Haptic model for experience of decorating Kutani ware with overglaze

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1 Introduction

By improving the performance of the computer in recent years, the field of the computer graphics that needs a large amount of the operation has been researched. The virtual reality is applied field of the computer graphics. The virtual reality is a technology for making man virtually experience the virtual world made on the computer. The virtual reality technology can be verified in the real world beforehand. It is expected in various fields because of such an advantage. The virtual reality technology is an interface that does an intuitive connection of man and the computer. Therefore, the research is done in the field of the art that needs an intuitive operation. The field where such creativity is valued is assumed information on power to be important more than information on the sight. Various applications are expected by reproducing this by the virtual reality technology. For instance, it practices regardless of the presence of the material, or it works cooperatively with the remote place. Therefore, this research focuses on the use of the virtual reality technology in the art field. The art mentioned this research is a Kutani ware that is the traditional craft of Ishikawa Prefecture. The Kutani ware is pottery that is the main current with multicolored overglaze painting. In the production process of doing putting of the picture of pottery, a high learning effect is obtained by operation that uses the hand. And the sense actually experienced is obtained by the sense by the solid. Haptic device named PHANToM is used to achieve it. The reduction in the cost of the practice and time can be achieved by doing the experience study with the Kutani ware picture by using this on a virtual space. Then, the research for the development of the system of the solid to which the experience study of the overglaze decoration.

2 Reaction force characteristic by actual paintbrush

Because the brush that is used by the overglaze decoration of Kutani ware uses glost, a viscosity that is stronger than a usual drawing is received. Then, three kinds of shape like the circle, the quadrangle, and the hexagram was drawn in the container of an actual Kutani ware.

As a result, the feature of the brush in the picture putting was understood by showing the appearance of the change in the reaction force as data. The length of the brush is 17mm, and the diameter of the thickness is 4mm. I thought including the kind of the line that was basic when drawing to the surface of curved surface shape of the solid. Therefore, the testee wrote three kinds of shape like the circle, the quadrangle, and the hexagram.

As a result, the reaction force characteristic became shape that looked like well though there was an individual variation.

3 Expression of sense of force when the overglaze in virtual environment

In this research, the paintbrush on a virtual space is expressed by using haptic device named PHANToM. Rheological property has the characteristic gradually transformed according to the increase and decrease of power. Therefore, the paintbrush is expressed by using the MSD (Mass Spring Danper) model. In general, the reaction force by the spring model is shown by $F_s = -k_s \cdot x$. The reaction force by the damper model is shown by $F_d = -k_d \cdot v$.

Because this expresses one point of the brush, the coefficient to show the whole is needed. The coefficient was requested by measuring the reaction force actually took with paintbrush actually used As a result, the reaction force has been growing at the rate of the square of the depth of the brush. Therefore, the reaction force when the entire paintbrush is shown as contact force becomes it like $F = (F_s + F_d) * d^2$. Moreover, because the spring model is used in this model, it is necessary to decide the spring constant and the damper constant. Therefore, the reference value of each constant is decided based on the data when three kinds of figures are actually drawn. There was a reaction force change in 0.127N in the maximum in 0.3 seconds in the data of an actual paintbrush. Therefore, the spring constant made based on it was 0.000144. The damper constant became 0.000043.

4 Construction of haptic system for Kutani ware overglaze with PHANToM

In this system, the sense of force like the paintbrush with a glaze can be received by using PHANToM and operating the brush in a virtual space. I proposed the technique of the reaction force generation with a real feeling to the virtual reality environment for the construction of the haptic system of the glazed paintbrush. The proposal technique was evaluated by five stages by using the questionnaire to the testee. As a result, the

entire average point was 3.63. Moreover, decentralization was 0.48. Standard deviation was 0.69.

5 Conclusion

In this thesis, we proposed the haptic model in the virtual reality environment. The reaction force characteristic was investigated from an actual paintbrush to achieve this proposed model. As a result, The reaction force generation model regarded to be necessary for making the brush model was decided. Therefore, the sense of force that reality is high was enabled to be given to the user by the technique of the reaction force generation newly set. Moreover, operating as a sense of touch model with a high absorption feeling became possible.