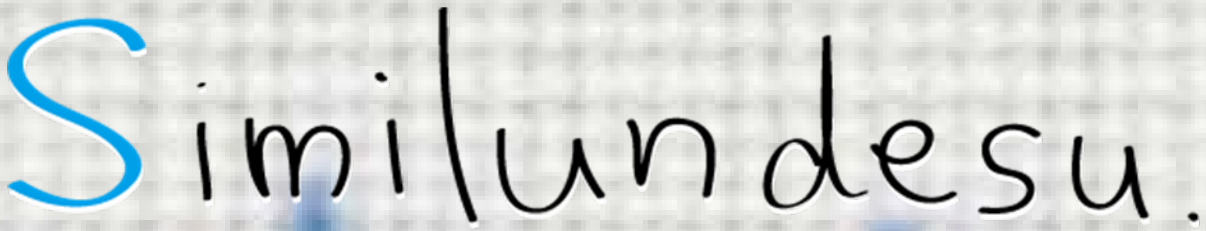
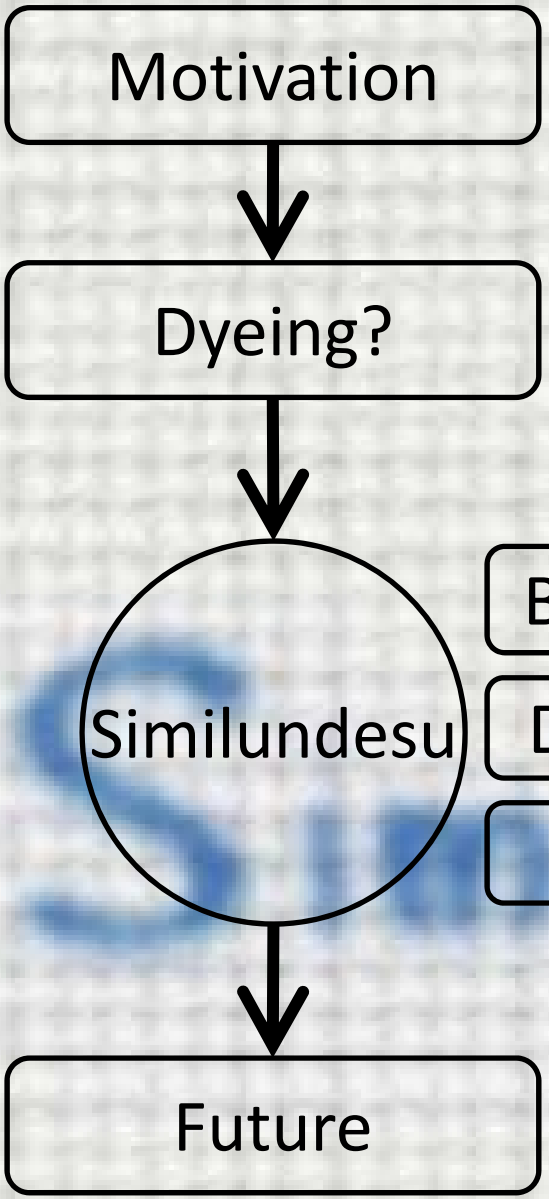
Development of Dyeing Pattern Simulator

(IPA Mitoh project: Final accomplishment report 2010/2/21)

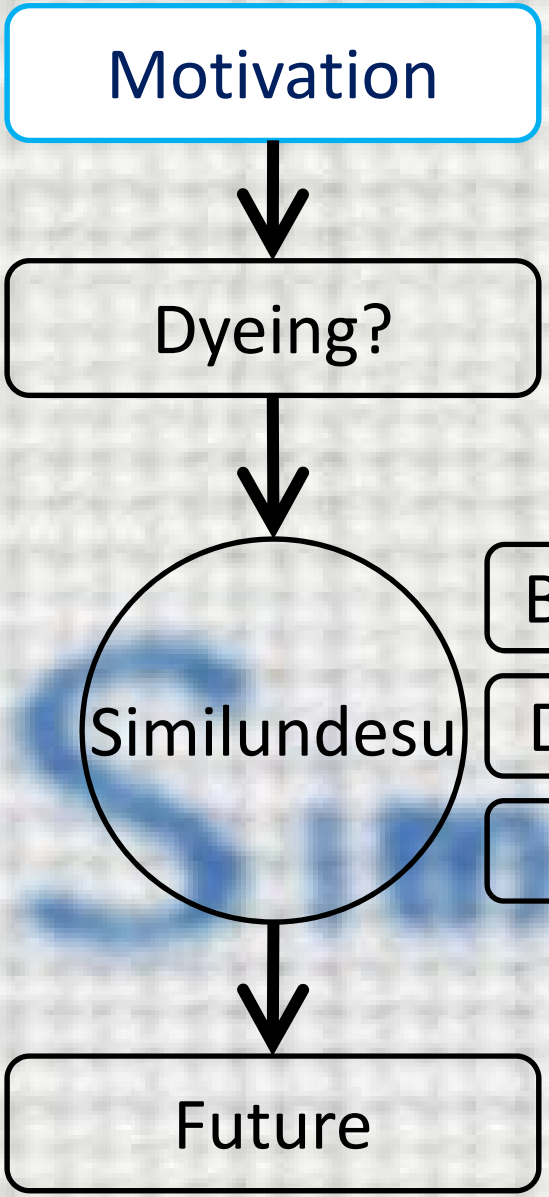


Yuki Morimoto



Similundesu.

Contents



Similundesu.

Contents

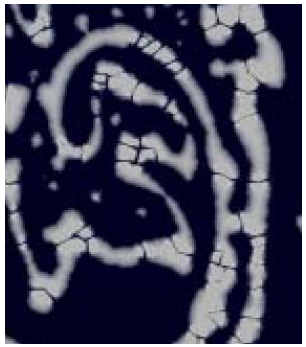
Similundesu is?

- Handcraft dyeing
  - Traditional, unique
    - Difficult to design
    - Difficult to make

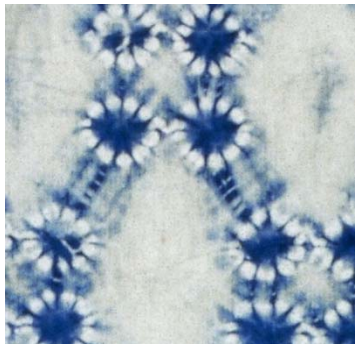
Simulation by PC

1. Pattern generation readily
2. Simulation for real dyeing
3. Promoting culture

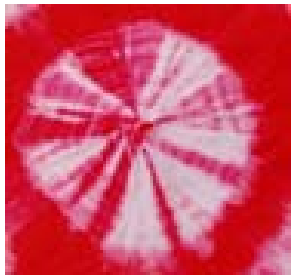
Yuzen



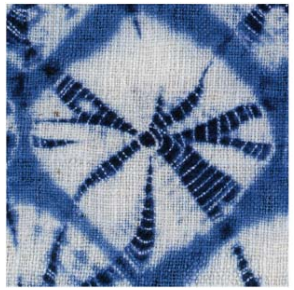
Batik



Shibori



Made by me
(non-expert)



expert

Same Kumo shibori

日本伝統絞りの技、榊原あさ子、紫紅社、1999.
日本の染織3　友禅染、丸山伸彦、京都書院美術双書、1993.

Name: “Similundesu”

- I love “Utsurun desu”
  - Comic book
  - Means “It infect“
  - “Similundesu” means “It diffuse”

- Global : “Similundesu”
  - Simulation, Dye, ……Simulation.
- Short name: “Similun”

“Similundesu” Dyeing pattern simulator

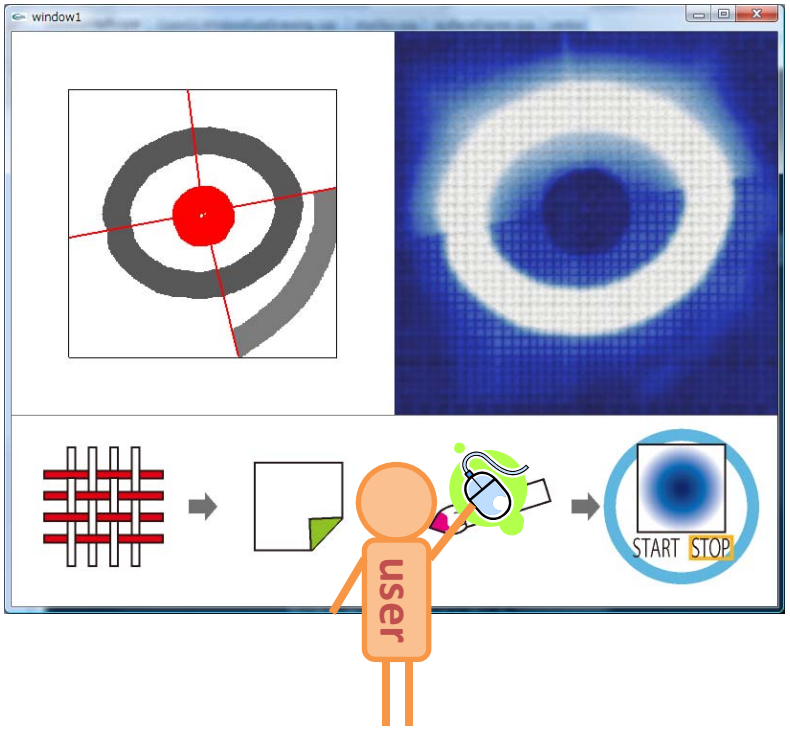
Basic CG tech for visual simulation of dyeing

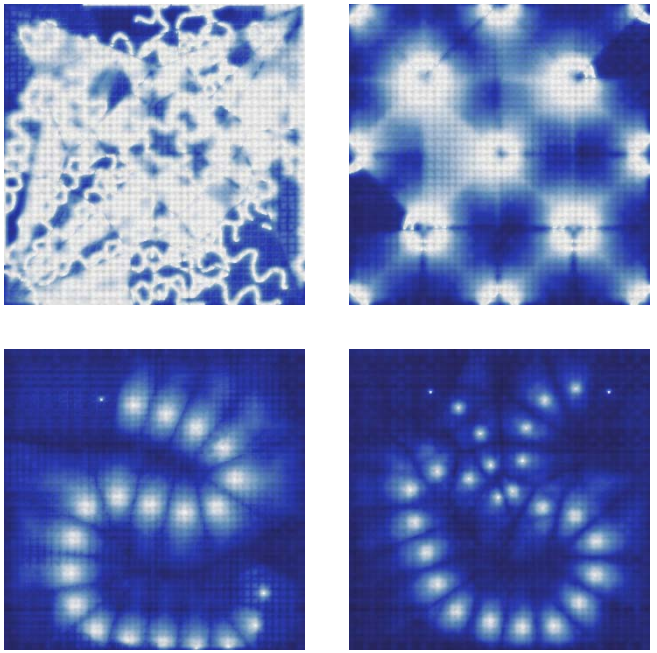
+

Variable dyeing tech

Development of its application software

Achieve!





Creation time: 5 min

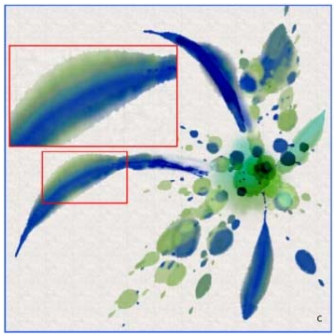
Target

1. Pattern generation readily
2. Simulation for real dyeing
3. Promoting culture (our aims)

- New computer graphics
- Non-expert for dyeing
- Designer
- Schools
- People who is curious about traditional culture

Rerated works

- research
- software
- service

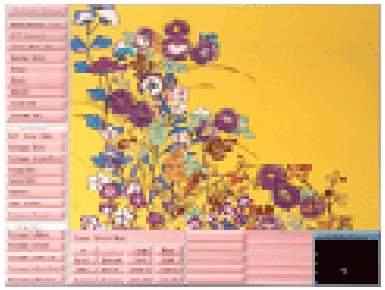


Watercolor[Curtis 1997], Chinese Ink[Chu 2005], Batik[Wyvill 2004]

水彩画風フィルタ
Adobe Photoshop

Art Brush
Adobe Illustrator

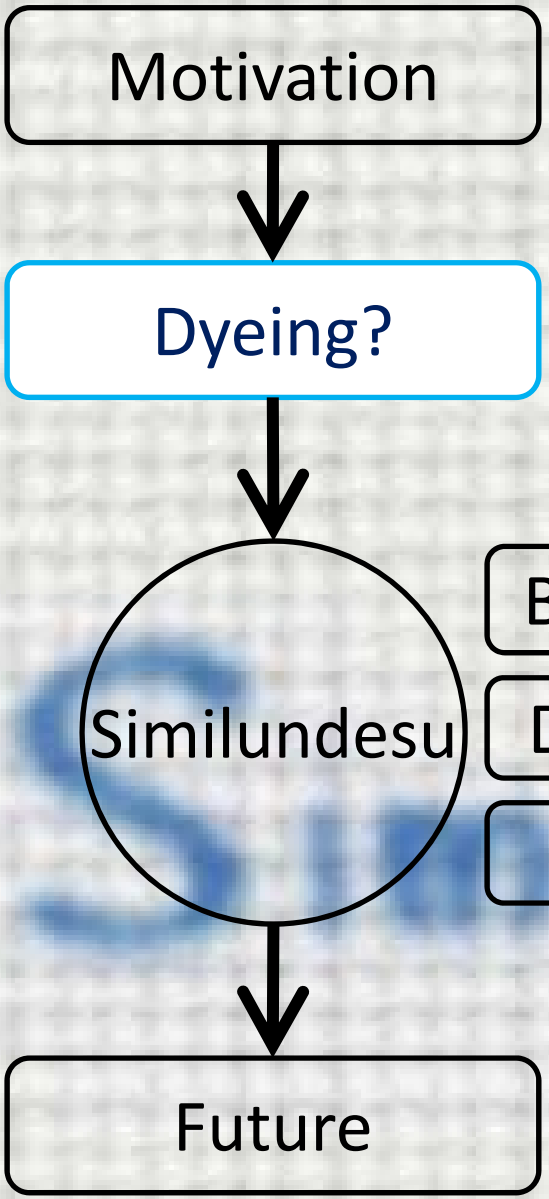
No dyeing pattern simulators



Extraction of stencil from design data
Armonics Co., Ltd.

Difficulties

- No 3D cloth structure in the related works
- Folded and woven Complicated cloth geometry
- Simultaneous physical phenomenon (dye transfer)
- Real dyeing tech. is varied
- Design by user
- Handmade and geometric factors
- World first! dyeing pattern simulator



Similundesu.

Contents

Dyeing (Top: Yuzen, Bottom: Shibori)

1. Prepare 2. Resist 3. Give dye 4. Dye transfer #Dyeing pattern

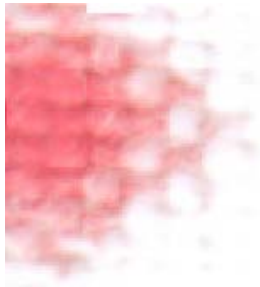
Cloth, dye, etc

Glue

Draw

Fold, bind, stitch, etc

Dip-dyeing



Diffusion, adsorption

[Drago 2004]

Dyeing (Top: Yuzen, Bottom: Shibori)

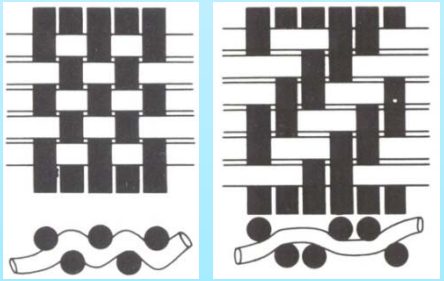
1. Prepare 2. Resist 3. Give dye 4. Dye transfer #Dyeing pattern

Cloth, dye, etc

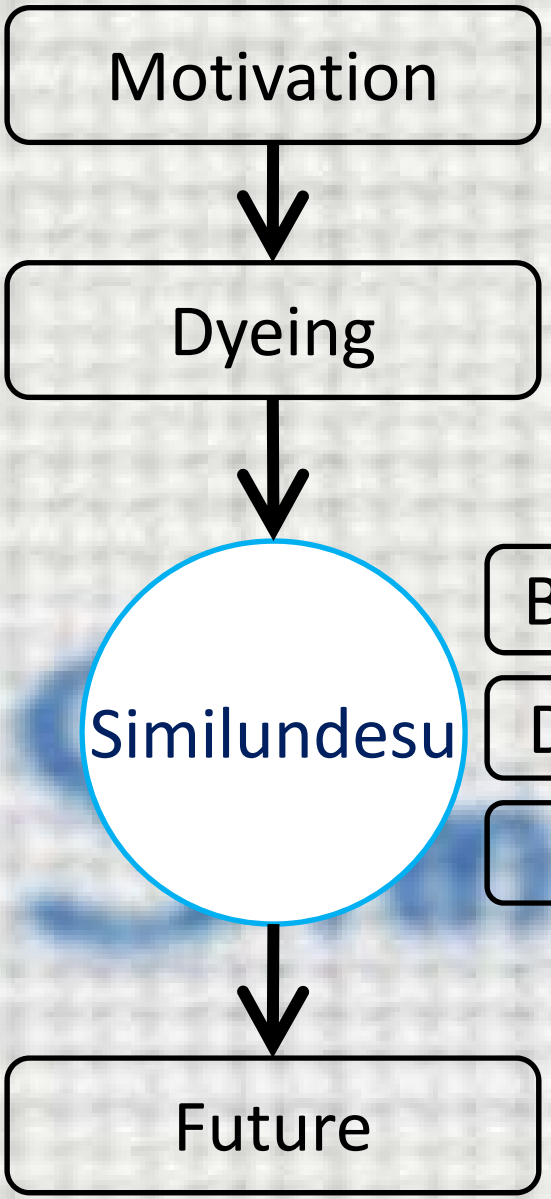
Dyeing tech
↓
Design patterns

Physical factor (Cloth, dye, etc)

Diffusion



Weave



Similundesu.

Contents

Dyeing pattern simulator Similundesu

Dyeing tech

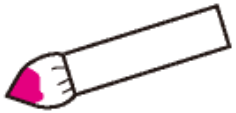
Physical factor

1. Weave

2. Fold

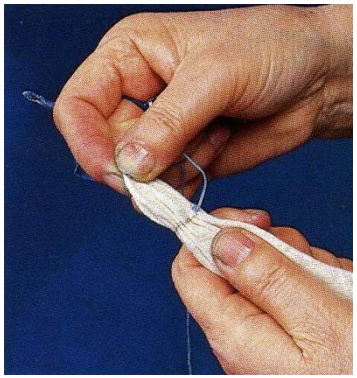
3. Draw

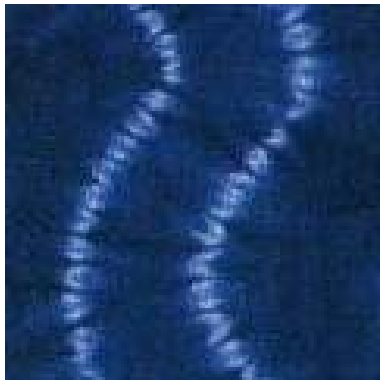
4. Simulation <dye transfer>



<Demo>

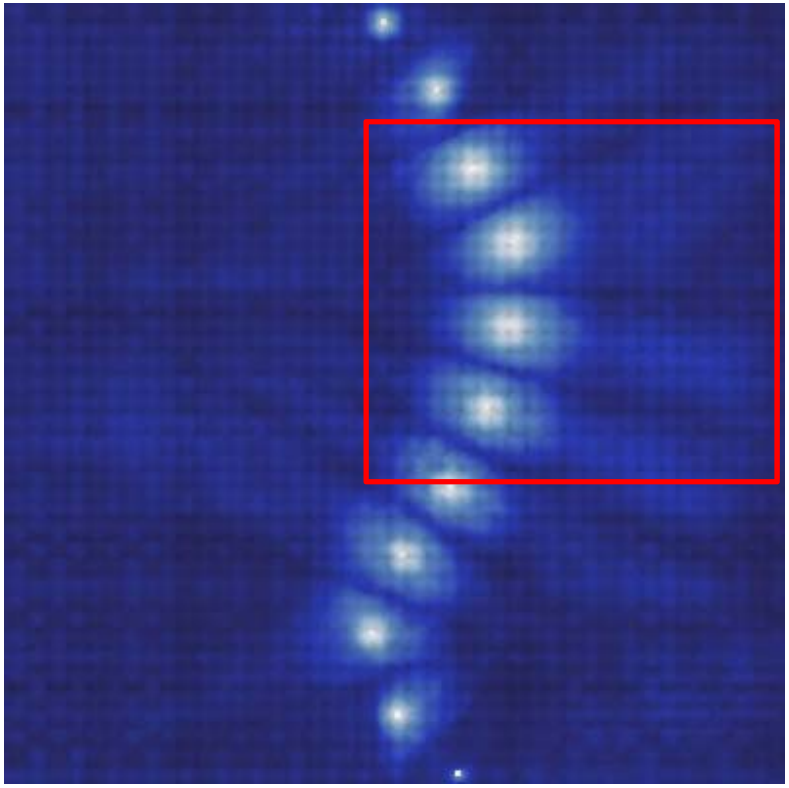
Introduction & making a pattern bellow



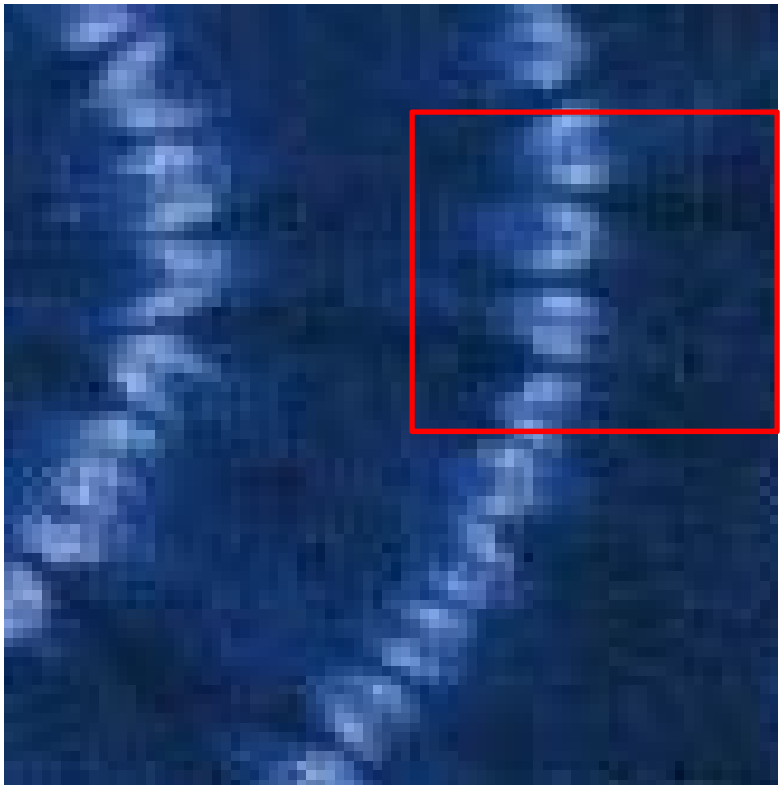


Nui shibori: stitched and diped into dyebath
(We assume wrinkles are small folds)

Dyeing pattern simulator Similundesu



Our result



Read dyed stuff

Comparison of Nui shibori

Correspondence between our simulator & real process

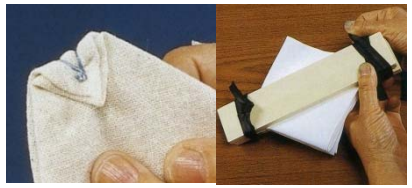
①布準備　②防染する　③染料付与　④染料移動

織り

縫い

折り

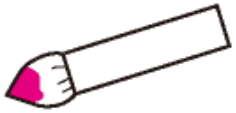
Cover/
糊置き、ビニール



Press/
縫い、板締め

Dye/染料

浸染

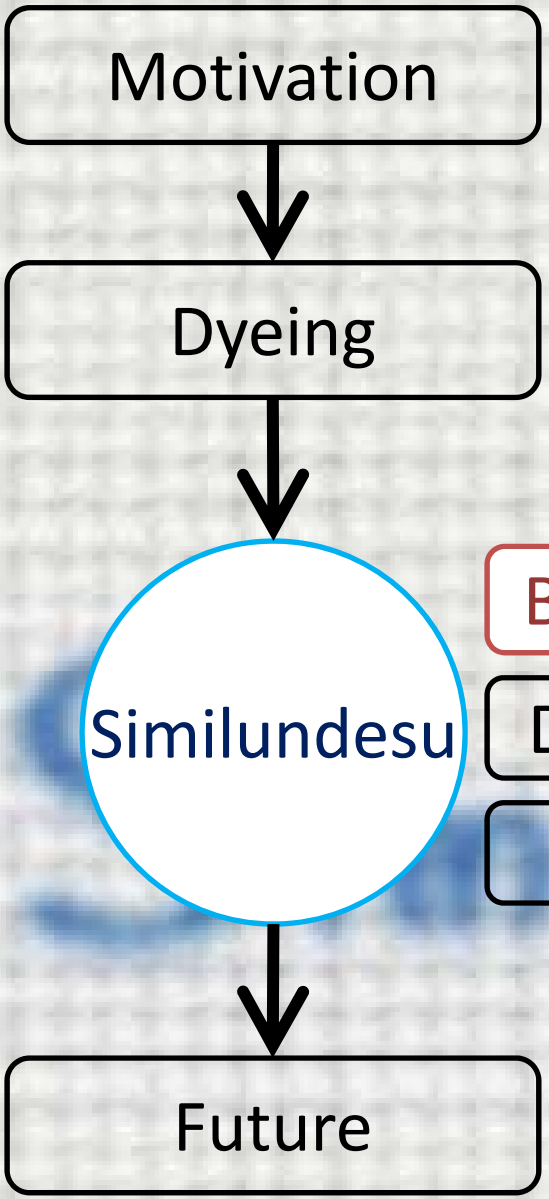


1. Cloth

2. Fold
縫い・折り・読込

3. Draw
Press・Cover・Dye

4. Simulation



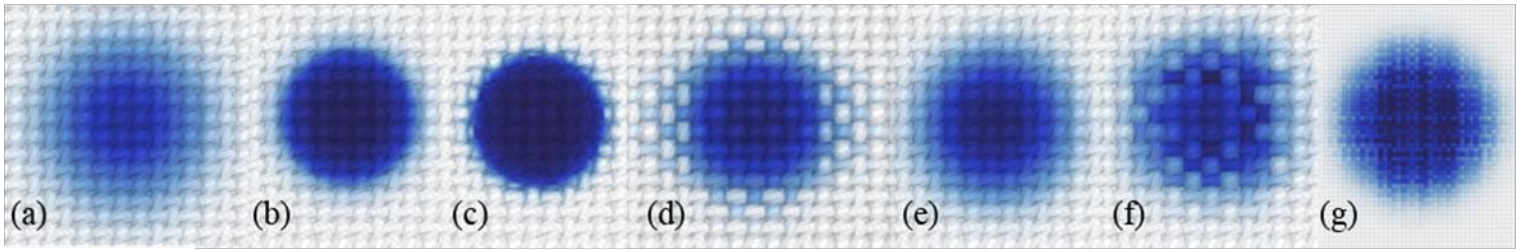
Similundesu.

Contents

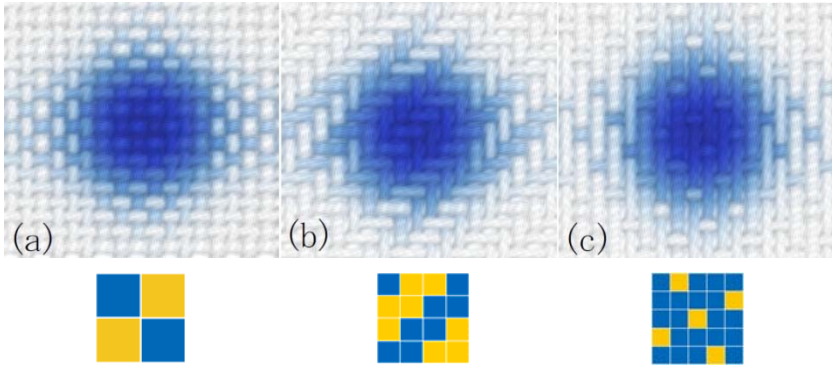
- Basic model
- Dyeing tech
- Appli

Basic physical dyeing model

– Samples



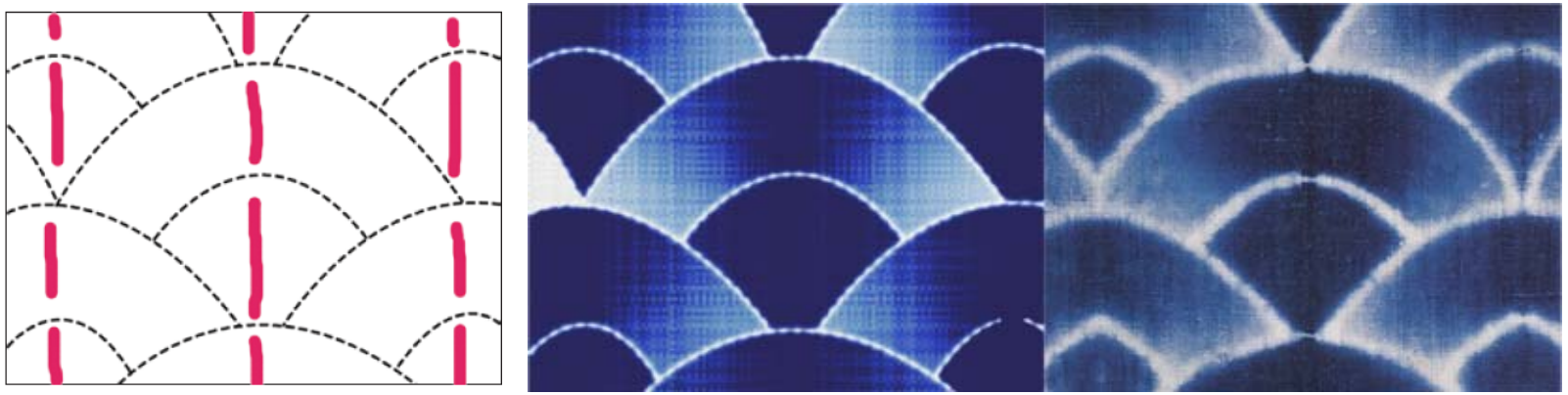
Results with various tortuosity, porosity, and adsorption coefficient.



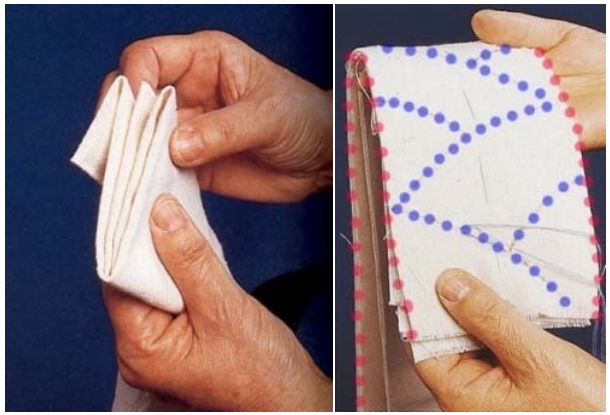
Results with different weaves.

Basic physical dyeing model

– Seikaiha pattern

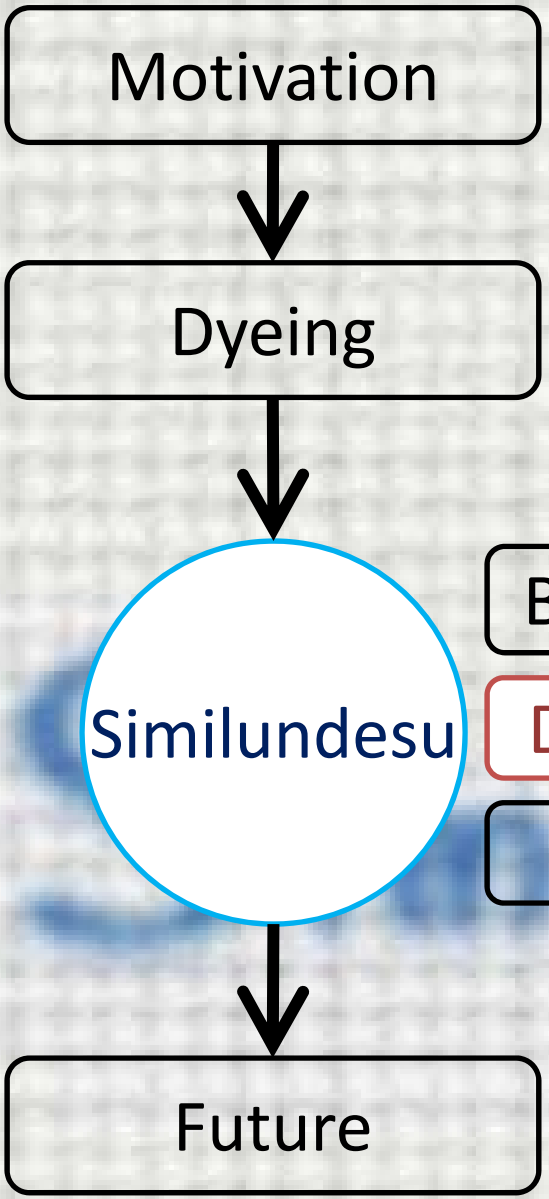


2D distributions of dye and resist, its result, and real dyed pattern [video]



How to make Seikaiha

1. Fold a cloth
2. Stitch along to the blue dots in the left figure, and resist both wide sides of the folded cloth
3. Dip it into dye



Similundesu.

Contents

- Basic model
- Dyeing tech
- Appli

Dye transfer model

Dye Transfer Model $\frac{\partial f(\mathbf{x},t)}{\partial t} = \nabla \cdot (D(\mathbf{x})\nabla f) + g_1(\mathbf{x},f) - g_2(\mathbf{x},f)$

拡散　供給　吸着

- Diffusion Term
  - With our Diffusion Graph (new proposal)
  - f(x, t)= diffusion dye concentration
- Dye supply Term
  - With our Dye Supply Map (new proposal)
  - α0= user specified, α(x)= dye supply map

$$g_1(\mathbf{x},f) = \begin{cases} \alpha_0\alpha(\mathbf{x}) & \text{if } \alpha(\mathbf{x}) - f(\mathbf{x},t) > 0. \\ 0 & \text{Otherwise,} \end{cases}$$

- Absorption Term
  - With Dyeing theories
  - β= user specified value, h(x, t)= absorption concentration,
  - ad(x, f)= adsorption model defined as theories,
  - Cd= capacity of diffusion concentration,
  - Ca= capacity of adsorption concentration.

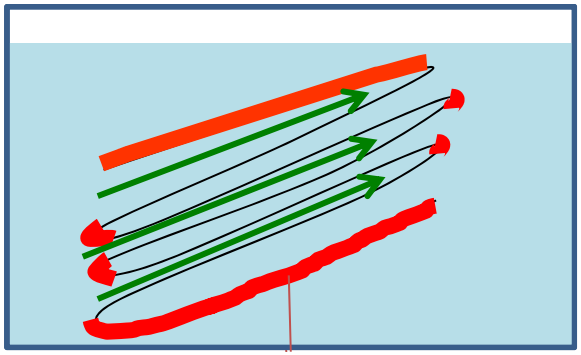
$$g_2(\mathbf{x},f) = \begin{cases} \beta f(\mathbf{x},t) & \text{if } h(\mathbf{x},t) < a_d(\mathbf{x},f). \\ 0 & \text{Otherwise,} \end{cases}$$

$$\frac{\partial h(\mathbf{x},t)}{\partial t} = g_2(\mathbf{x},f)\frac{C_d(\mathbf{x})}{C_a(\mathbf{x})}$$

Discretize the eq. according to the cloth geometry

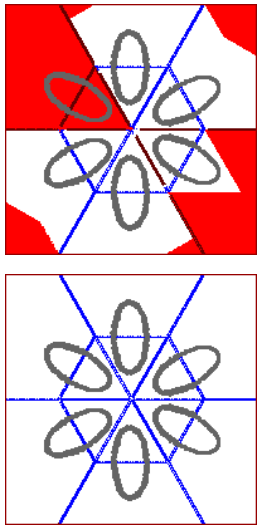
Dye supply map for dip-dyeing

Dip-dyeing

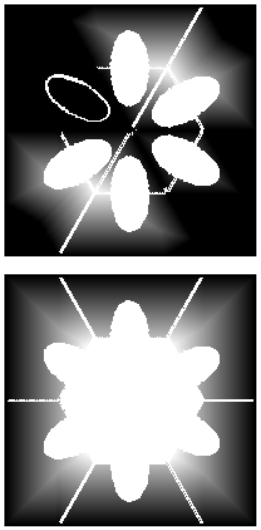


Outside parts
exposed to dyebath

Ex. Flower resist



Geometric feature

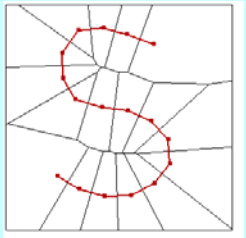


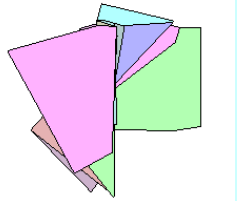
Distance fields

3D geometry

2D distribution

Broken geometry can be simulated.

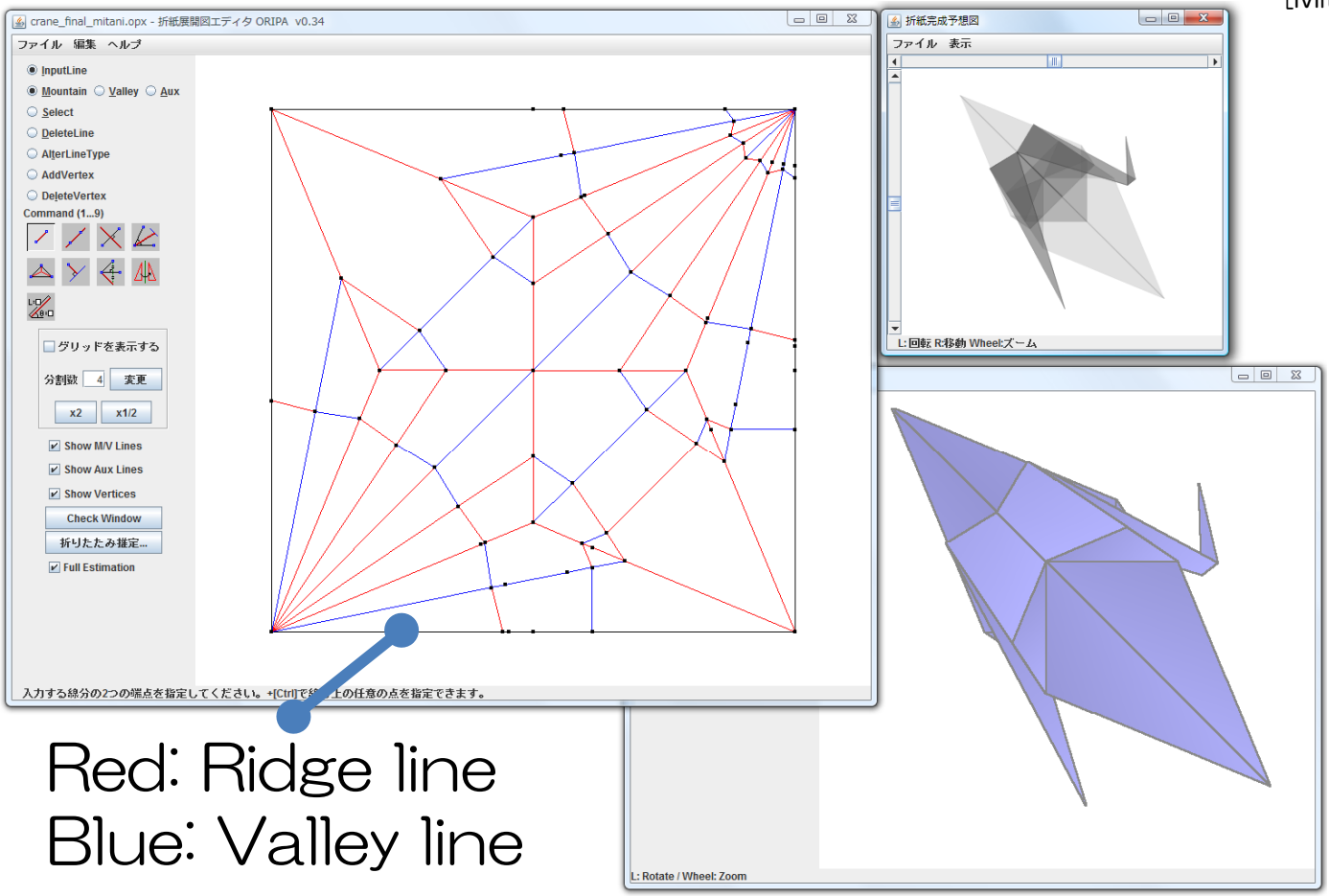




Fold function 1: ORIPA

: free editor for development view of Origami

[Mitani 2008]

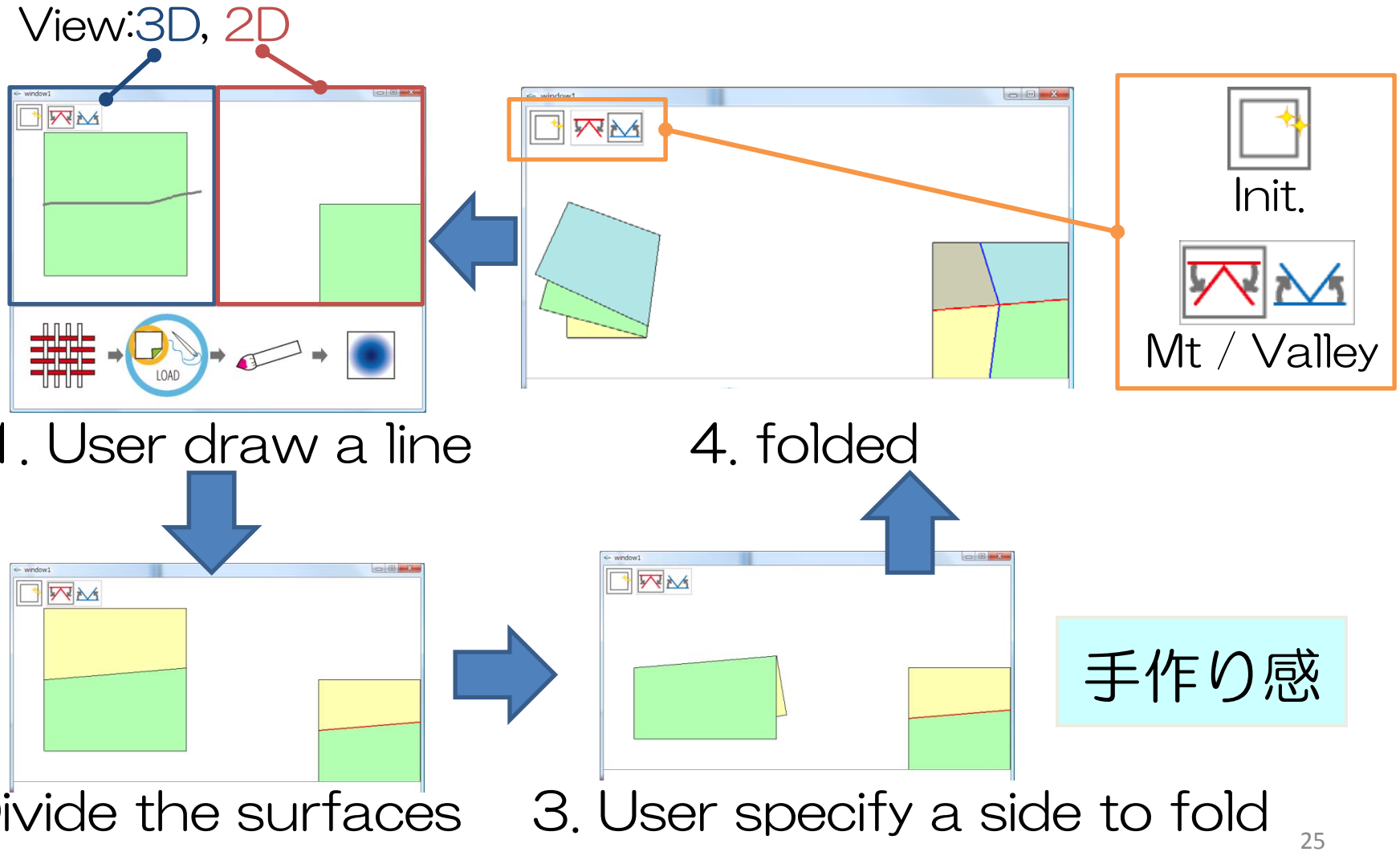


Red: Ridge line
Blue: Valley line

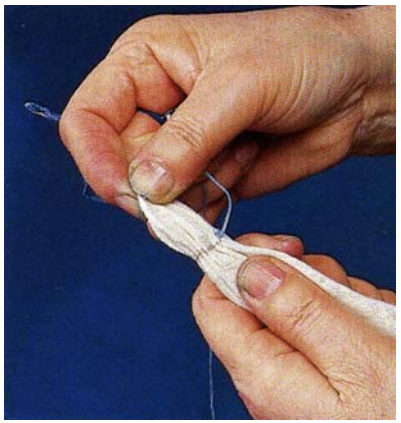
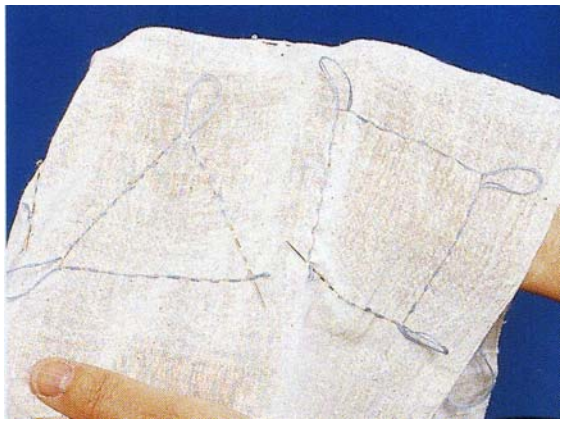
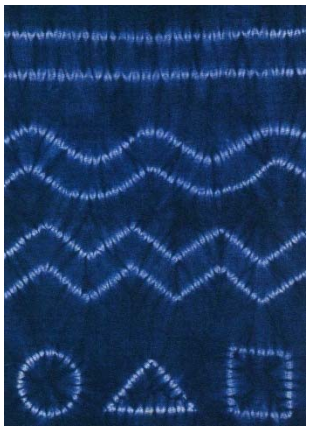
http://mitani.cs.tsukuba.ac.jp/pukiwiki-oripa/

Fold function 2: Sequential fold

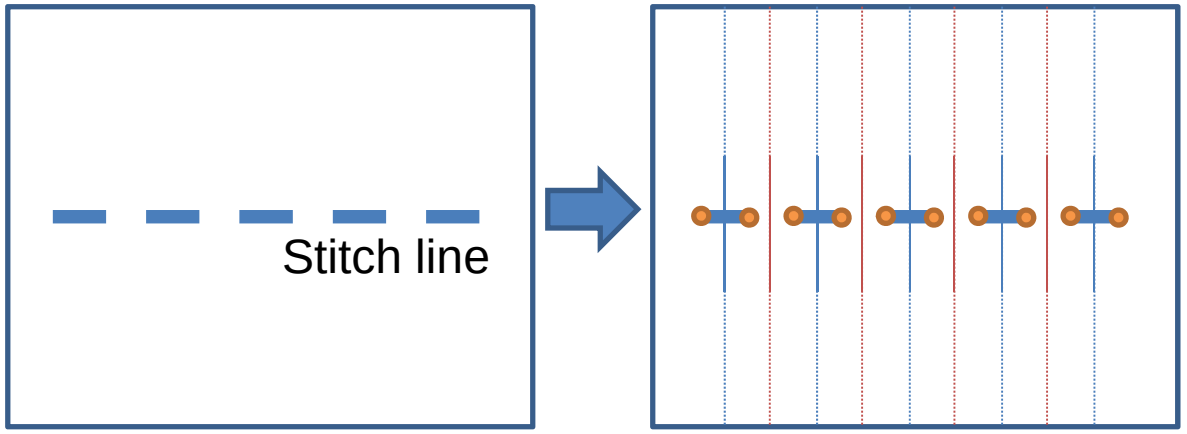
User specify lines to fold cloth sequentially

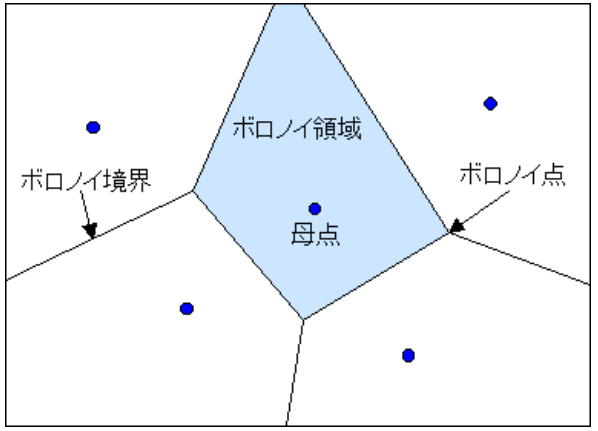


Fold function 3: Stitch

cloth

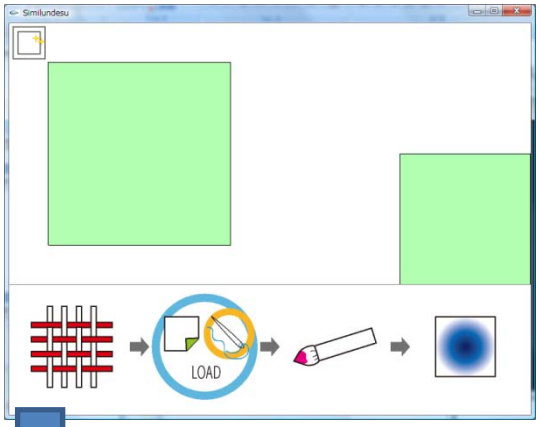




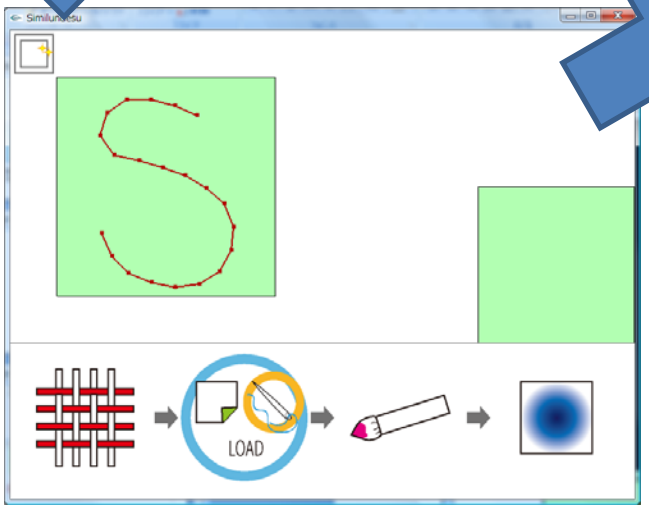
Voronoi diagram

Fold function 3: Stitch

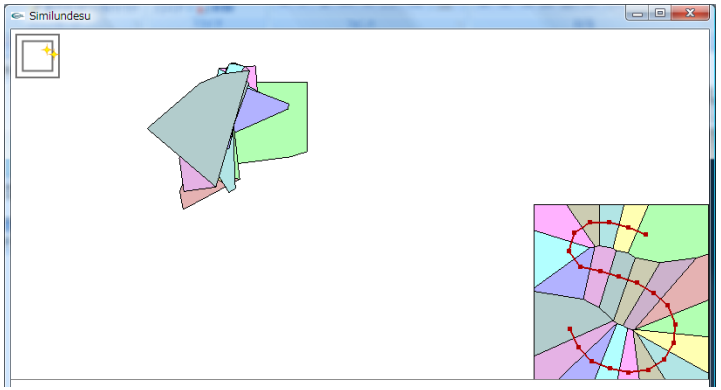
Generate 3D geometry by a user specified stitched line



Initial screen

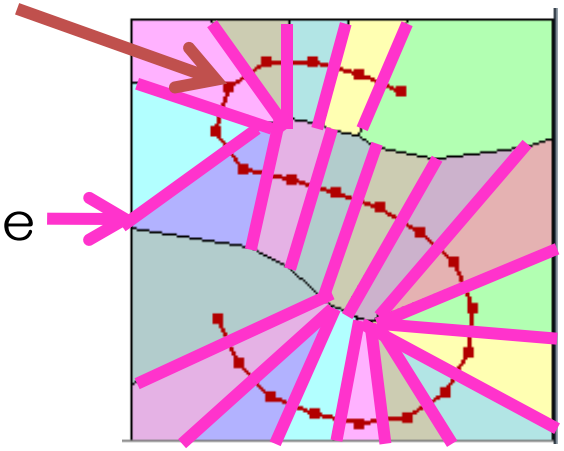


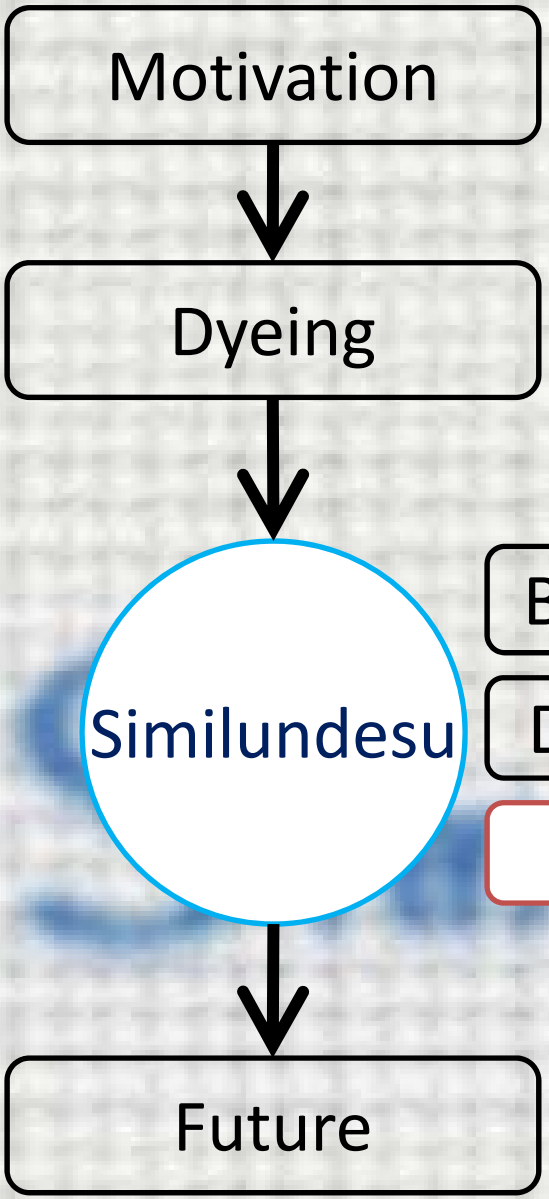
1. User draws a stitched line



2. Segment the cloth By voronoi diagram assuming pinholes as points

Folding line





Similundesu.

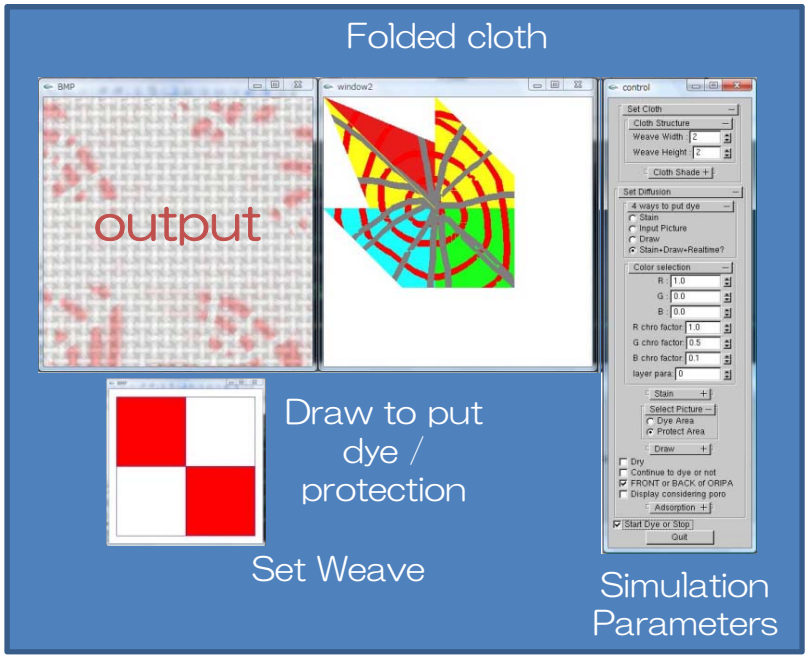
Contents

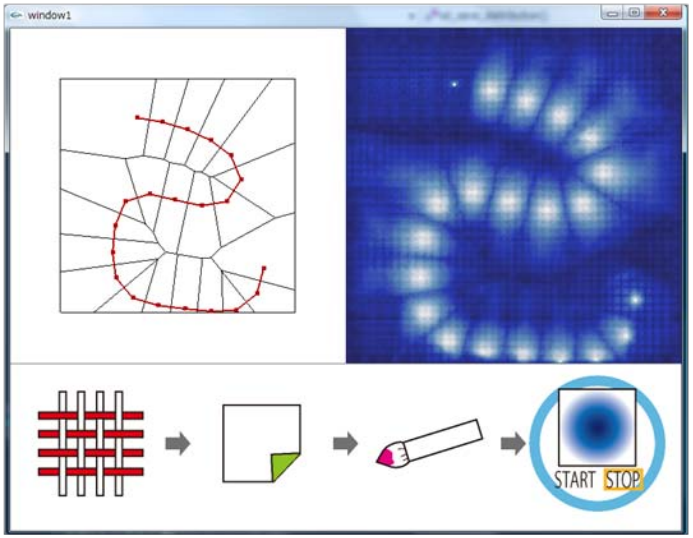
- Basic model
- Dyeing tech
- Appli

Development of appli.

- Speeding up
  - Simplify some parts of physically-based calculation
  - Develop UI and add some functions

Unify its window and control



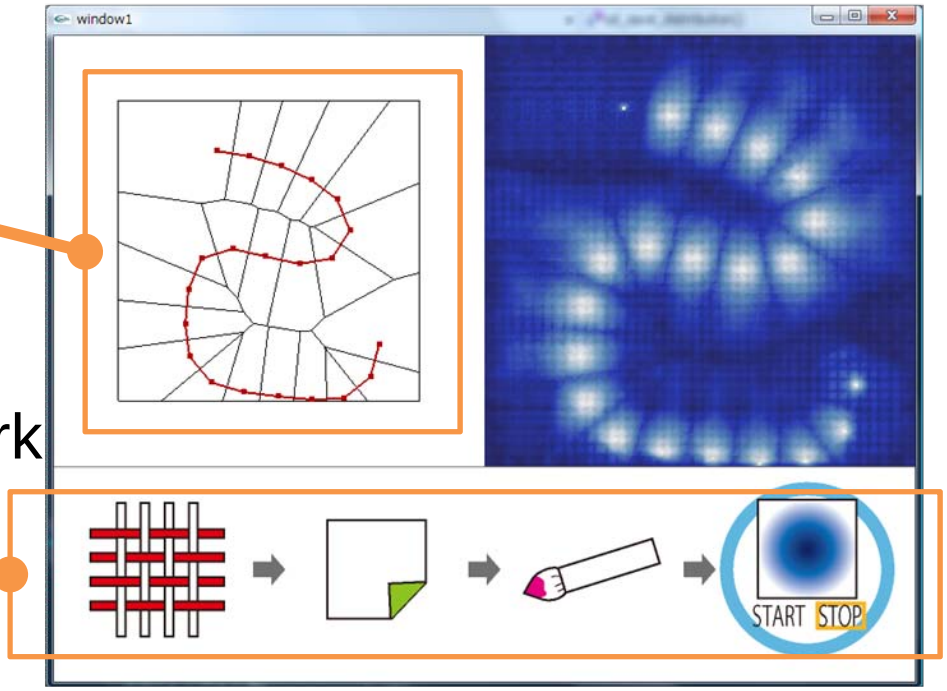


Development of appli.

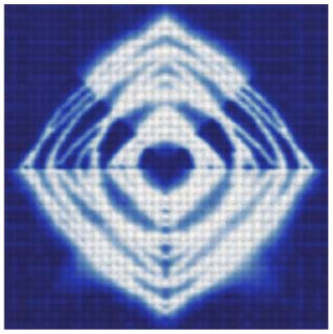
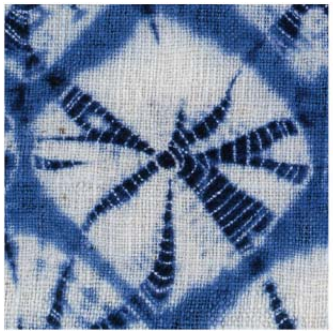
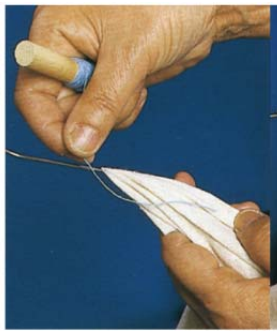
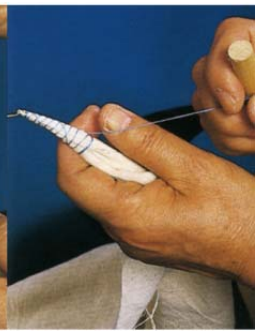
- Develop UI and add some functions
  - <Demo video>

Design diagram for real dyeing

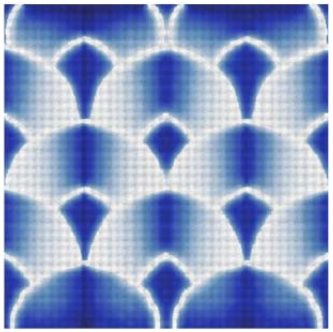
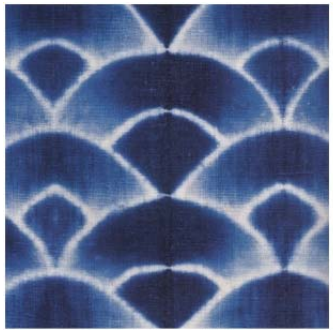
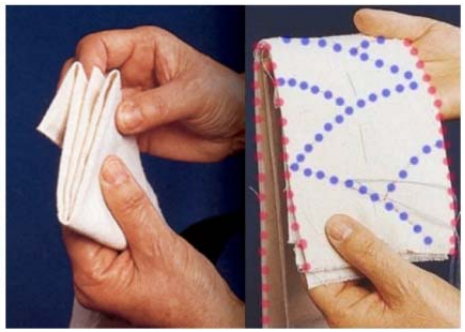
Buttons indicating the framework & functions



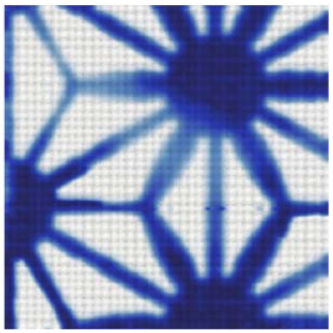
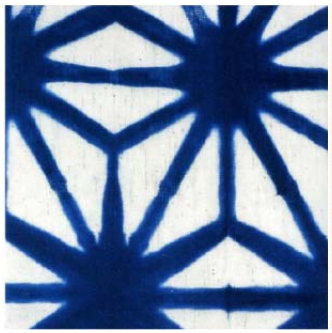
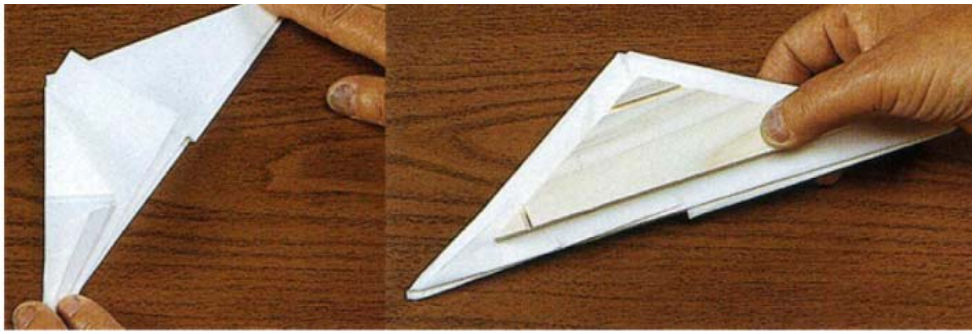
Output result

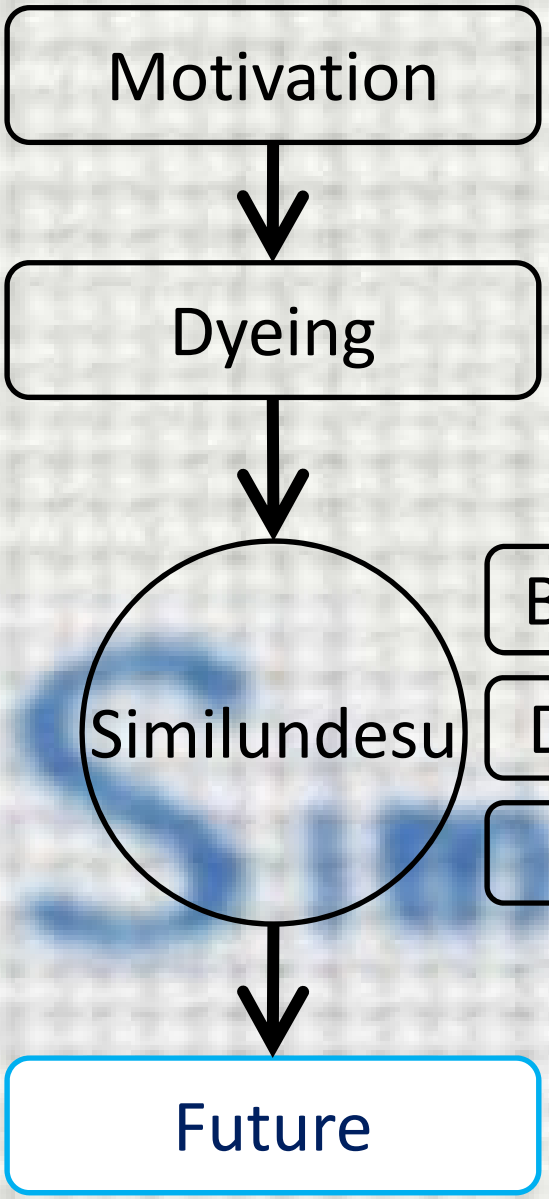
<Video>

Top) Kumo shibori
Center) Seikaiha
Bottom) Itajime

Simulation Real How to make

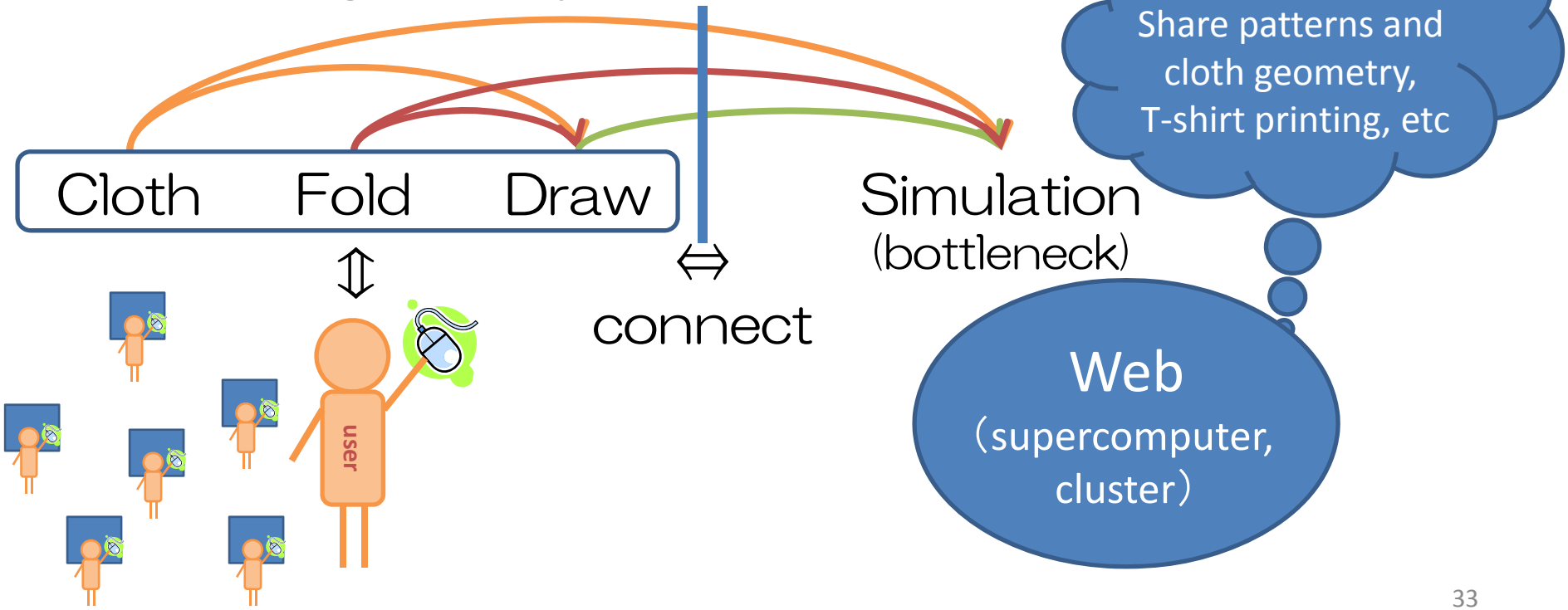


Similundesu.

Contents

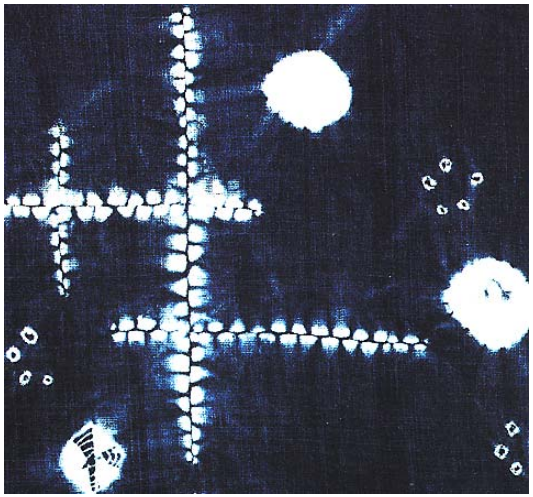
Future <Web appli>

- Meaning
  - Dyed patterns are all unique.
  - Promotion of traditional culture.
- Building web system



Future

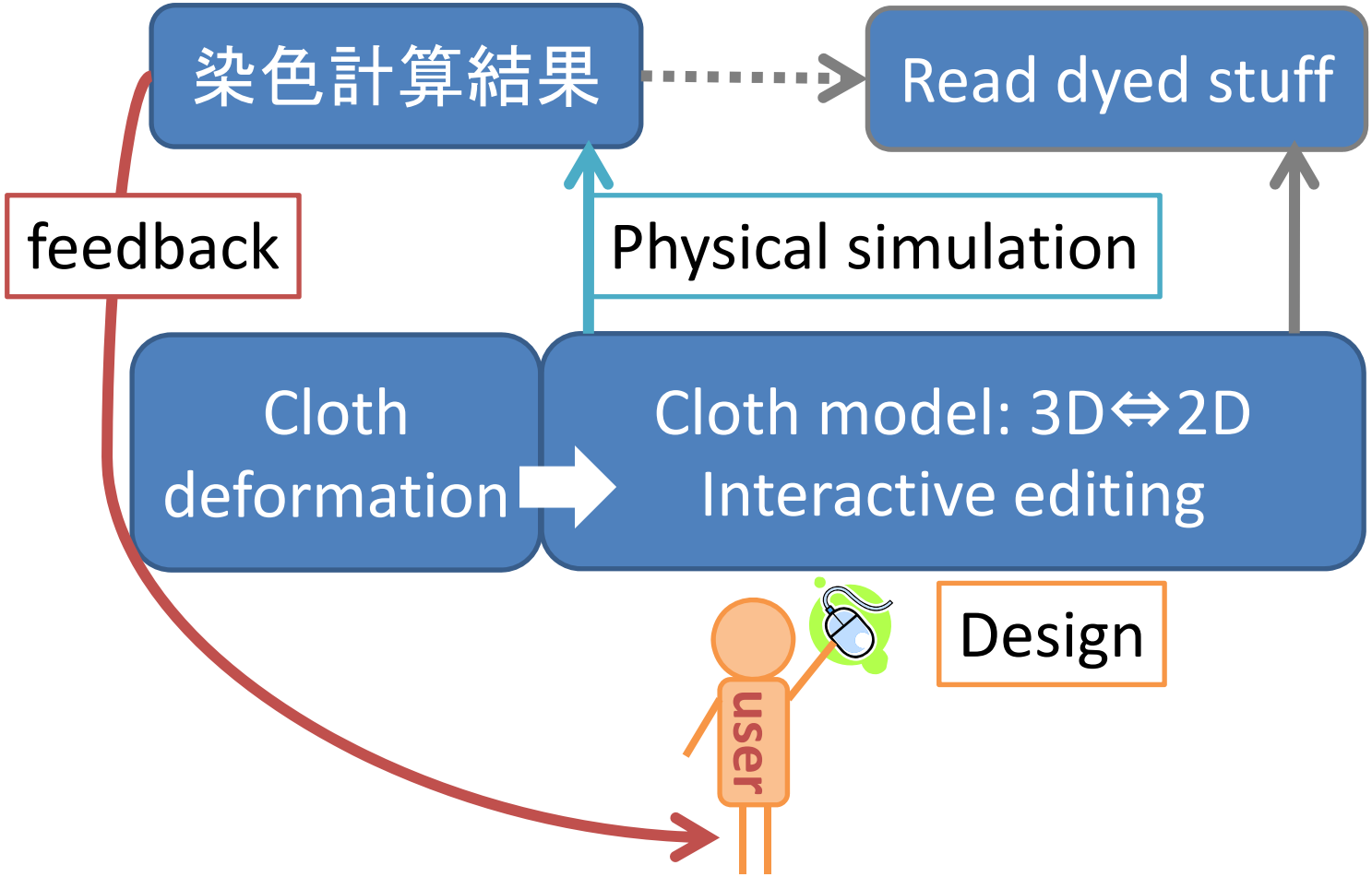
- Local folding
- Mixing colors
- Improving UI
- Open to the public



日本の染織11　日本の絞り、安藤宏子、京都書院美術双書、1993.

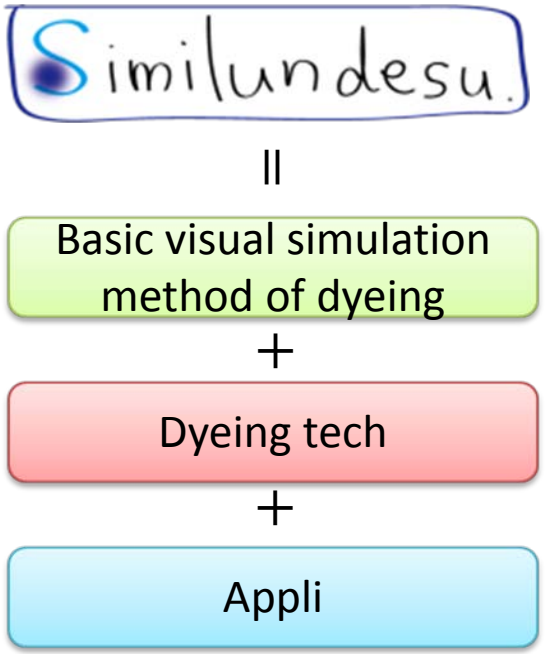
Conclusion

We achieve the new pattern generation by interactive editing between 2D/3D models of cloth deformation linked with simulation



Archievement

- No 3D cloth structure in the related works
- Folded and woven Complicated cloth geometry
- Simultaneous physical phenomenon (dye transfer)
- Real dyeing tech. is varied
- Design by user
- Handmade and geometric factors
- World first! dyeing pattern simulator



Development of dyeing pattern simulator

Yuki Morimoto
http://www.nexyzbb.ne.jp/~yu_ki/Similun.html

Similundesu.

Motivation

Dyeing?

Similundesu

Basic model

Dyeing tech

Appli

Future

Question?