Layered Solid Texture Synthesis from a Single 2D Exemplar

Kenshi Takayama*
The University of Tokyo

Takeo Igarashi
The University of Tokyo,
JST/ERATO

1 Introduction

In our previous work of lapped solid textures [Takayama et al. 2008], layered (or 'type 1-b') texture exemplars were used to create solid textured models such as strata and cakes. However, no methods have been proposed so far to synthesize this kind of texture automatically. This poster proposes an extension of Kopf et al.'s method [2007] to synthesize such layered solid textures from single 2D exemplars.

2 Algorithm

Figure 1 illustrates the problem to be solved. The input is a 2D exemplar image representing the cross section of layers, and the output is a 3D solid texture whose cross sections parallel to the depth direction (assumed to be the z-direction) always look similar to the 2D exemplar.

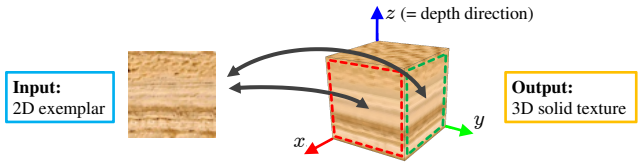


Figure 1: *The problem of layered solid texture synthesis.*

We solve this problem by adding several extensions to Kopf et al.'s method [2007] for synthesizing homogeneous solid textures from 2D exemplars. First, we add a depth map channel to the 2D exemplar that encodes the layer information (Fig. 2(left)). We also alter the random initialization step of the 3D synthesis volume such that it starts with proper depth values (Fig. 2(right)). We perform the two-pass synthesis process (search and optimization) only in the x- and y-directions, because we have only a single 2D exemplar corresponding to those directions.

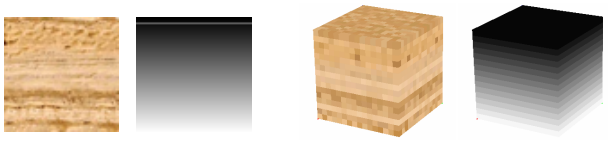
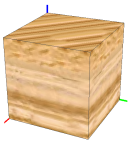


Figure 2: *The additional depth map channel of the 2D exemplar (left) and the altered random initialization of the 3D synthesis volume at the coarsest level (right).*

However, the above scheme can easily lead to a severe sweeping artifact as shown in the inset. This is because it accepts a simple sweep of the 2D exemplar in a direction orthogonal to the z-direction and oblique to both the x- and y-directions, as an optimized synthesis result. In other words, for each voxel, the two neighborhoods of the current synthesis volume corresponding to the x- and y-directions are very likely to best match with exactly the same neighborhood in the 2D exemplar (Fig. 3).



*E-mail: kenshi@ui.is.s.u-tokyo.ac.jp

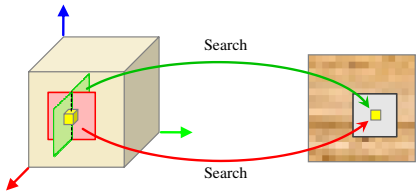


Figure 3: *The cause of the sweeping artifact.*

We solve this problem using the following simple scheme illustrated in Figure 4. When searching neighborhoods, for each voxel, we collect the two best matching neighborhoods in each of the x- and y-directions. If the first best matching neighborhoods in both of the two directions point to exactly the same location in the 2D exemplar, we select one of the two according to the matching distances and assign that pixel as the best matching neighborhood for the selected direction. For the other direction, the second best matching neighborhood is chosen as the matching result.

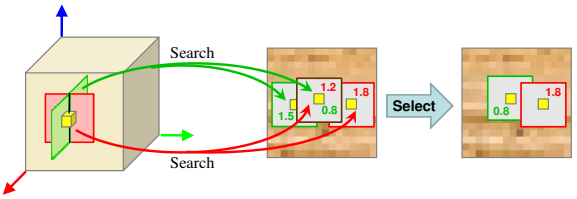


Figure 4: *Our solution to the sweeping problem. The numbers shown at the neighborhoods indicate the matching distances (red and green colors correspond to the x- and y-directions, respectively).*

3 Results

Figure 5 shows how this simple scheme works well for many layered textures.

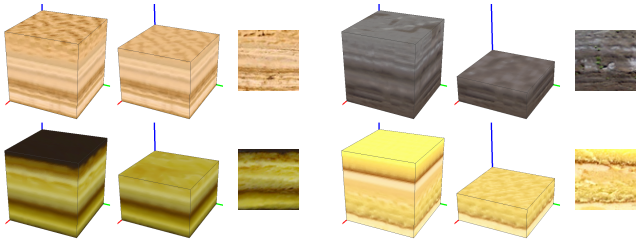


Figure 5: *Results of our layered solid texture synthesis algorithm.*

References

KOPF, J., FU, C.-W., COHEN-OR, D., DEUSSEN, O., LISCHINSKI, D., AND WONG, T.-T. 2007. Solid texture synthesis from 2d exemplars. *ACM Trans. Graph. 26*, 3, 2.

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