Computer-Generated Tie-Dyeing Pattern (sap_0158)

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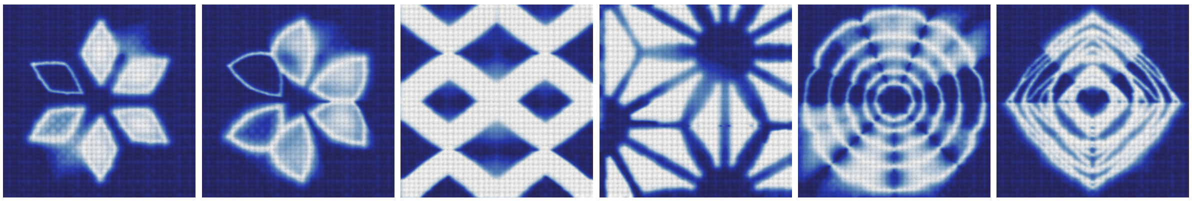

Figure 1: *Results of our simulation of Japanese traditional Tie-dyeing techniques; hana-shibori, Itajime, and Kumo-shibori.*

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, dyestuff 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 dye bath, dyes penetrate from the surface parts of folded cloth that are exposed to dye directly. There are also other parts that possibly become surface by slightly opening folded cloth in dye bath. Our method finds such potential surface parts and its degree to become surface. We use the degree to calculate an amount of dye given to cloth in dye bath. In addition, our dye diffusion model considers additional cells made from folding cloth. We can obtain tie-dyeing patterns by simple inputs with our model while it is difficult to predict the final figure of real tie-dyeing.

2 Our Method

Our method calculates a degree to become surface G that is a distribution of ratios of dye given par a time step to consider tie-dyeing techniques. Furthermore, our method considers additional neighboring cells with their weights for diffusion coefficients to simulate diffusion in folded cloth.

Figure 2 (a) shows a real dyed pattern called Hana-shibori [Sakakibara 1999]. Such a pattern is generated from folded and sewn cloth as shown in Figure 2 (b). We describe our method with an example of Hana-shibori in the following sentence. We use a Origami pattern editor called ORIPA [Mitani 2005] to generate cloth geometry data. Then, we make volume data from ORIPA data, and user input drawings on it as distributions of dye and protection as shown in Figure 2 (c). Next, we find the surface parts (red parts in Figure 2 (d)), the crease parts inside the cloth (blue parts in Figure 2 (d)), and the protection parts (gray parts in Figure 2 (d)). We generate a distance field DFs from red parts to blue or gray parts (Figure 2 (e)) because we assume that the closer a position is to the surface part, the higher G become. We also generate a distance field DFc from blue parts (Figure 2 (f)) because we also assume that the closer a position is to the crease part, the more difficult dyes touch. We then calculate G by normalizing sum of reversed DFs values and DFc values as shown in Figure 2 (g). The amount of dye given par a time step is computed by multiplying G by a capacity of dye on each cell. We also generate a distance field DFp from gray parts (Figure 2 (h)). DFp represents broadening protection area from self-collision of folded cloth, and the protection area decrease the capacity of dye at all cells.

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 folded cloth misaligns the faces. For such a case, we adds extra neighboring contact cells for dye transfer calculation as shown in Figure 2 (i). Our method considers 14 neighboring cells that are 5 basic neighboring cells and less than 9 extra neighboring cells in the neighboring face made by folding cloth. We calculate contact areas between these 9 cells and a target cell. Those contact areas are used as a weight of diffusion equation by multiplying by diffusion coefficient.

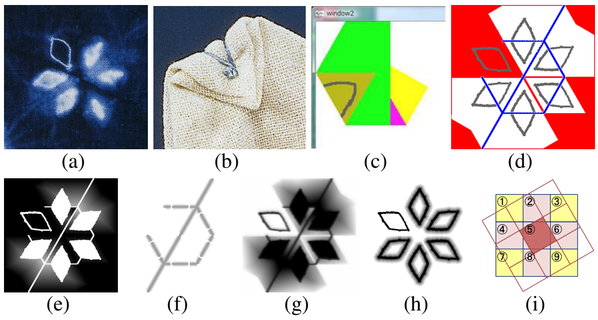

Figure 2: *Illustrations for modeling distributions of dye and protection, mismatched cells.*

3 Conclusion and Acknowledgements

Figure 1 shows results from our method. For our future work, we hope to achieve improvement to a model considering some factors except for distance, speeding-up the system, and development of specialized GUI for dyeing to achieve more realistic, wide-ranged representation of dyeing.

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References

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