Computer-Generated Tie-Dyeing Pattern

Yuki Morimoto* RIKEN

Kenji Ono† RIKEN

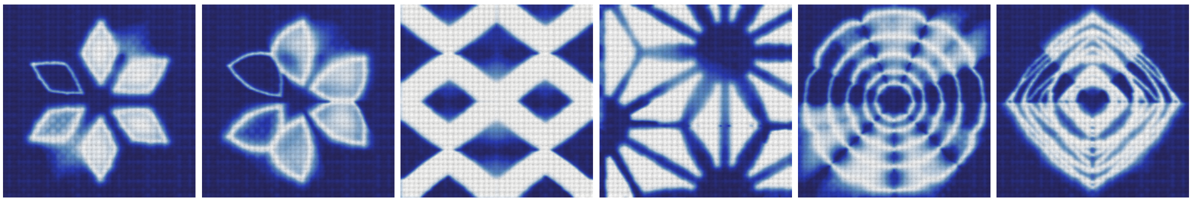

Figure 1: *Results of our simulation of traditional Tie-dyeing techniques; Butterfly-flower stitch resist from China, Itajime, and Kumo-shibori.*

1 Introduction

We present a novel method to simulate tie-dyeing patterns considering 3D folded cloth geometry with user interaction. Morimoto et al. propose a dye transfer model that accounts for dyeing theories by considering parameters of weave structure, dyestuffs and cloth [Morimoto et al. 2007]. However this model does not consider a behavior of dye and distribution of protection against dyeing in 3D cloth geometry. We improve this model to consider 3D folded cloth geometry. In the process of tie-dyeing, cloth is folded and tied, and then dipped into dye bath. In a dyebath, the dyestuffs penetrate from the outside surface parts of folded cloth that are exposed to the dyebath directly. The other fluttery parts of the cloth possibly become the surface parts in the dyebath. Our method calculates such fluttery parts and the ratio to supply dyestuffs of the parts. Also, our dye diffusion model considers edges by folding cloth. This technique enables to obtain various tie-dyeing patterns from simple user inputs while it is difficult to predict the final figure of real tie-dyeing.

2 Our Method

Our method calculates the dye supply map G that is a distribution to supply dye to the cloth that consists of cells par a time step to simulate dipping into the dyebath. Furthermore, our method considers the edges from folding cloth by their contact areas. We apply the contact areas as the edge weights to calculate diffusion coefficients for our dyeing simulation in a folded cloth.

Figure 2 (a) shows a real dyed pattern called Butterfly-flower stitch resist from China [Sakakibara 1999]. Such tie-dyeing is generated from folded and sewn cloth as shown in (b). We obtain the folded cloth geometry [Mitani 2005]. Then user draw on it as distributions of dye and protection as shown gray part in (c).

(d) shows the fold features on the unfolded cloth data. The outside surface parts is the red parts, the inside crease parts is the blue parts, and the gray parts is the protection parts in (d). We generate a distance field DFs (e) from outside surface to the inside crease or protection parts. Since we assume that the closer to the outside surface part is, the higher G become. We also generate a distance field DFc (f) from blue parts. Since we also assume that the closer to the inside crease part is, the more difficult dyestuffs touch. We then calculate G by normalizing sum of reversed DFs values and DFc values. Finally we compute the dye supply map by multiplying G by dye capacity. We also generate a distance field DFp from the protection parts as shown in (h). DFp represents broadening protection area from self-collision of folded cloth inside. Moreover, the protection area decrease the dye capacity at all cells because it pushes the fabrics and decreases the physical volume where the dyestuffs can be.

We compute dye transfer based on the diffusion equation by the implicit method. The previous model uses 5 neighboring cells in two-layered cellular cloth model. However, the folded cloth misaligns the faces as shown in (i). For such cases, we add the edges between the contact cells in the folded cloth geometry. We calculate contact areas between 9 cells and a target cell as the weights. Then, we multiply the weights by diffusion coefficients.

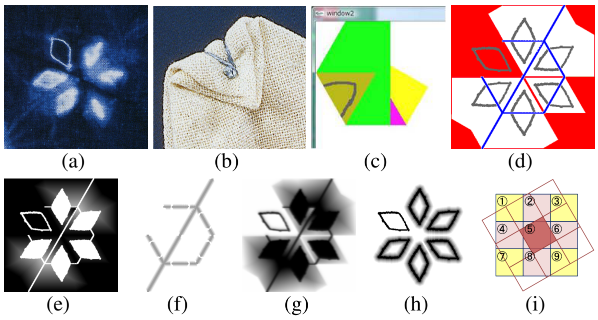

Figure 2: *Illustrations for modeling distributions of dye and protection, mismatched cells.*

3 Conclusion and Acknowledgements

Figure 1 shows results from our method. In future work, we would like to improve our model to consider not only the distance but also some physical factors. Also, speeding-up the system and development of specialized GUI for dyeing provide us more realistic, wide-ranged representation of dyeing.

We would like to thank Prof. Jun Mitani for his comments and advice to use ORIPA in our system.

References

MITANI, J. 2005. ORIPA (Origami Pattern Editor).

MORIMOTO, Y., TANAKA, M., TSURUNO, R., AND TOMIMATSU, K. 2007. Visualization of dyeing based on diffusion and adsorption theories. *Proceedings of Pacific Graphics 2007*.

SAKAKIBARA, A. 1999. *Nihon Dento Shibori no Waza (Japanese Tie-dyeing Techniques)*. Shiko Sha (in Japanese).

*e-mail: yu-ki@riken.jp
†e-mail: keno@riken.jp

SIGGRAPH Asia 2009, Yokohama, Japan, December 16–19, 2009.
ISBN 978-1-60558-858-2/09/0012