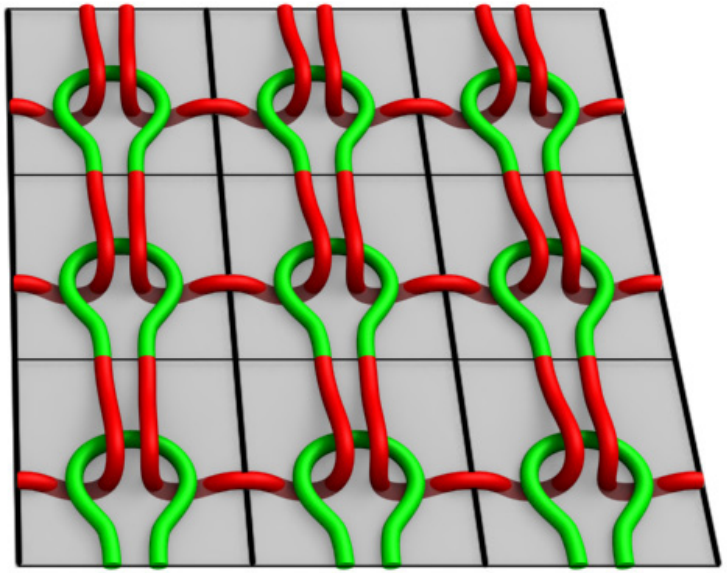

- Each face = certain yarn configuration
- Centered around the top part of one loop
- Geometry specified by control points

Stitch Types

- A face does not need to be quadrangular:

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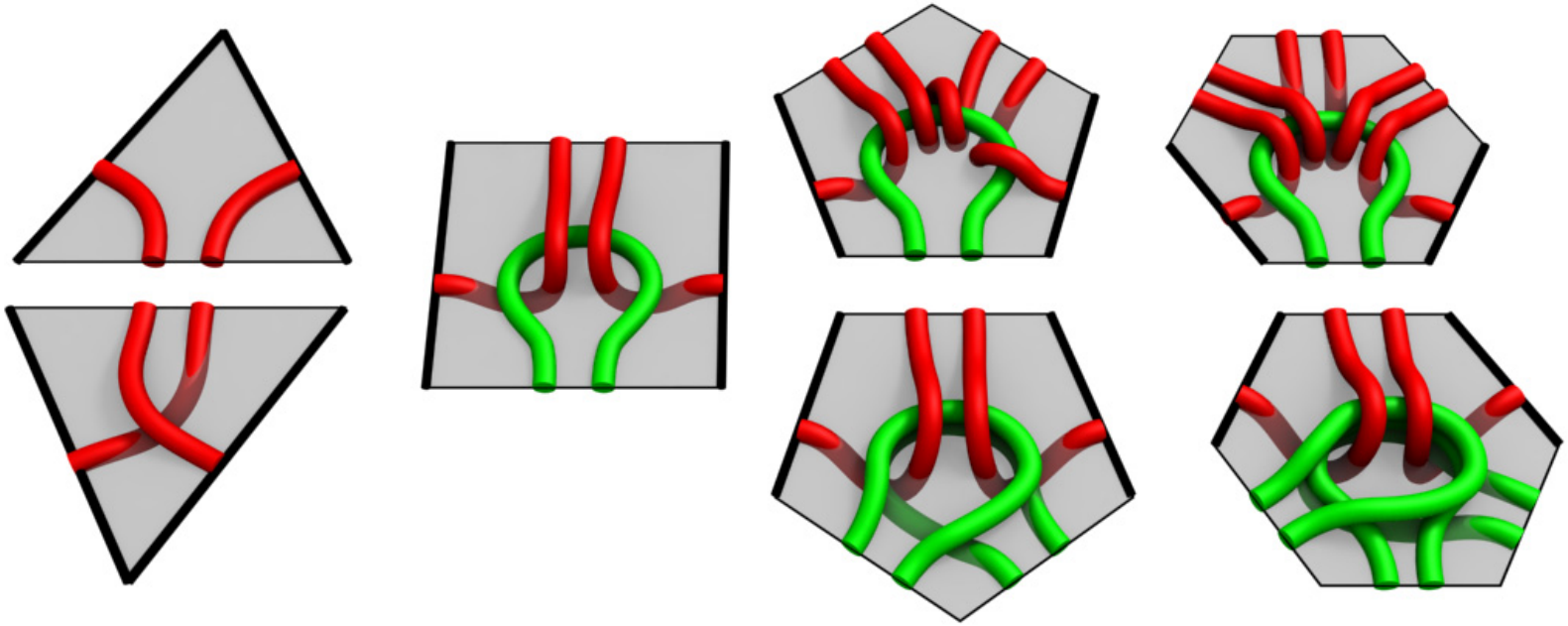

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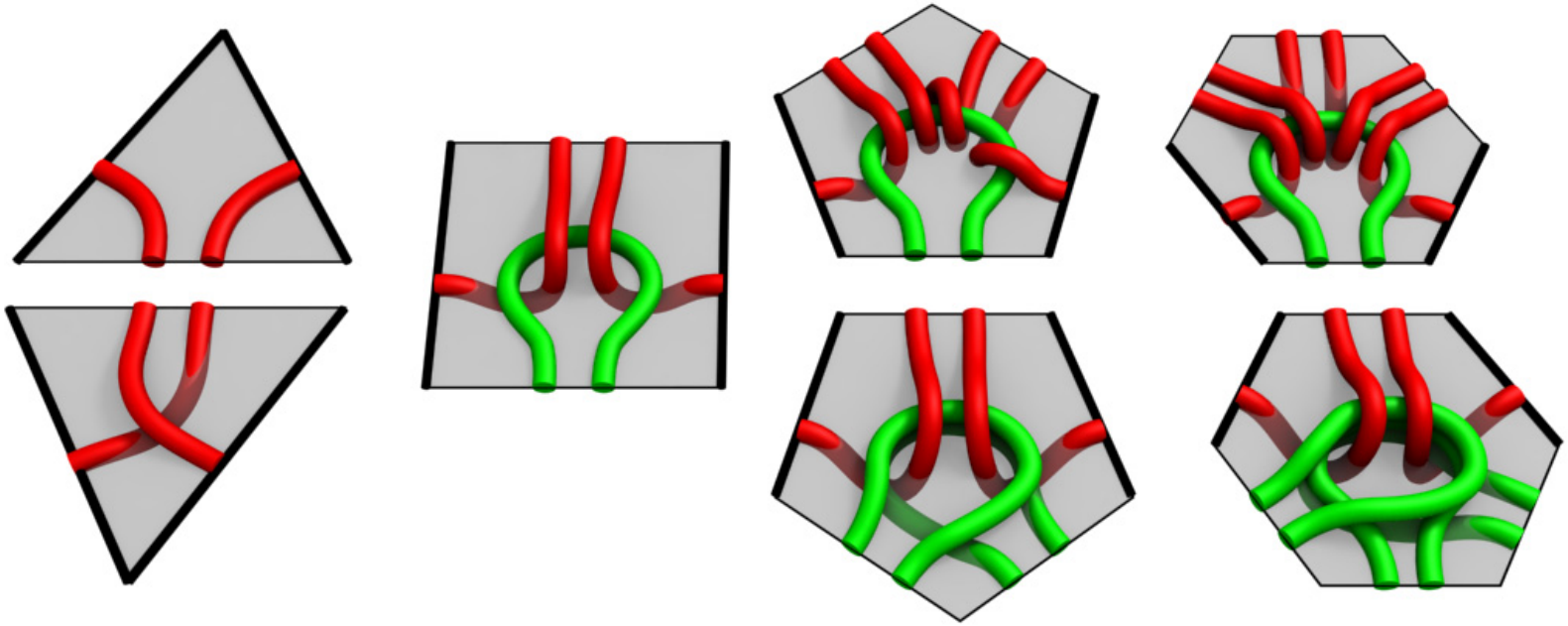
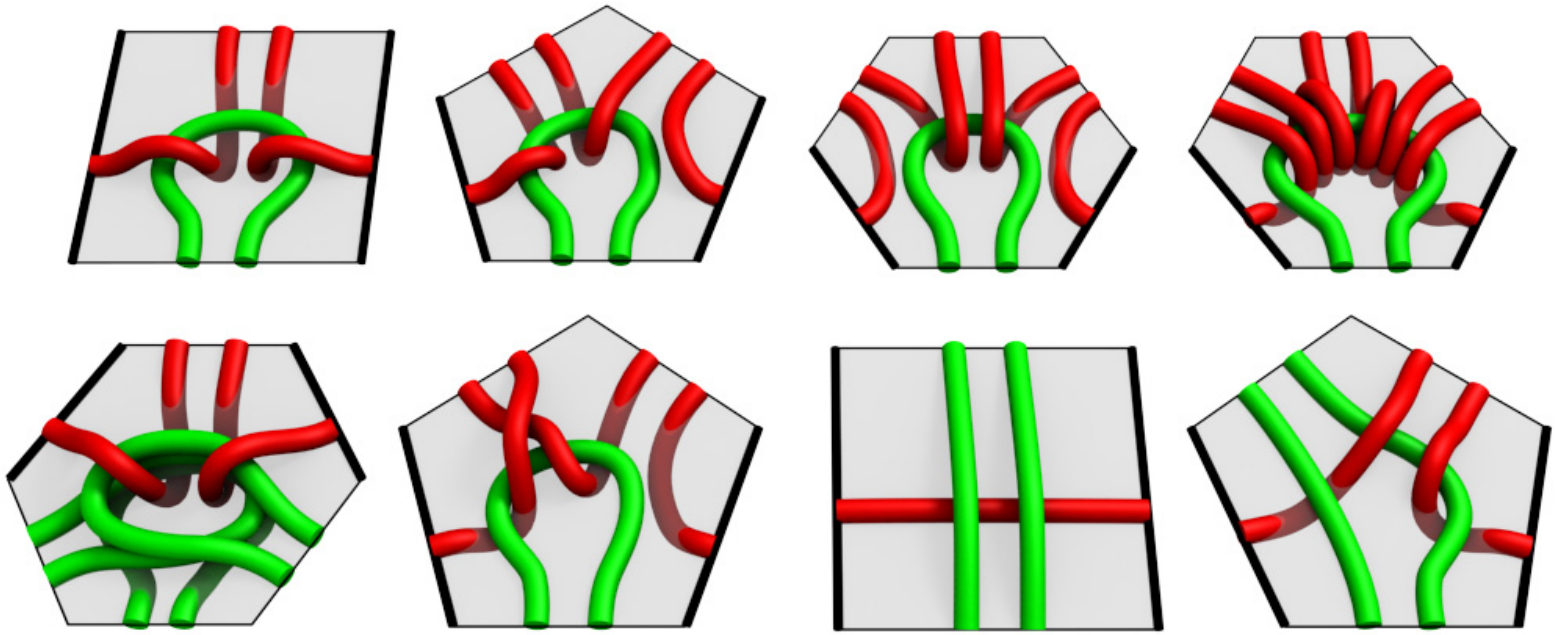


- Rule: Two sides crossed by one yarn, others crossed by two yarns.

And Even More Stitch Types



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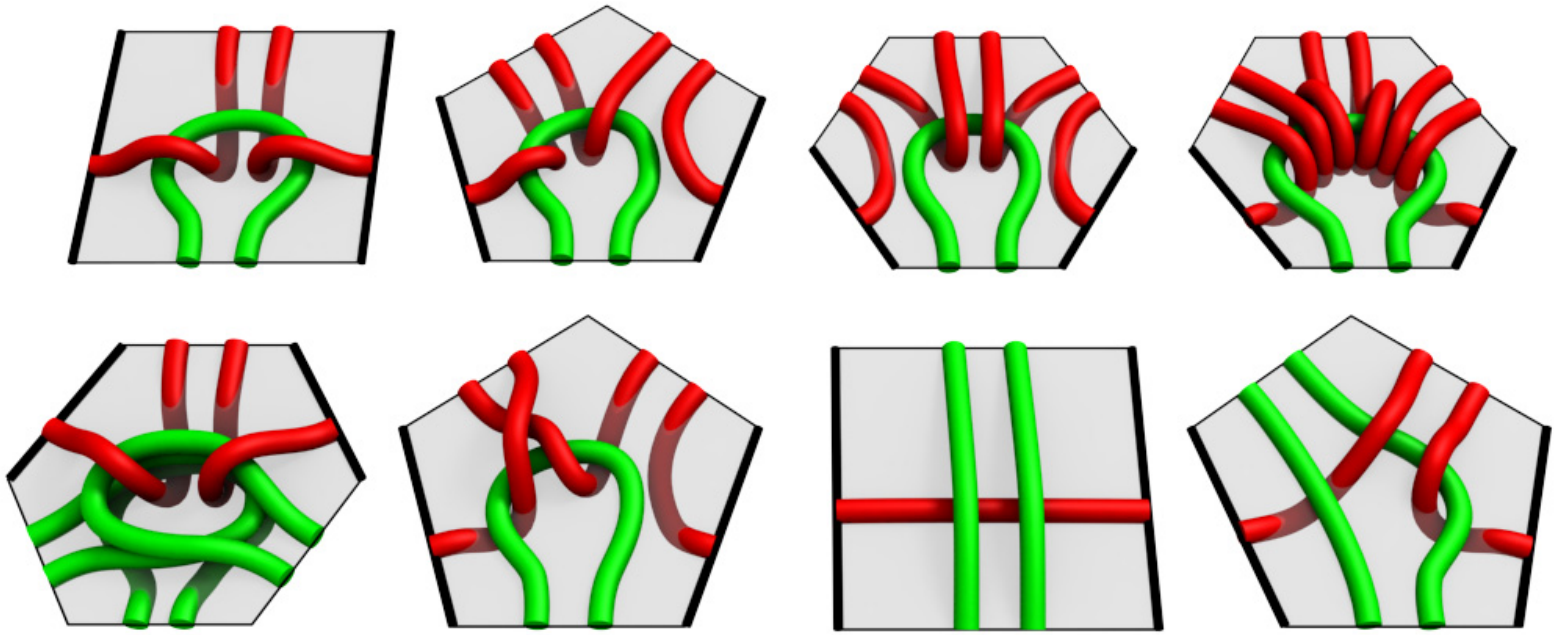
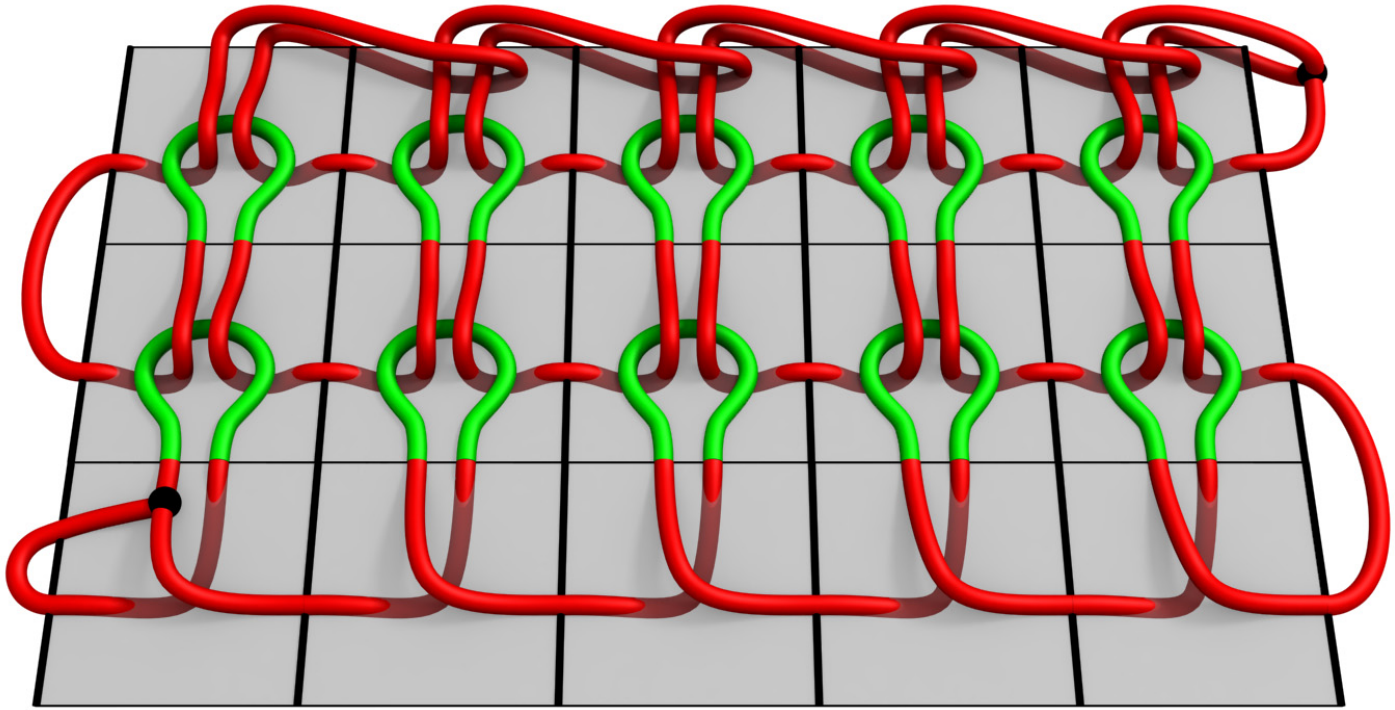


- Can all be combined, form rows!

Loose Ends



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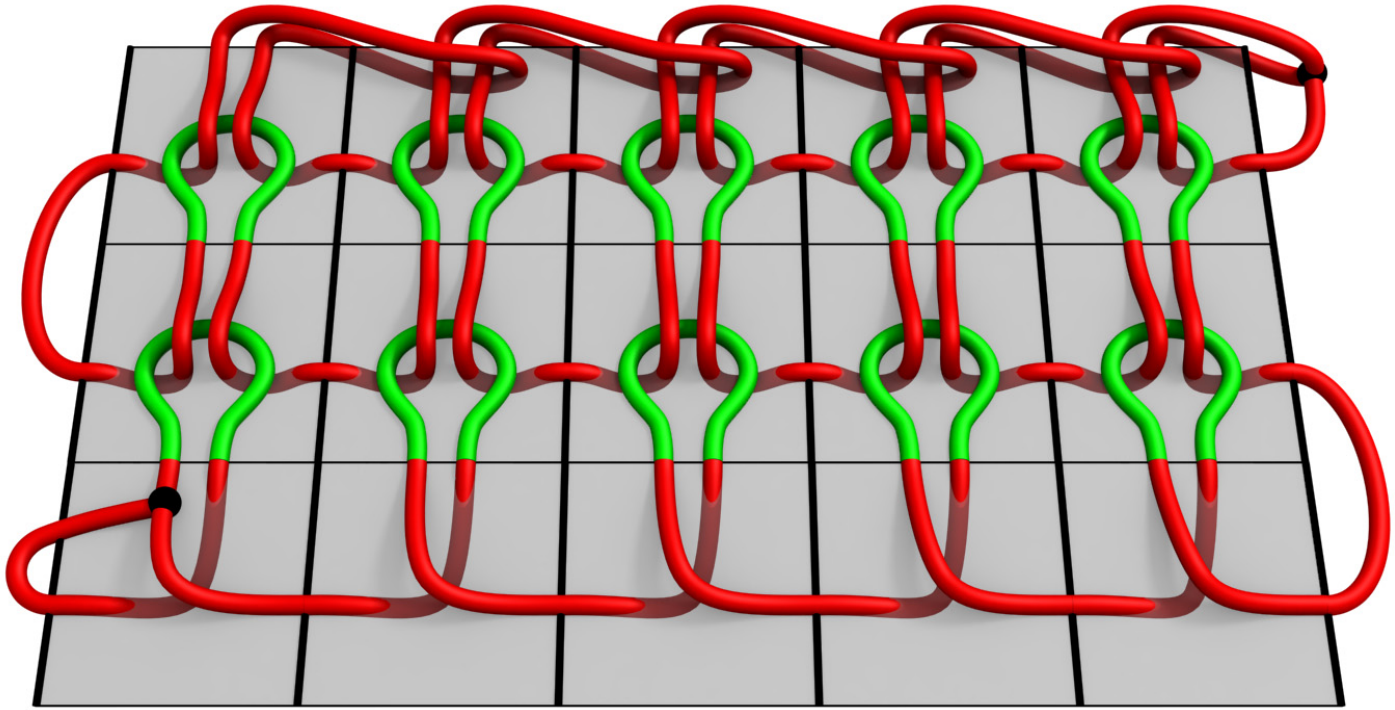

- Bottom: cast-ons

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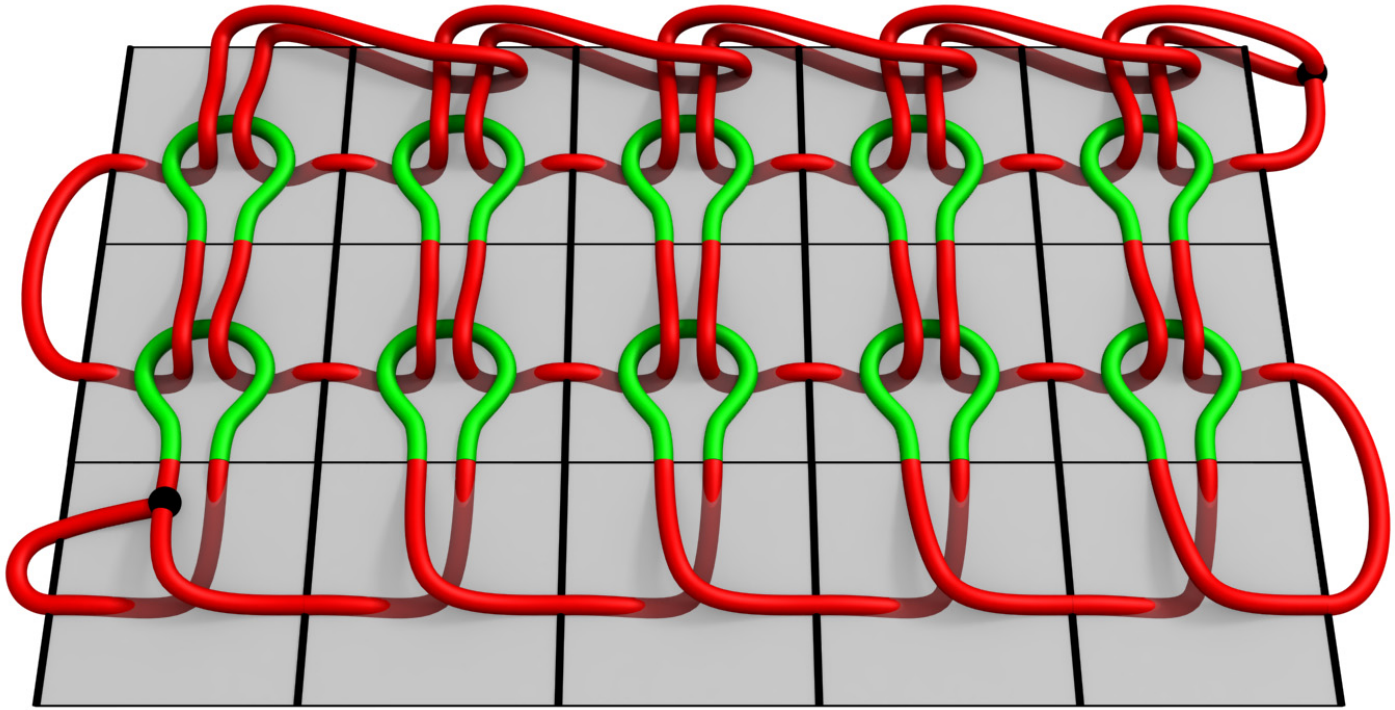

- Bottom: cast-ons
- Top: bind-offs

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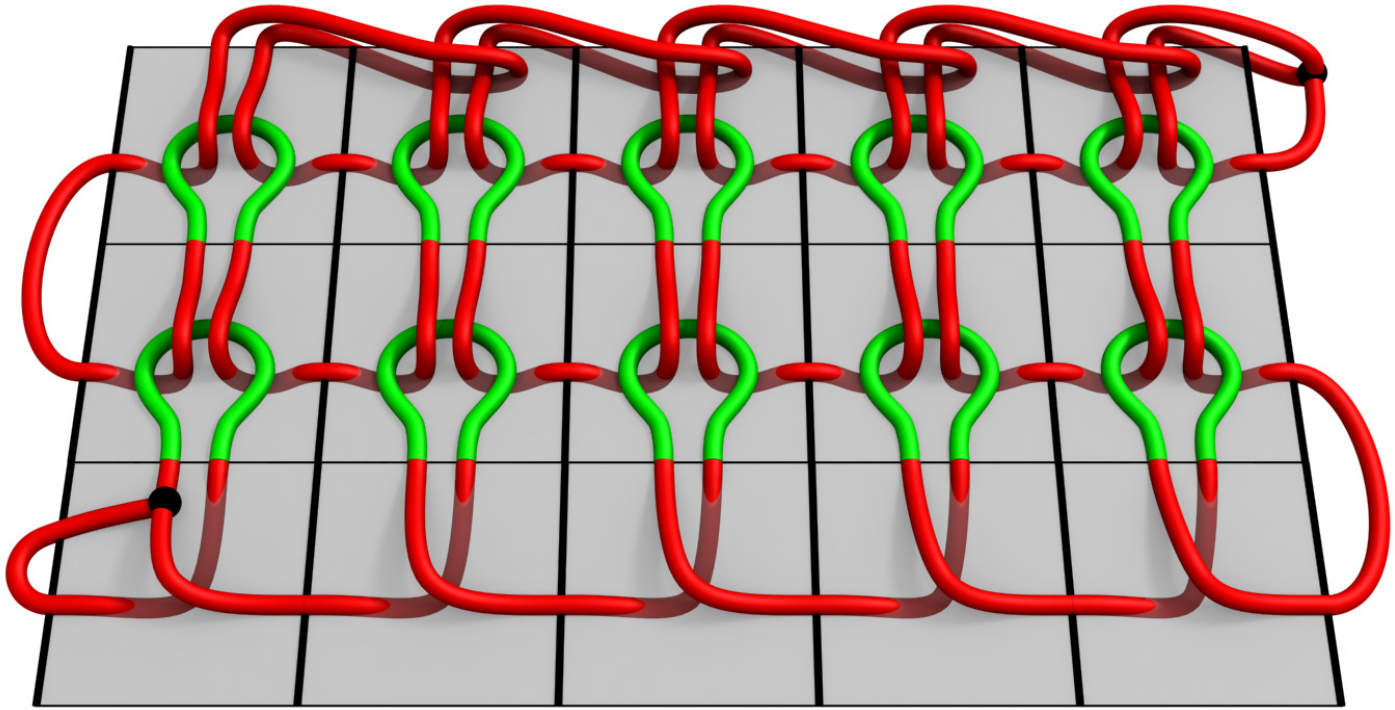
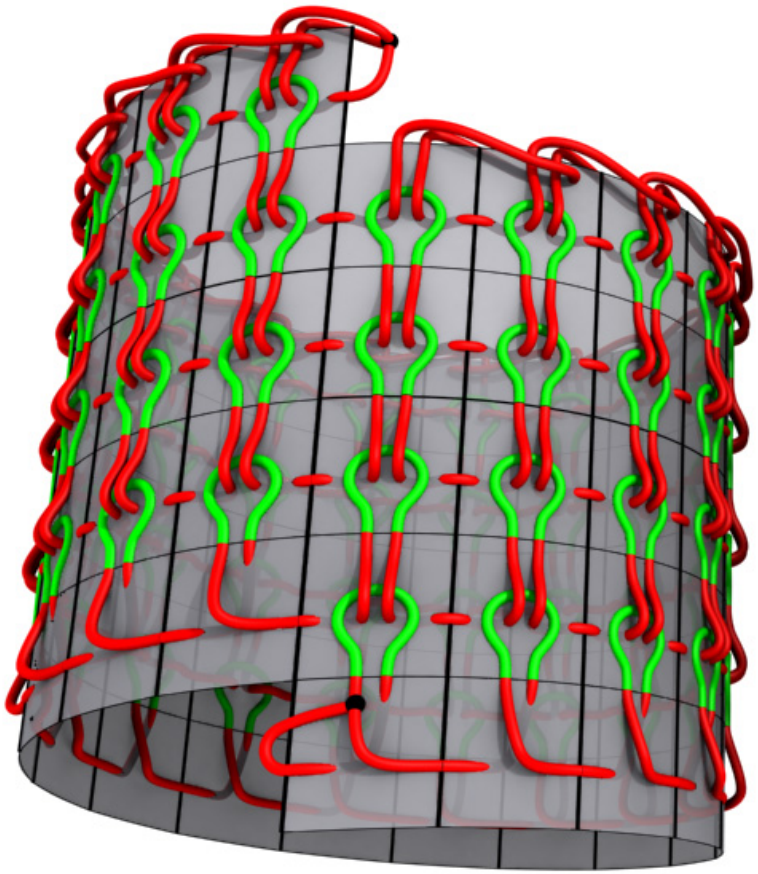
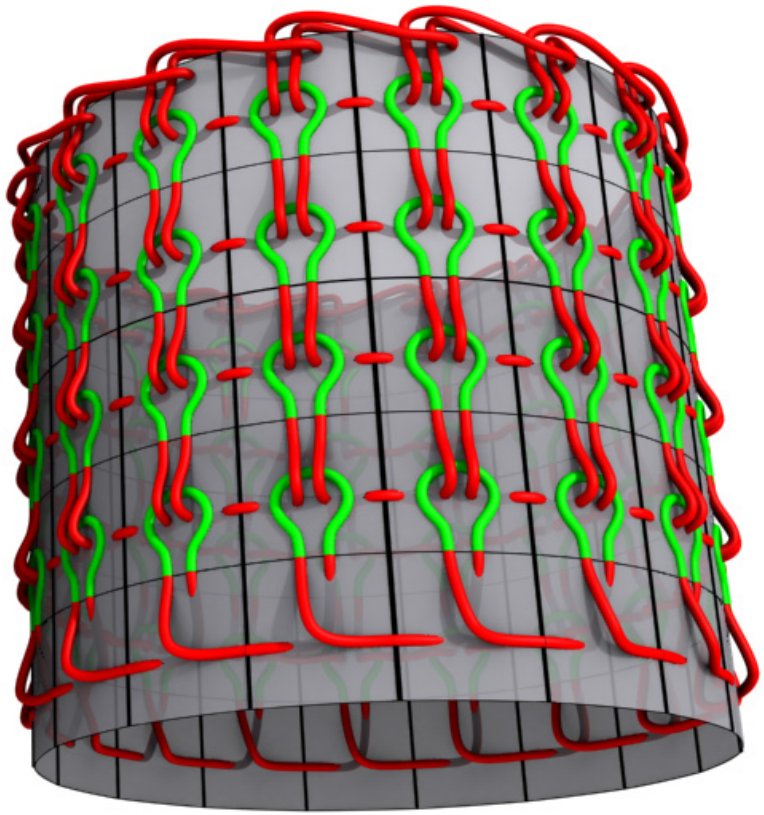


- Bottom: cast-ons
- Top: bind-offs
- Side: Tie or connect to adjacent ends

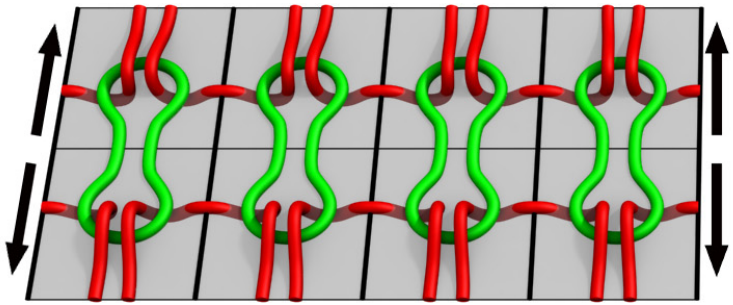
Tubes

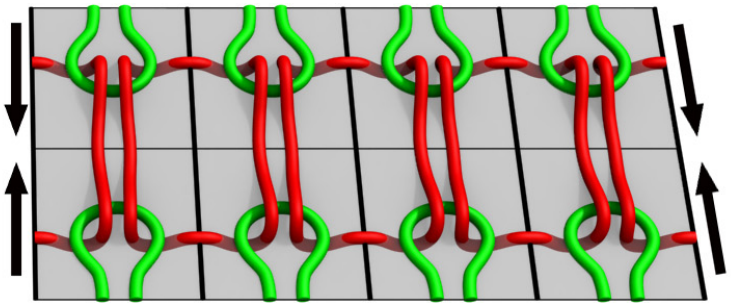
Spiral versus Separate Rows: 0 – 1





Opposing Knitting Directions





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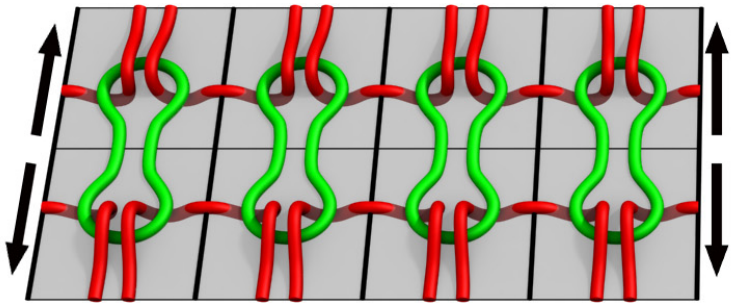

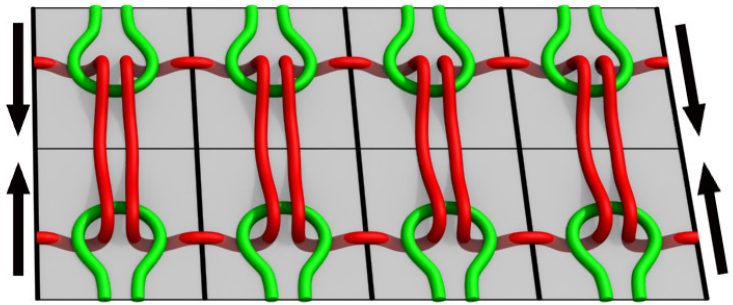

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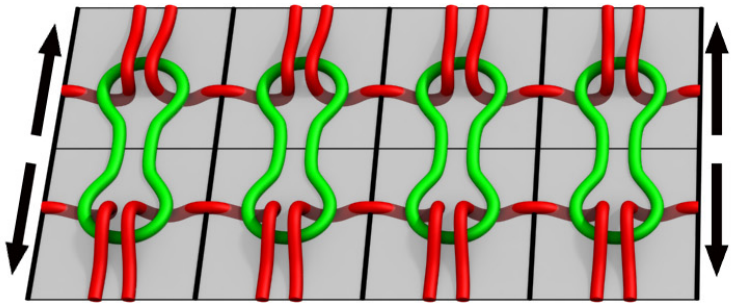
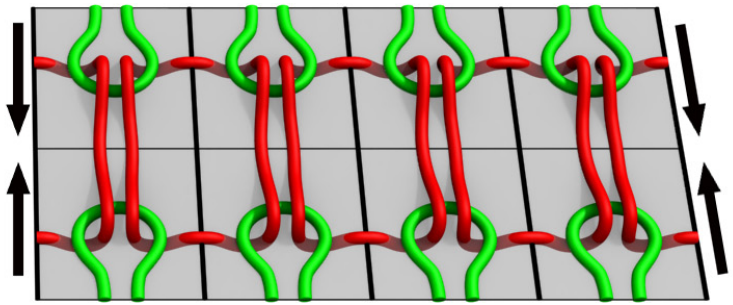
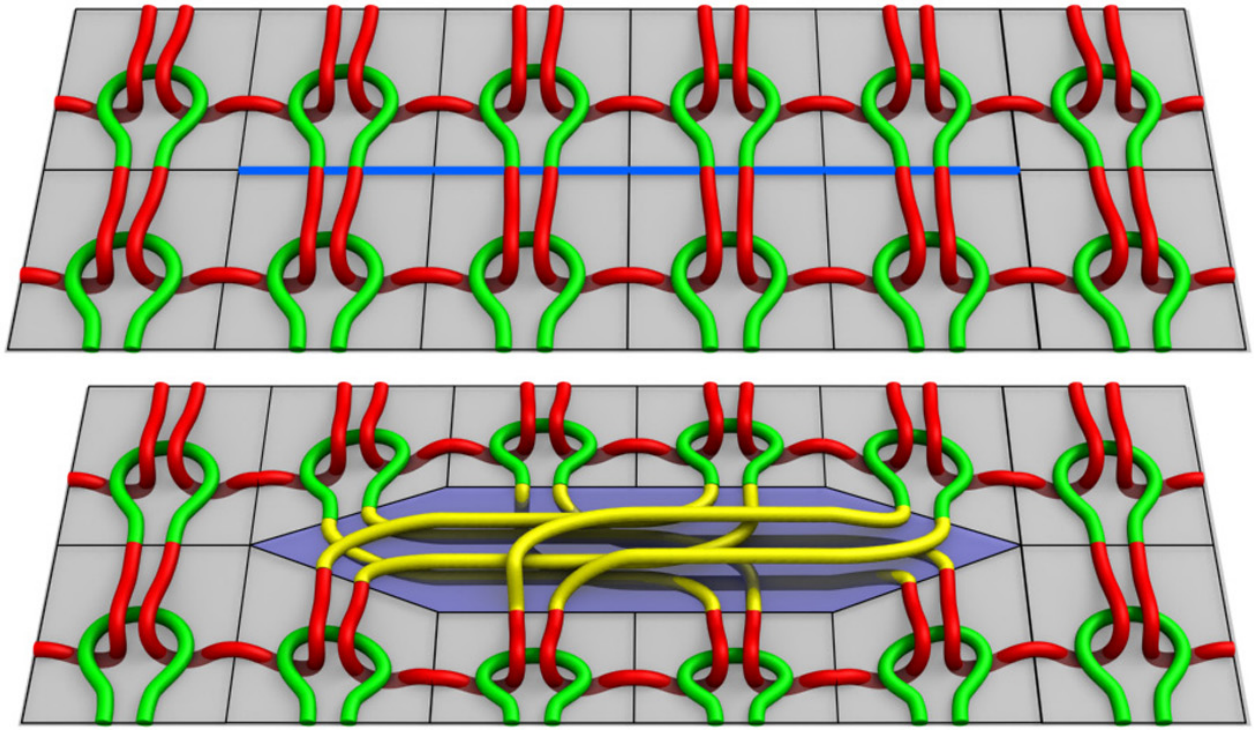




- . . . are handled automatically!
- No real-world structure, but looks plausible.

Cable edges



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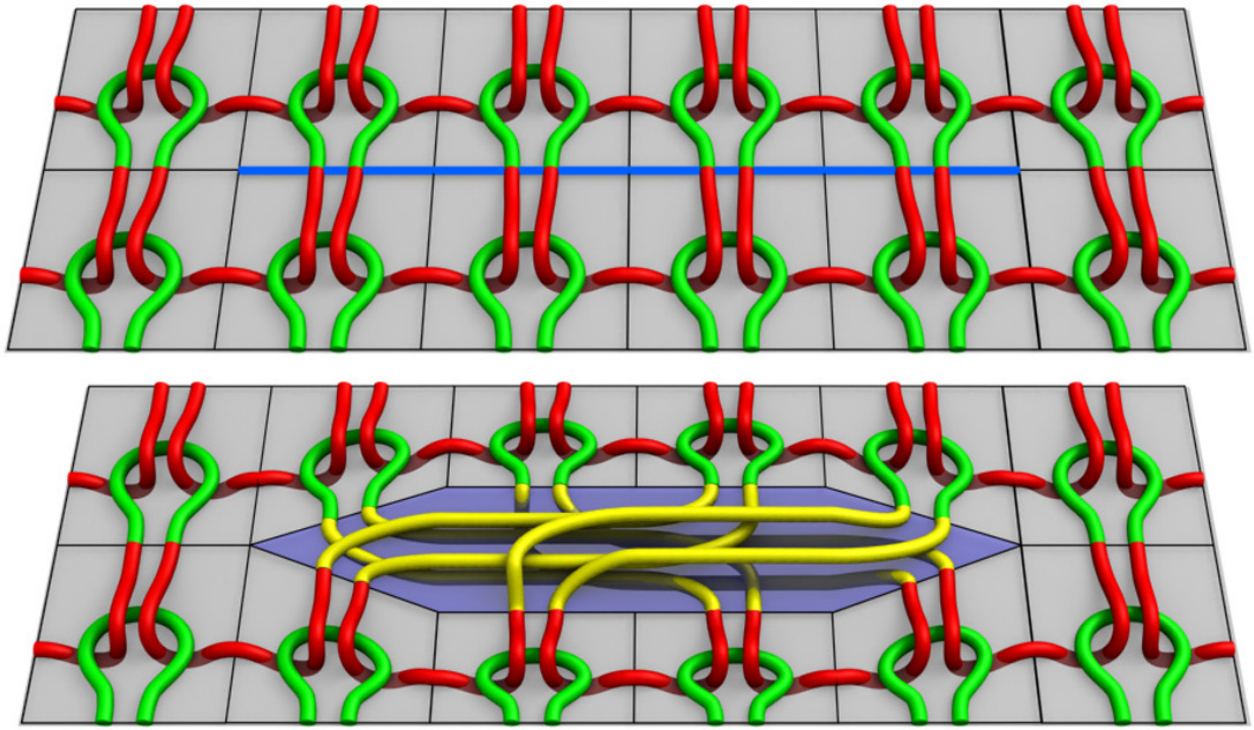

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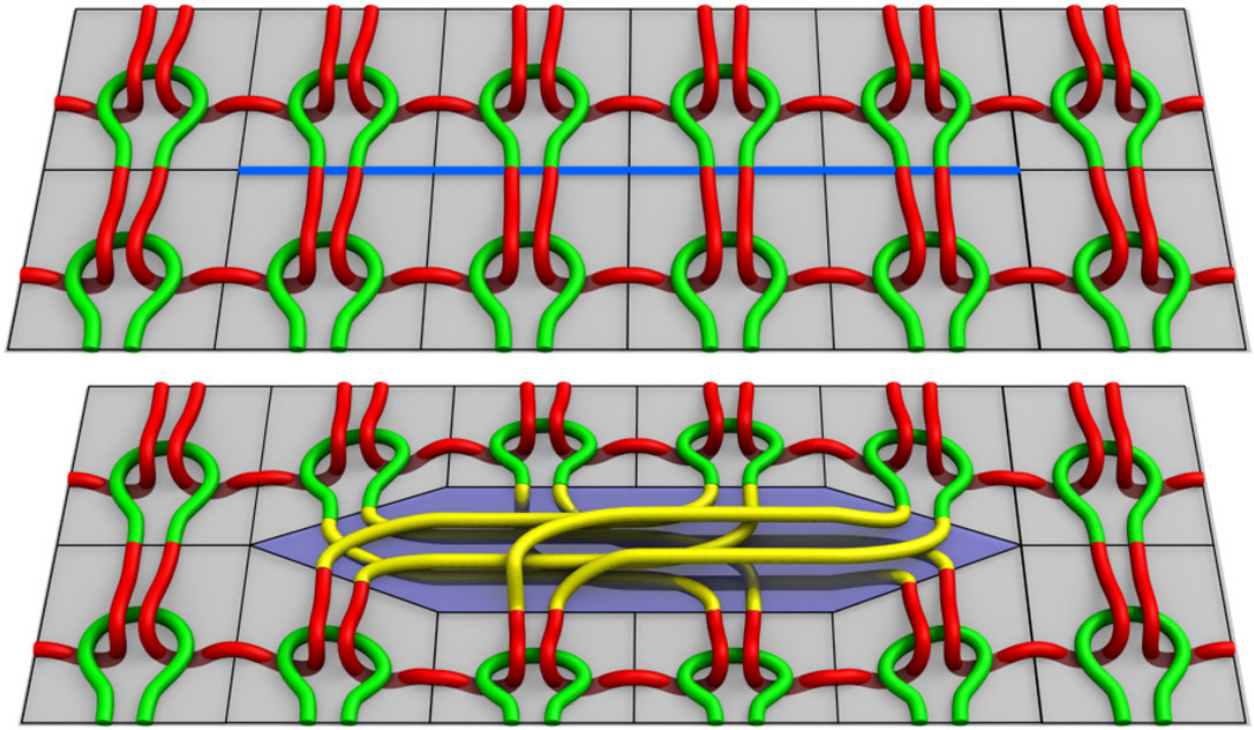
Cable edges



- Need to permutate the connection of some faces?
- Assign cable edges to insert cable faces later.

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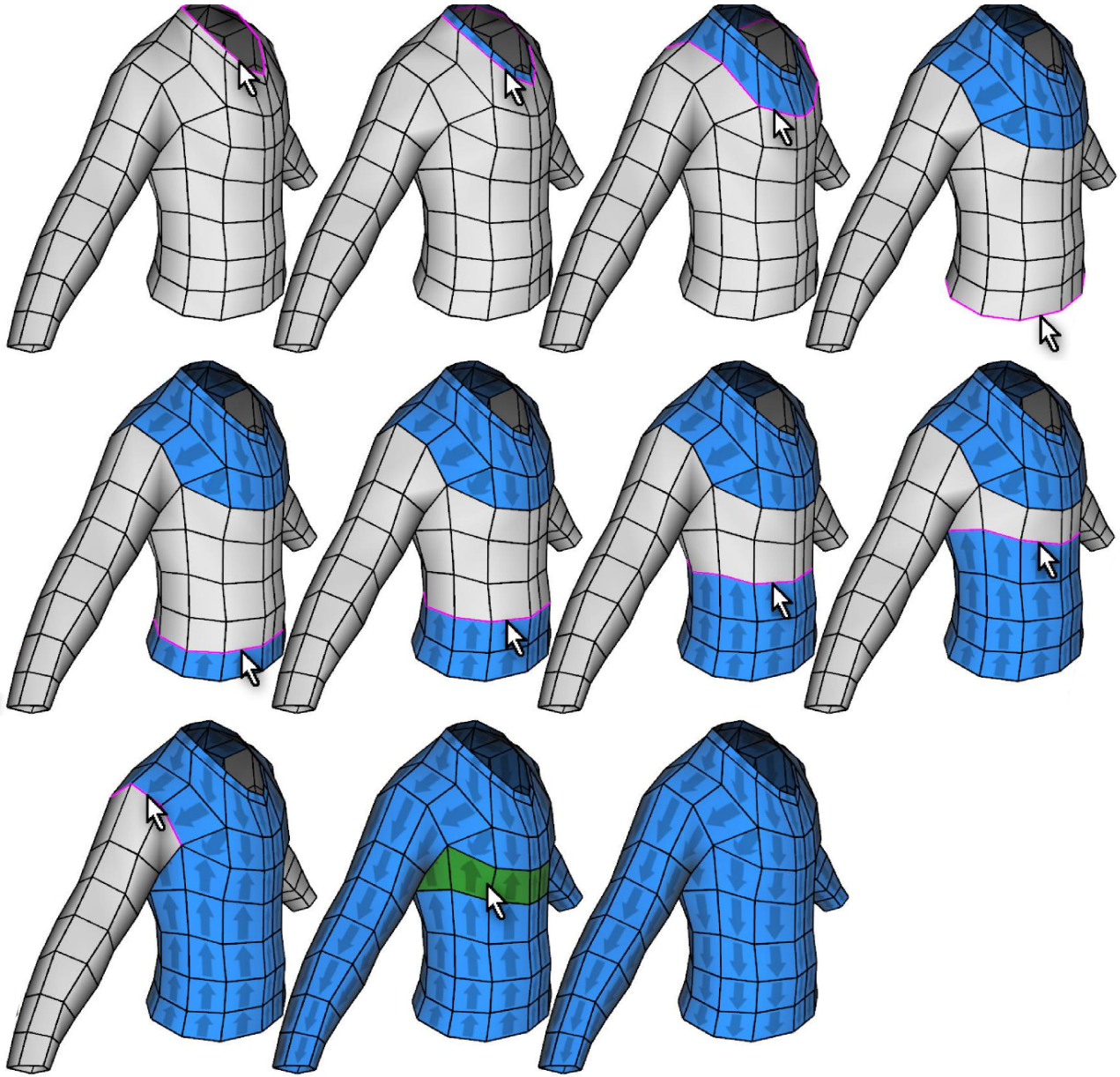

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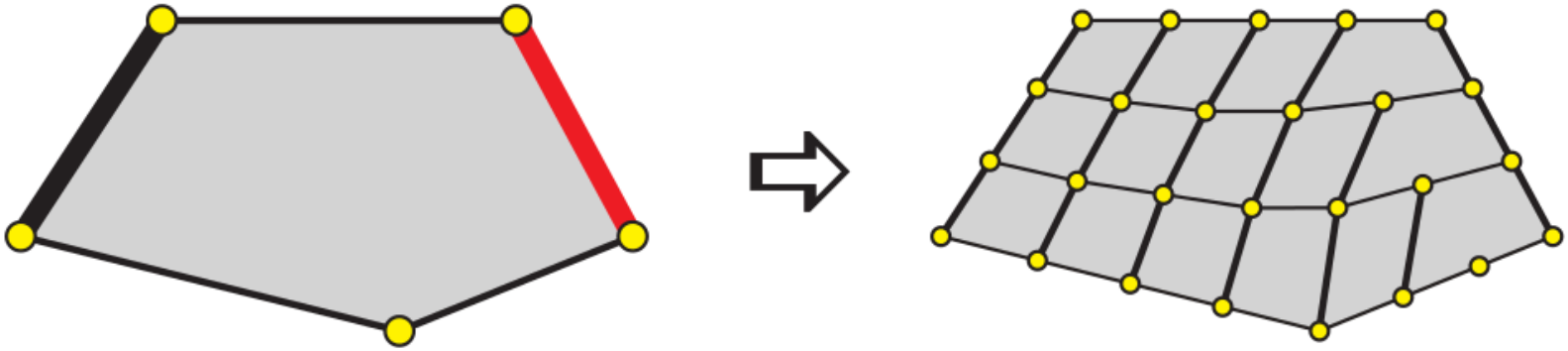

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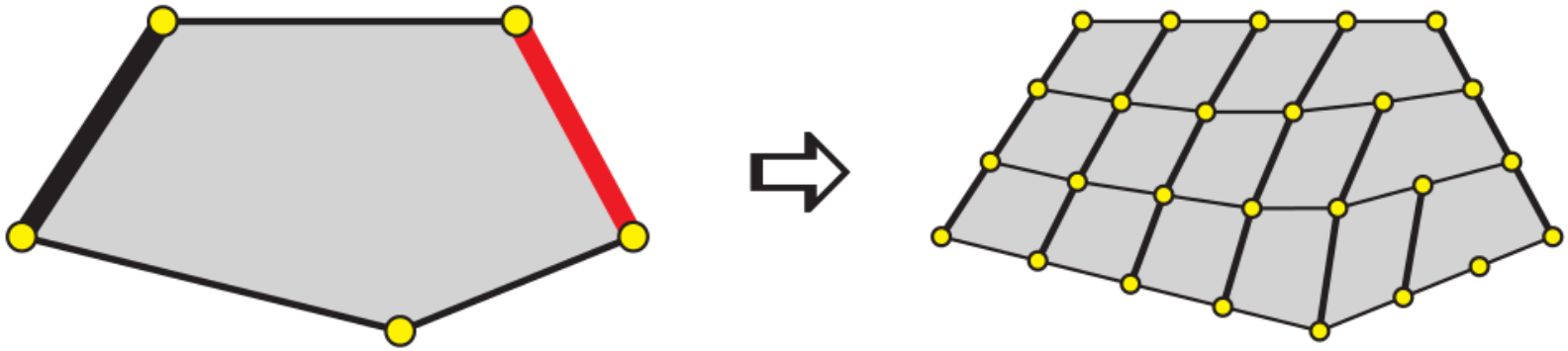
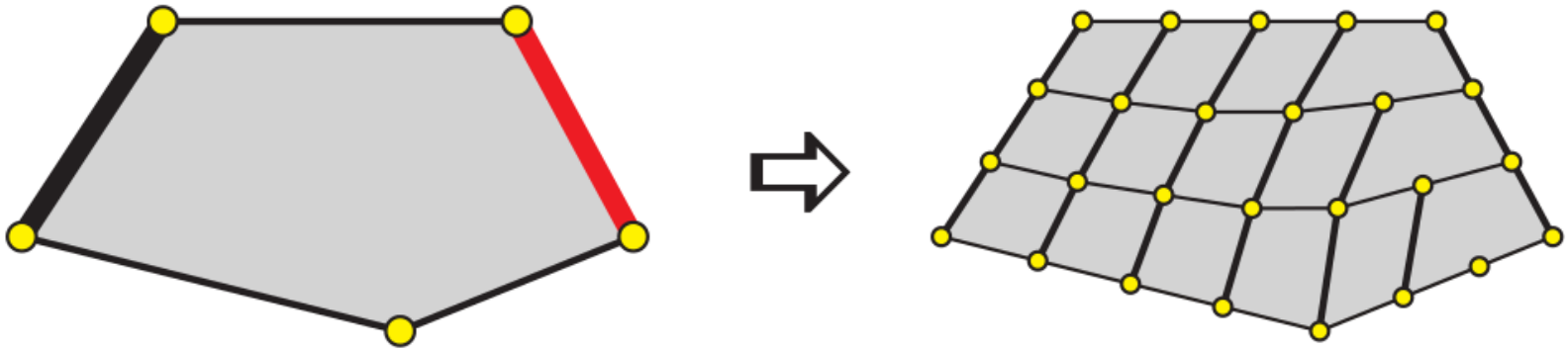


Strategy for each face

Step 2: Create Stitch Mesh



Strategy for each face

- Tessellate its edges

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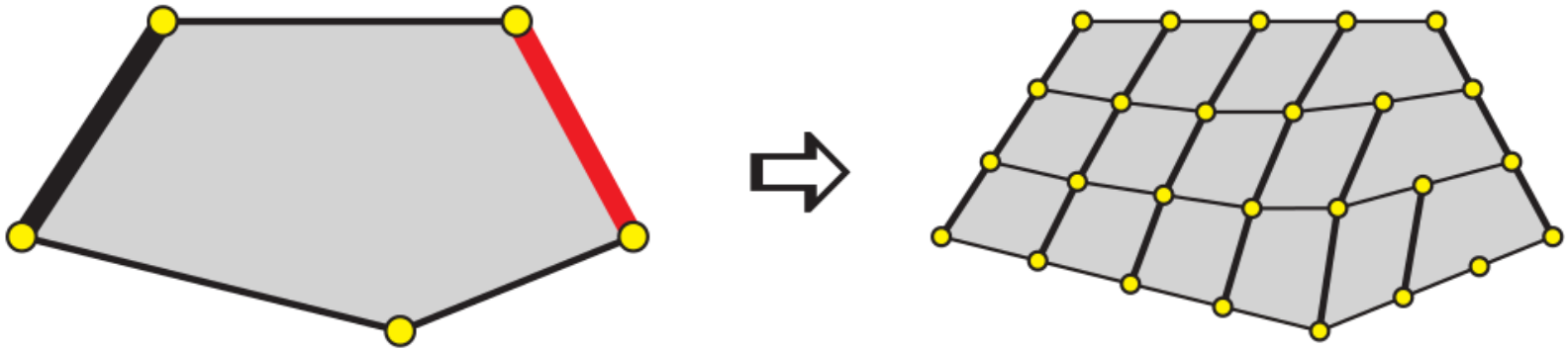

Strategy for each face

- Tessellate its edges
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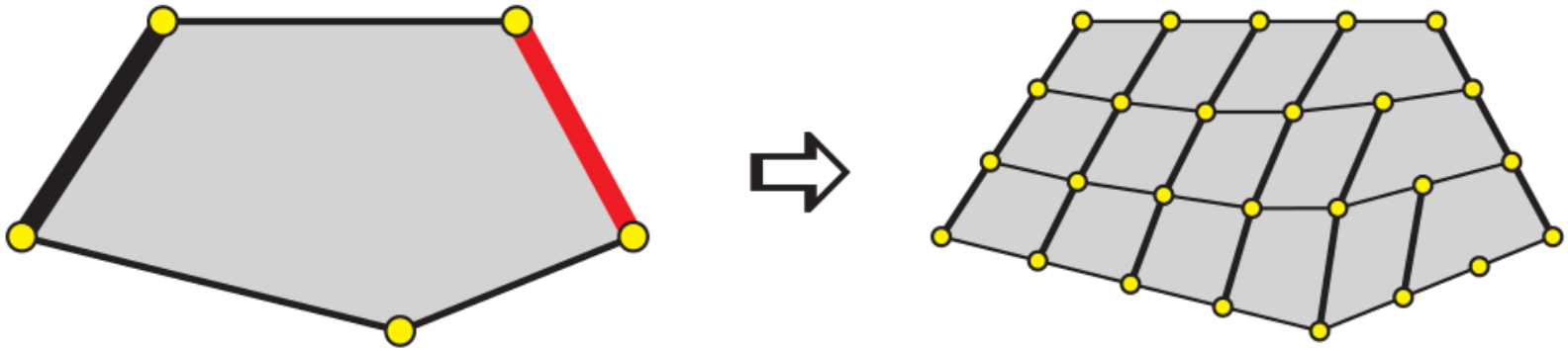

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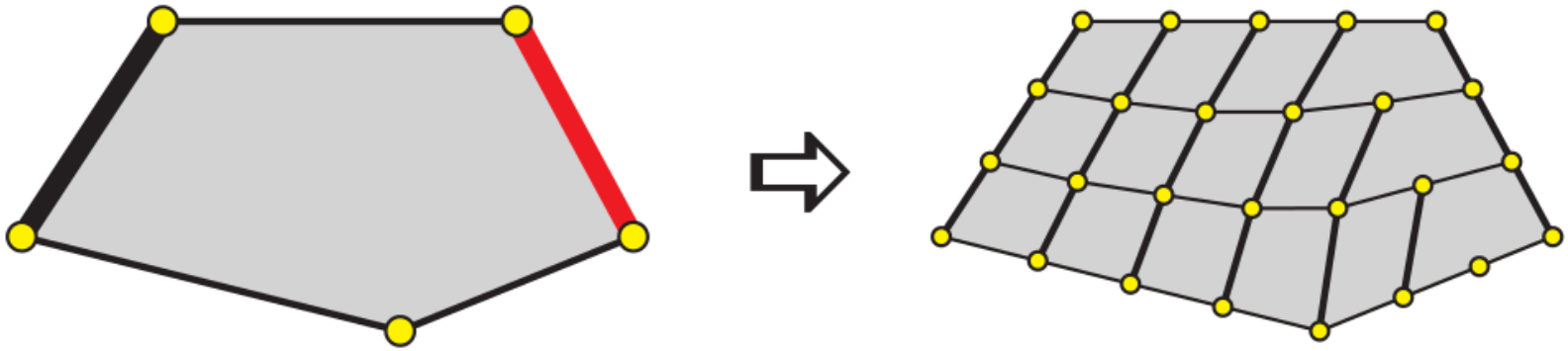

Strategy for each face

- Tessellate its edges
- Determine number of rows
- Determine the number of stitches on each row
- Insert increases/decreases, if necessary

Step 3: Editing the stitch mesh

- Operations on the mesh:

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- Operations on the mesh:

- User can set stitch types and create patterns

Outline

1 Introduction

2 The Stitch Mesh

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4 Offline Relaxation

5 Results

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Steps 4-6: Offline Relaxation

Insert yarn now? No, would look unrealistic. $\Rightarrow$ Simulation!

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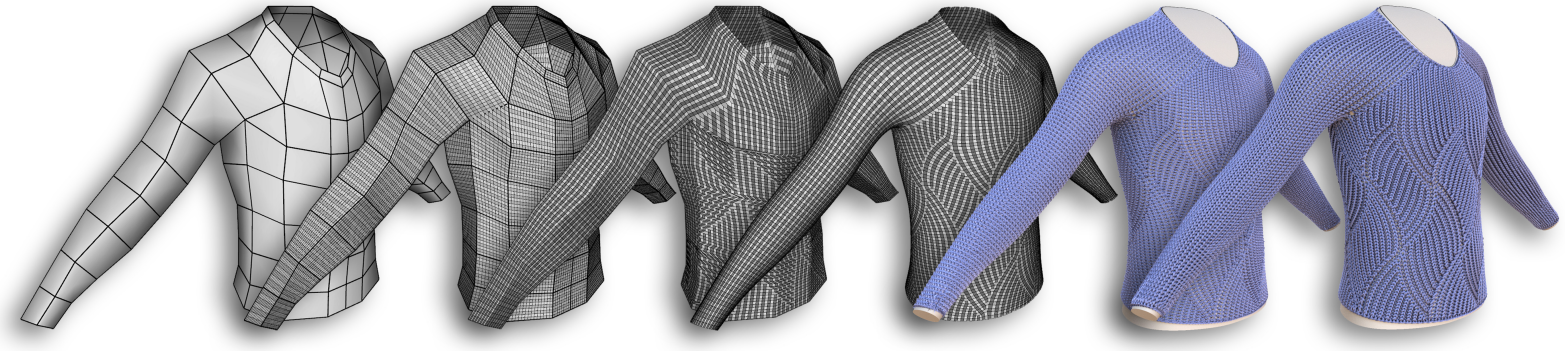

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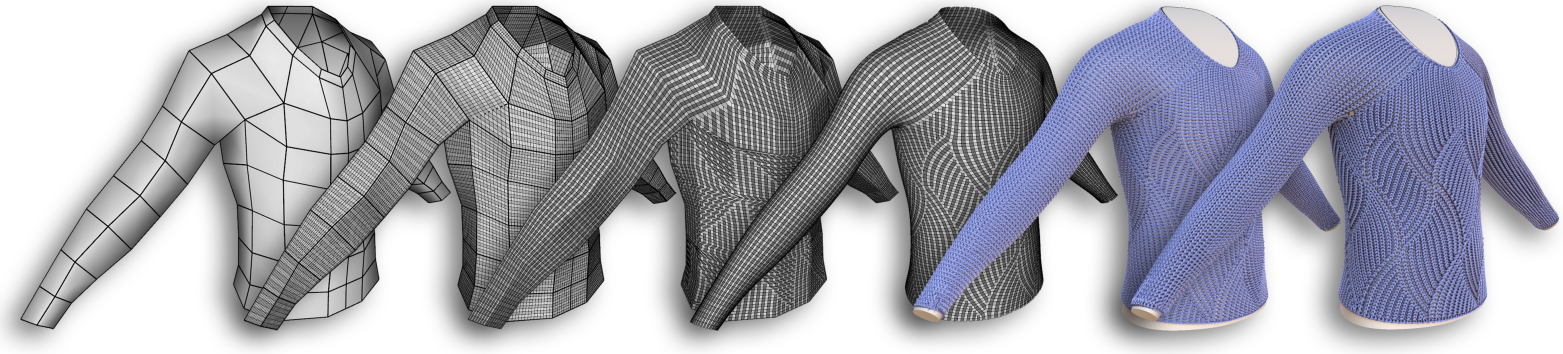

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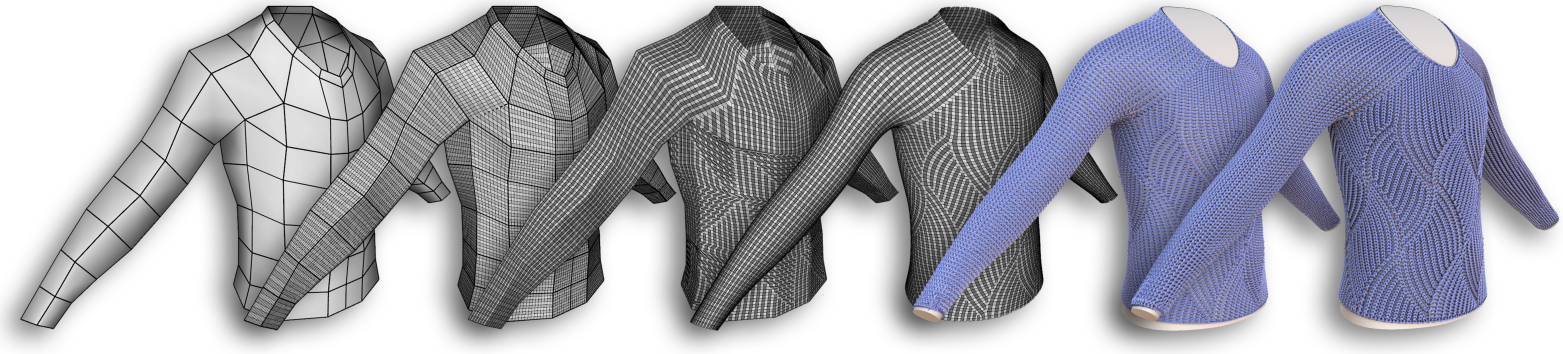

Overview

4. (Cheap) mesh-based relaxation

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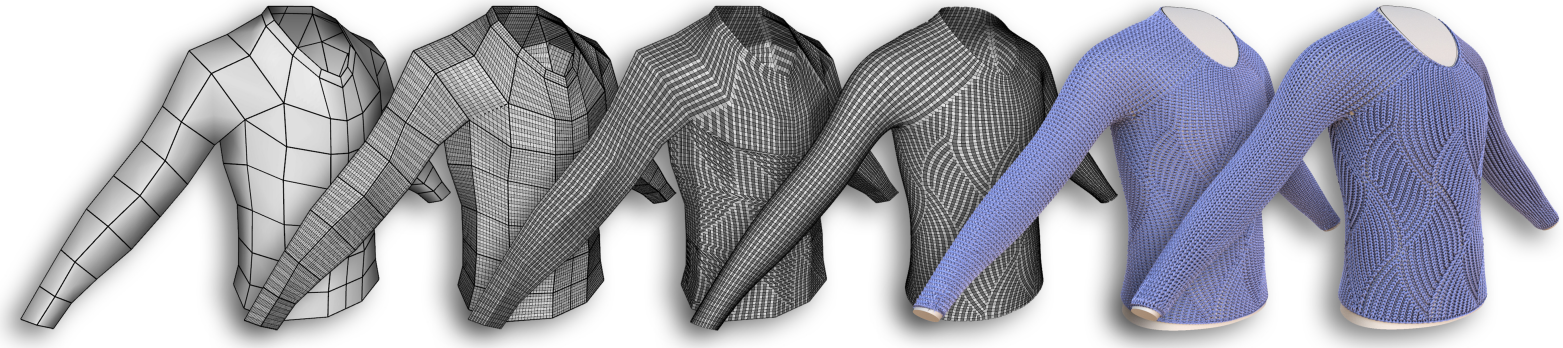

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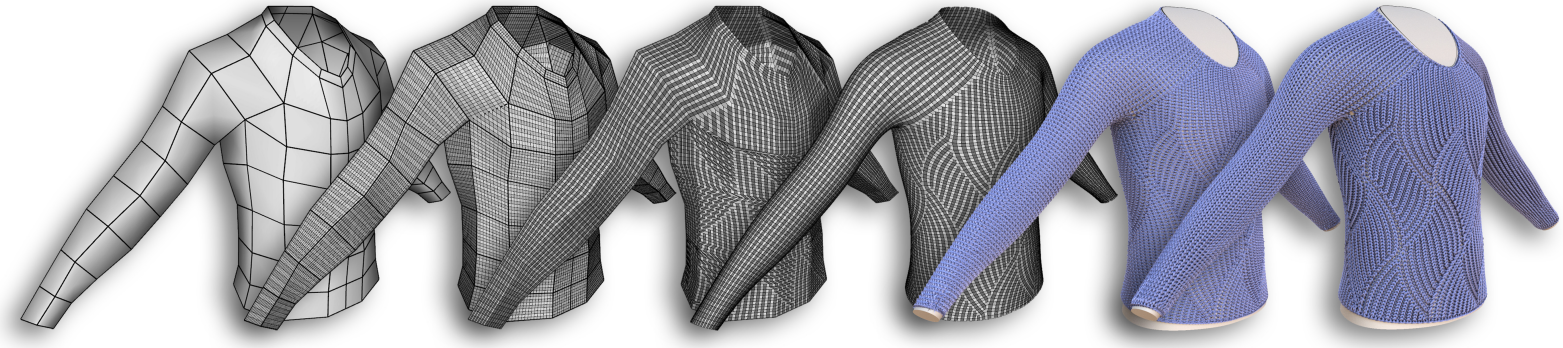
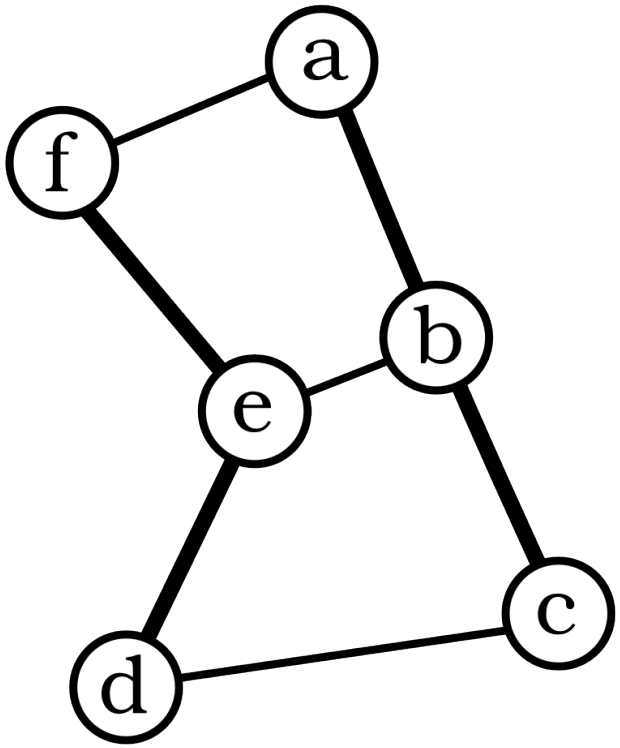


Overview

4. (Cheap) mesh-based relaxation
5. Yarn generation
6. (Expensive) yarn-level relaxation

Step 4: Mesh-based Relaxation

- Simulation of the stitch mesh only



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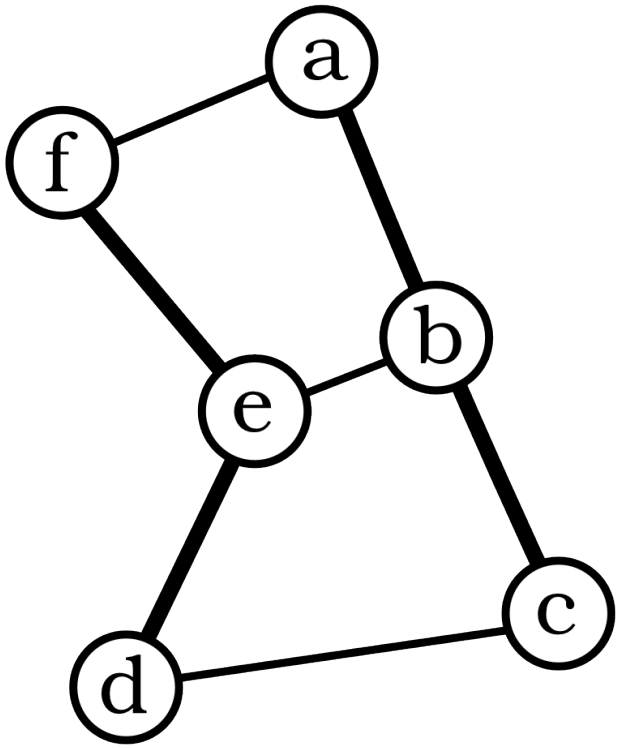
- Simulation of the stitch mesh only
- Define three forces:



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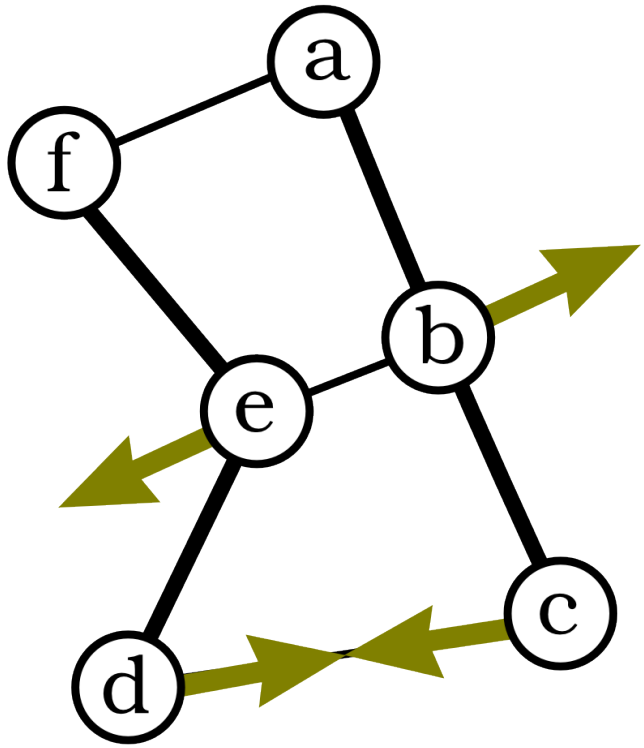

Step 4: Mesh-based Relaxation

- Simulation of the stitch mesh only
- Define three forces:
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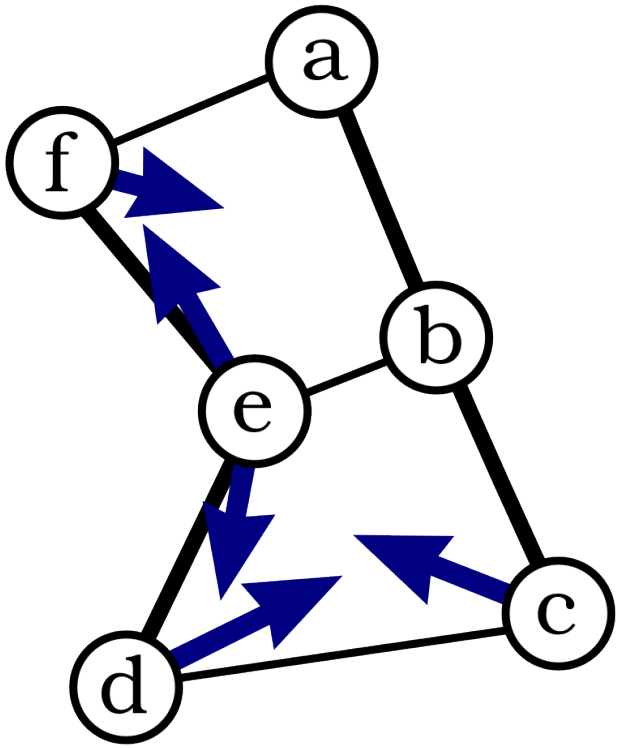

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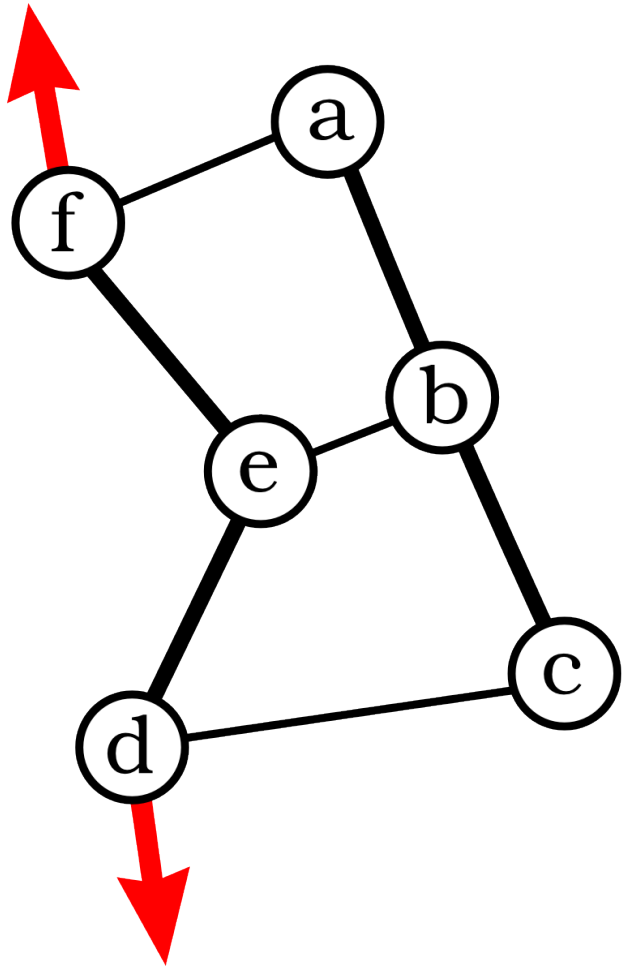

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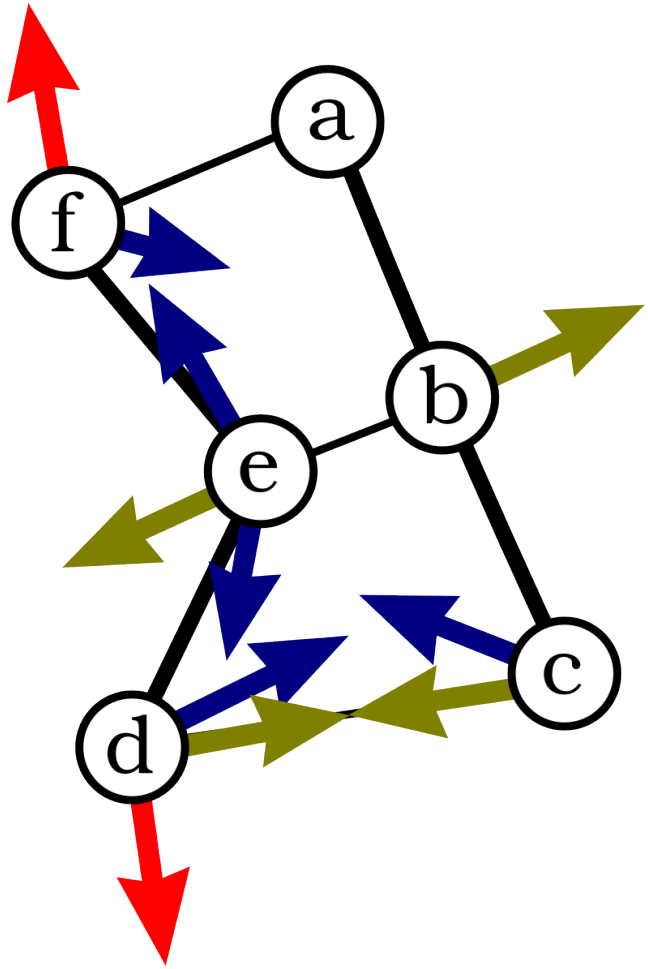

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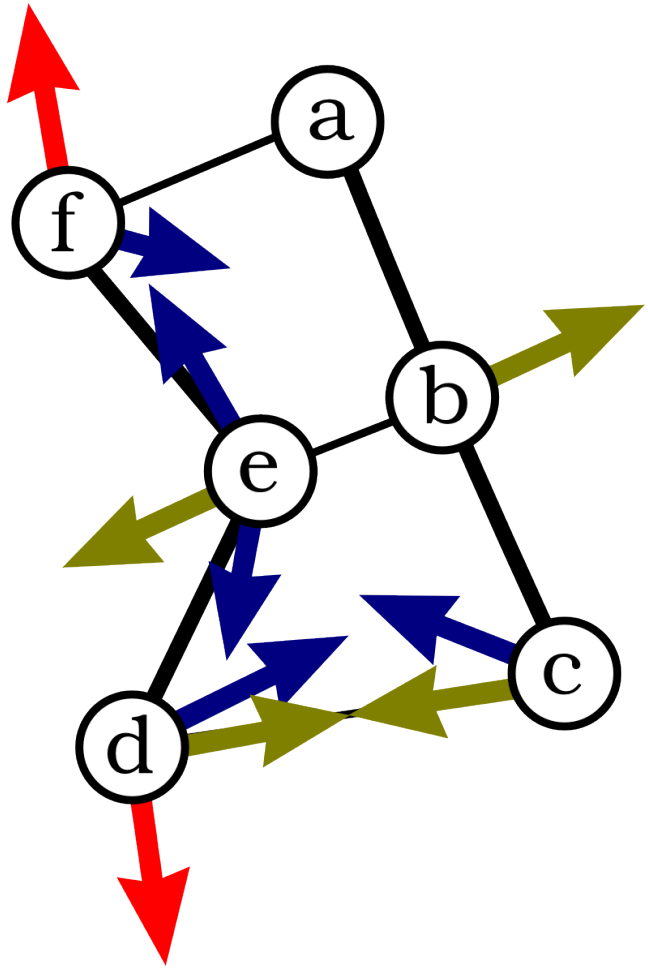
- Simulate this system until stable



Step 5: Yarn Generation

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3. Handle borders of the model.

Step 6: Yarn-level Relaxation

- Adaptive contact linearization

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- Without gravity

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- Adaptive contact linearization
- Without gravity
- Constraints for shape preservation

Finishing Up

- Perform relaxation until change per step falls below threshold

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- Perform relaxation until change per step falls below threshold
- Finally, perform a few steps with gravity to form wrinkles

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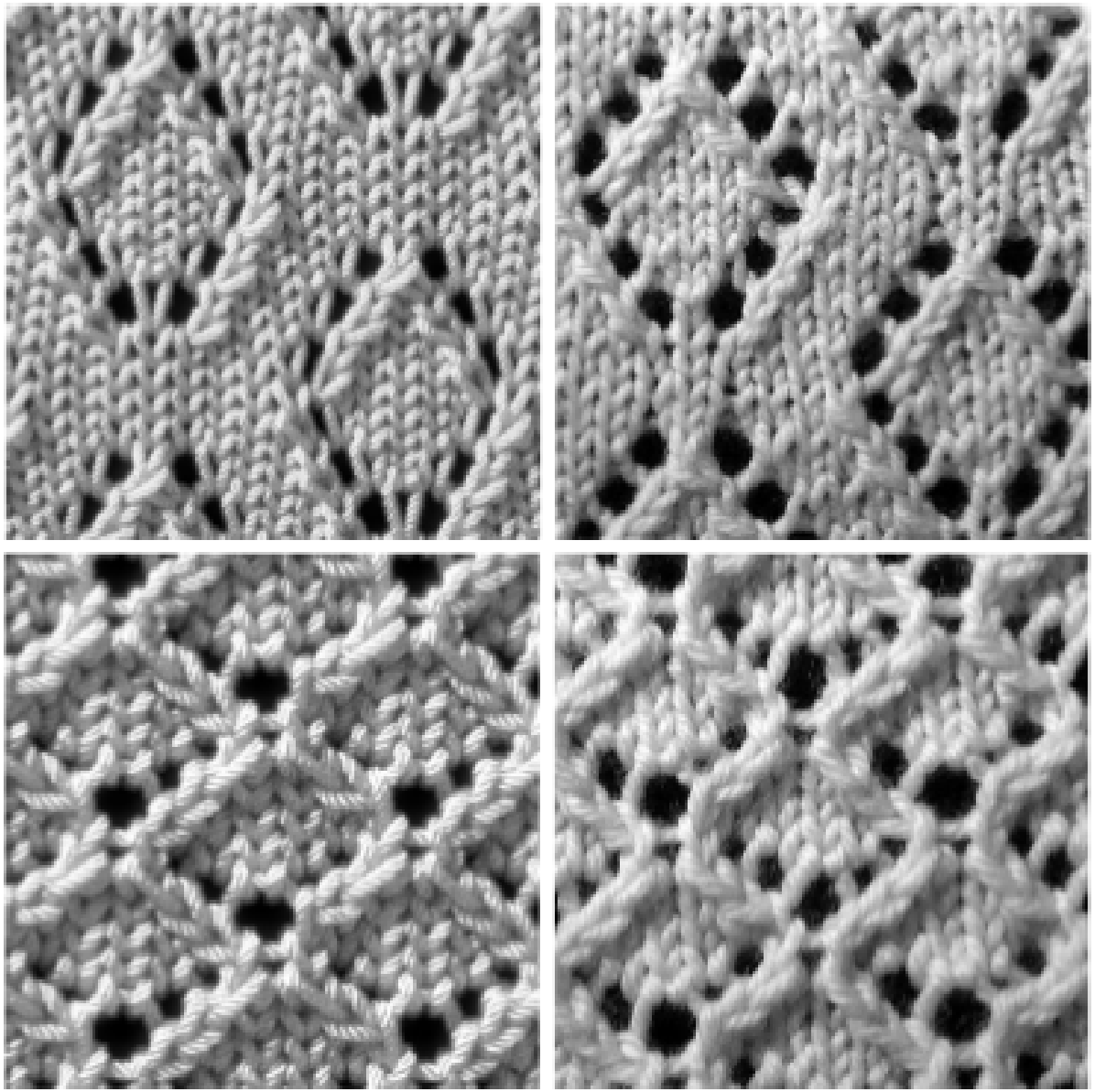
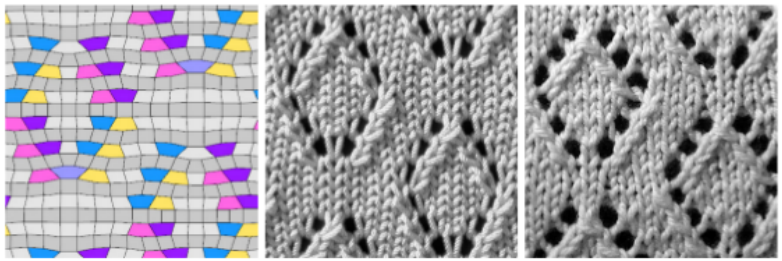
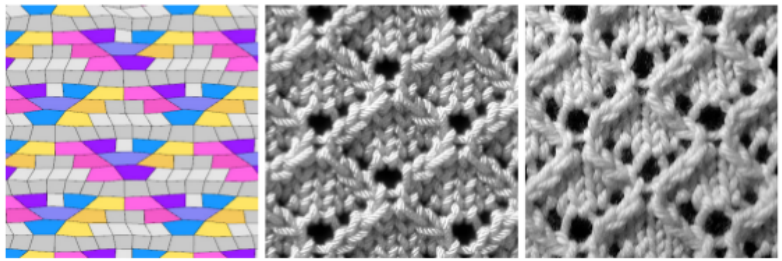
Guess: Photo or Rendering?



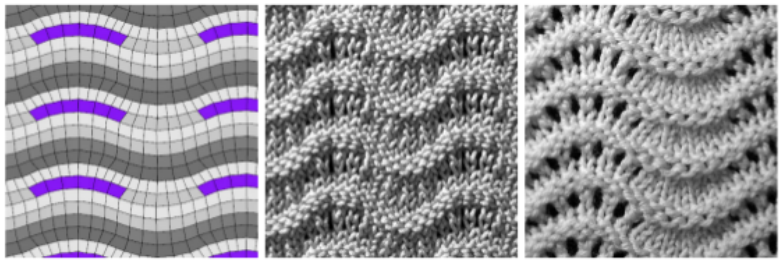
Details of Complicated Patterns



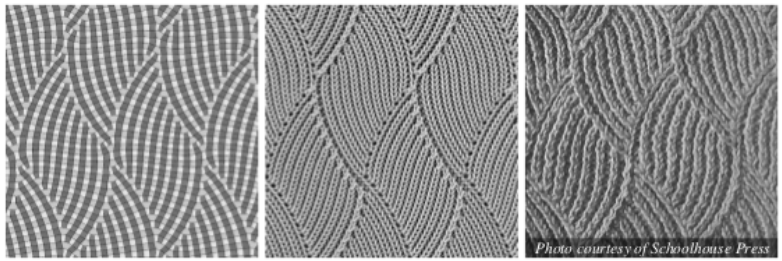
Mrs. Montague's Pattern [Matthews 1984]



Openwork Trellis Pattern [Matthews 1984]



Ridged Feather Pattern [Matthews 1984]



Flame Ribbing Pattern [Walker 2001]

Braid Cables Pattern [Allen et al. 2008]

Cable Work Pattern [Walker 2001]

Stitch Mesh color coding (odd rows are slightly darker): k p ky yk yky $d_{12}k$ $d_{21}k$

. . . as well as Full-scale Garments

Speed

Image	Stitch Faces	MBR time	YLR time

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Poncho	9,976	1 min.	1 hour

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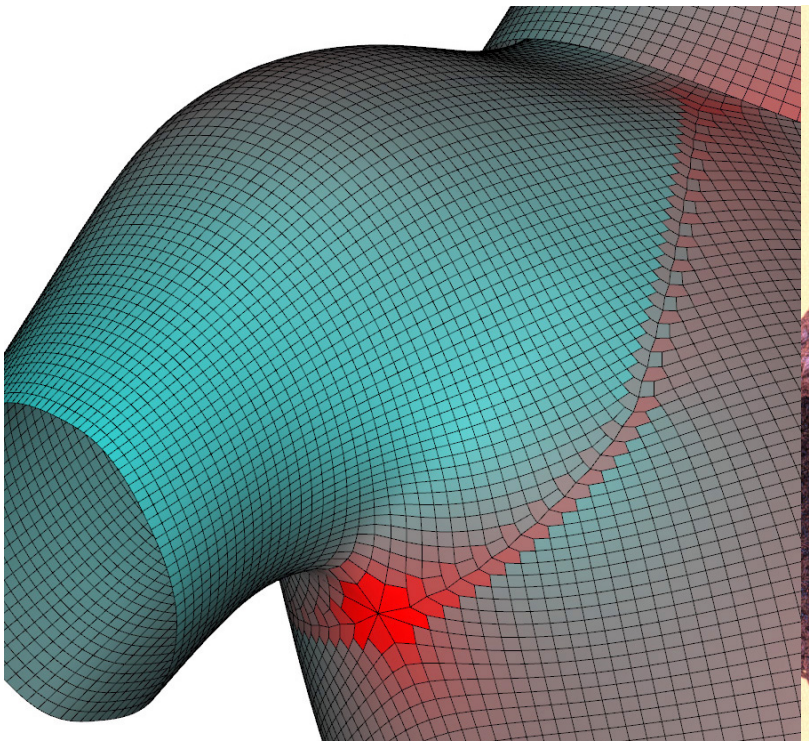
Limitations and Future Directions

- Slow yarn-level relaxation → speed it up, optimize for some patterns
- Tool requires a "sane" input mesh → allow any mesh
- Stitch mesh cannot handle layers (pockets) or stitched-together parts
- Stitches can be stretched apart or wrinkle → adapt number of stitches automatically



Q & A

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