Supplementary Material

Saliency-Preserving Slicing Optimization for Effective 3D Printing

Computer Graphics Forum, 2015

1. Dataset

Our algorithm has been tested on 267 models which were sampled randomly from the SHERC database [Shilane et al. 2004] and the Princeton database [Lian et al. 2011]. The test models consist of animals (such as pig, horse, lion, etc.), human beings, and others. The collection of these models is shown in Figure 1. In our test, 30% of models do not need to be segmented.

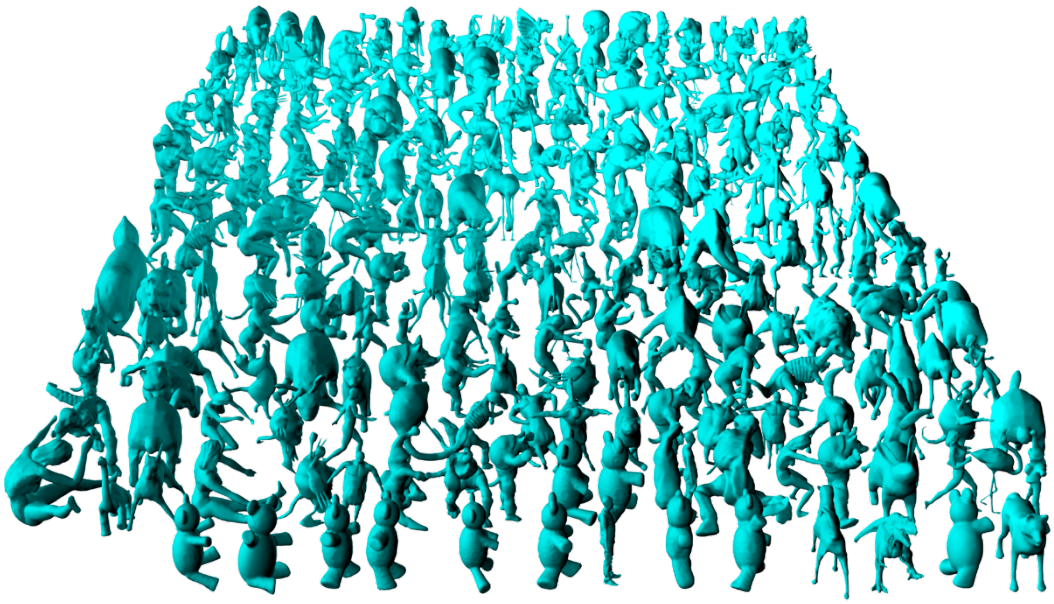

Figure 1. The collection of models used in our test.

2. User Study

We conduct a user study to further evaluate the performance of our method.

The objects used in our user study consist of seven groups, which are models of Lion, Squirrel, Rabbit, Buddha, CleanHead, Laurana, and Hess. Each group contains six objects, as shown in Figure 2, Figure 3, and Figure 4. For each model of the first

six groups, we generate 6 slicing results by applying the 6 methods mentioned above and manufacture them using the FDM printer. Thus we have 6 groups of printed objects, where each group consists of 6 printed objects for the same model.

In order to make the study more reliable, we create another group (the seventh group by Hess) of 6 printed objects, where each of them was created with a uniform layer thickness of $(1-\lambda)\underline{\alpha}+\lambda\bar{\alpha}(\lambda\in[0,1])$. The first subgroup of 3 objects were created with λ = 0.0, 0.1, 0.2 respectively and the second subgroup of the other 3 objects were created with λ = 0.8, 0.9, 1.0 respectively. It is easy to judge that the objects in the first subgroup are visually better than those in the second subgroup. If one subject choose one of objects in the second subgroup within top 3 visually good objects in the user study, we regard this study invalid and discard the result from the study (See Figure 4).

The user study was designed as follows. One letter randomly selected from A, B, C, D, E, F was pasted on the back or the top of each object. Each participant was asked to select three objects with the best visual quality from each group and then give a ranking of the selected three objects according to the visual quality. Without any limit, each participant spent about 10 minutes to finish our questionnaire. After the questionnaire, we analyzed the answers for the seventh group. As the differences of the objects in the seventh group are very obvious, if the three objects selected by some participant were not in the first subgroup, we ignored the sample data from this participant. For the left samples, we calculated the frequencies for each object which was ranked first, second, and third.

We recruited 67 participants (have female and male), who were college students or teachers, to join in our user study. Some of them had heard of 3D printing technology before and some of them were interested in 3D printing. Among the 67 answers, 3 of them are invalid and we have 64 valid user study. The statistics of the user study is show in Figure 5. From the results, we have the following observations:

- the objects produced by our method (OurResult) are superior to DM94 and Sab96 in most cases;

- the objects produced by our method (OurResult) are comparatively as good as those produced by GroundTruth: for 3 groups (Buddha, Laurana, CleanHead), OurResult were ranked as top 1; for 4 groups (Buddha, Laurana, Lion, CleanHead), OurResult were ranked within top 2; for 5 groups (Buddha, Rabbit, Laurana, Lion, CleanHead), OurResult were ranked within top 3.

The results of our user study obviously shows that our algorithm can efficiently reduce the printing time while preserving good visual quality as the ground truth.

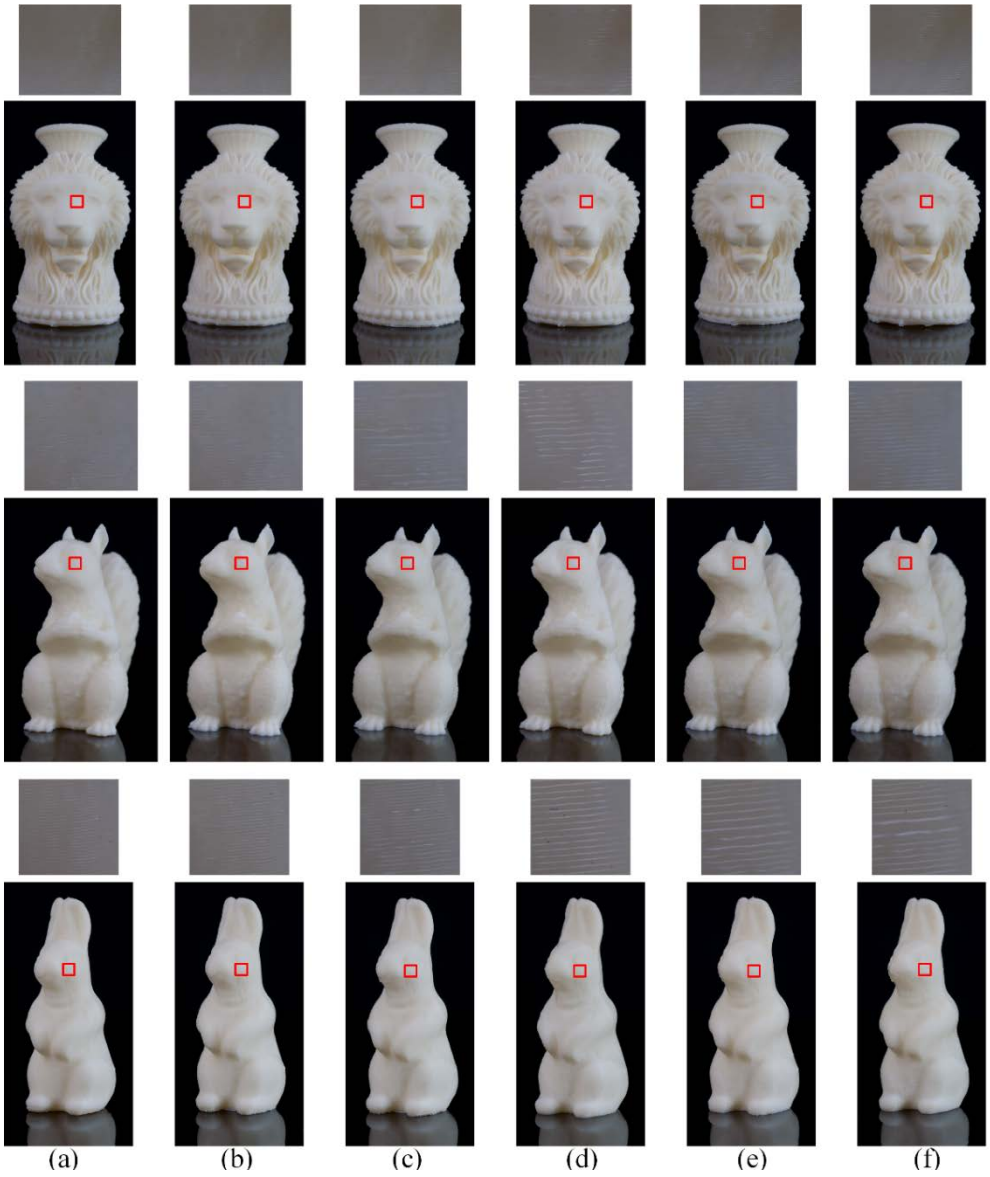

Figure 2. Three groups of objects used in our user study and their zoomed-in images. Here (a), (b), (c), (d), (e), and (f) stand for GT, OR, RE, ST, C1, and C2, respectively.

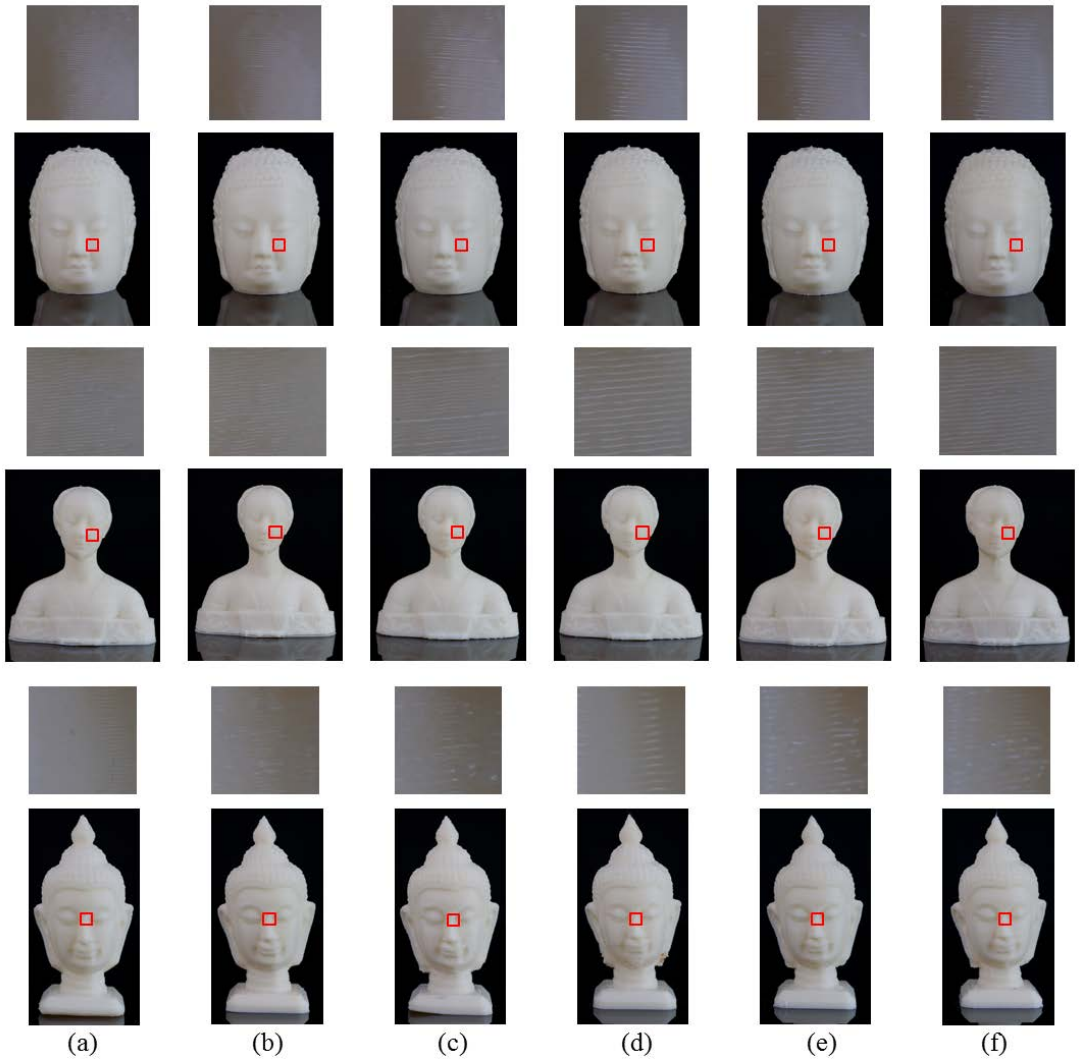

Figure 3. Another three groups of the objects used in our user study and their zoomed-in images. Here (a), (b), (c), (d), (e), and (f) stand for GT, OR, RE, ST, C1, and C2, respectively.

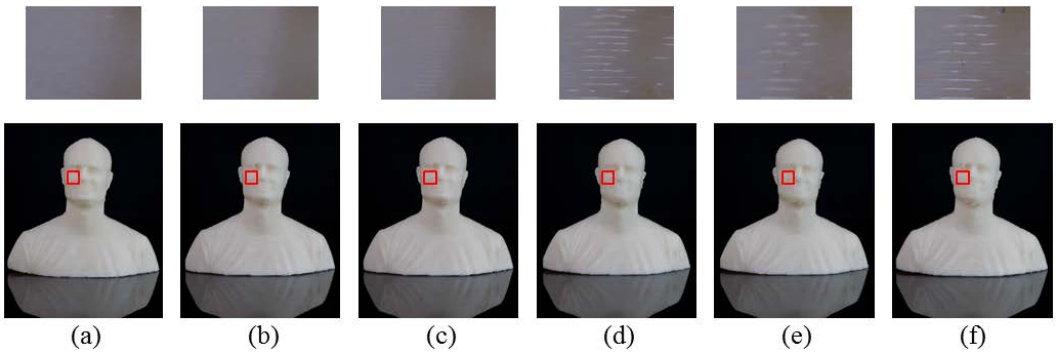

Figure 4. The seventh group used to judge believability of the answers of the participants. Here (a), (b), (c), (d), (e), and (f) are printed with 0.1, 0.13, 0.16, 0.34, 0.37 and 0.4, respectively.

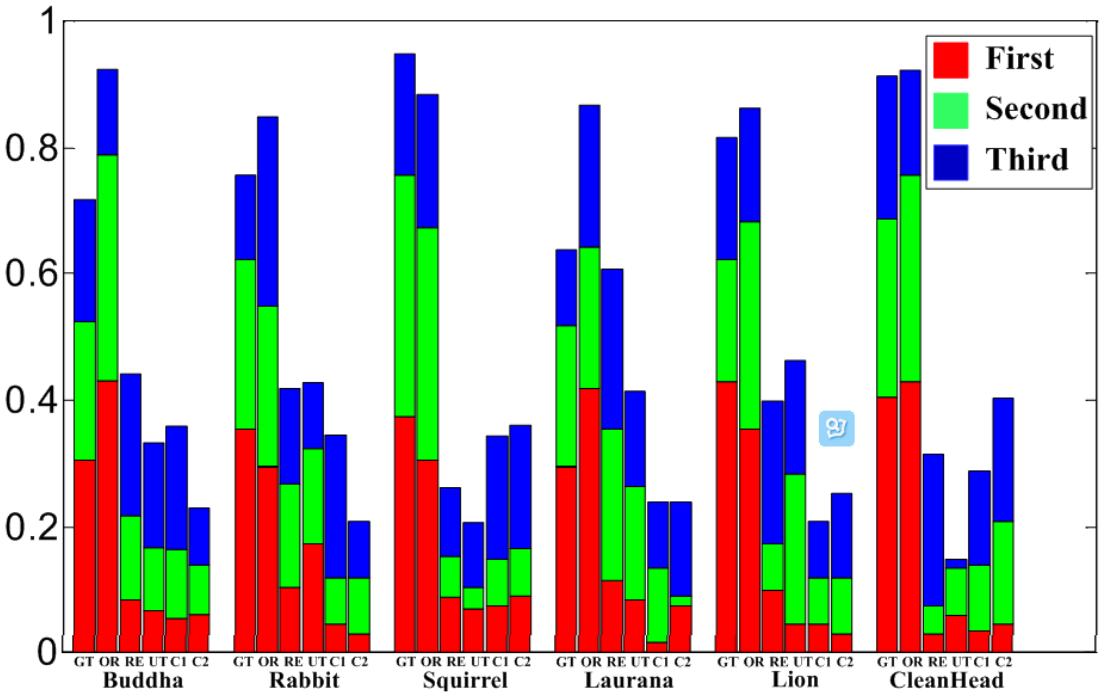

Figure 5. The results of user study. Here the GT, OR, RE, UT, C1 and C2 are GroundTruth, OurResult, Random, Uniform, DM94 and Sab96 respectively.