
"3D Effects box" for bridging 3D Scan and 3D Print

Hiroya Tanaka

Associate Professor
Social Fabrication Lab,
Keio University SFC.
Endo 5322, Kanagawa, Japan
htanaka@sfc.keio.ac.jp

Yusuke Tominaka

Master course student,
Social Fabrication Lab,
Keio University SFC.
Endo 5322, Kanagawa, Japan
ondaislash@gmail.com

Atsushi Masumori

Visiting Researcher
Social Fabrication Lab,
Keio University SFC.
Endo 5322, Kanagawa, Japan
t10501am@gmail.com

Taisuke Oshima

Master course student,
Social Fabrication Lab,
Keio University SFC.
Endo 5322, Kanagawa, Japan
hosono1@gmail.com

Keita Sekijima

Master course student,
Social Fabrication Lab,
Keio University SFC.
Endo 5322, Kanagawa, Japan
keita.sekijima@gmail.com

Youka Watanabe

Visiting Researcher
Social Fabrication Lab,
Keio University SFC.
Endo 5322, Kanagawa, Japan
youka.tanakalab@gmail.com

Abstract

3D scanning and printing technologies are becoming very popular recently. But when we think of 2D-Photo image analogy, we easily find that choosing and applying various effects (e.g. sharp, blur or mosaic) to an original photo is one of creative parts of digital processing. So now we are trying to develop "3D effects" series, which enrich 3D digital-physical creation and make a bridge between scanning and printing. In this paper, we describe our preliminary research on basic 3D effects and foresee the integrative design process with scanning, effects, printing and finishing.

Author Keywords

3D Scanning, 3D Printing, 3D Effects, Creative Process

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

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1. Introduction

When we use a 3D printer, it's apparent that we have to prepare 3D models in advance. Somebody makes 3D model by modeling software (ranging from professional ones like Solidworks to non-professional ones like 123D), somebody downloads existing models from sharing websites such as thingiverse, instructables, ponoko, shapeways. But we know the third strategy-scanning. Recently 3D scanning technologies are becoming very popular. Especially, X-tion (which is a kinect-like device but don't need AC100V) can be used outside and easy-to-carry out. It works like a digital camera for 2D photo shooting. So we foresee that in the near future many people will enjoy 3D scanning and printing as a continuous process. New culture just like 2D photo taking and printing is emerging.

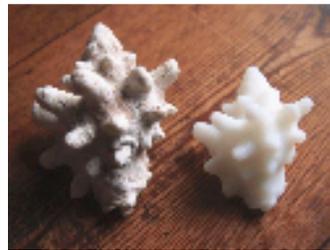


Figure 1. 3D Scan and Print of a natural object

But when we think of 2D (digital) photo culture, we easily find that choosing and applying various effects (e.g. sharp, blur or mosaic) to an original photo is one of creative parts of "digital" processing. It made the fundamental difference between digital photo and so-called analog photo. So now we are trying to develop "3D Effects box", which can be applied to 3D models. Remember that in the famous 2D processing

environment such as Photoshop and GIMP, there are lots of expressive effects like blur, sharp and mosaic. Learning from such 2D effects, we design 3D effects which will enrich our 3D creation environment, and make a bridge between scanning and printing.

2. Design

3D effects box consists of lots of small scripts. We decided to develop our system as open source script (software and contents, derived from openprocessing.org) by using popular programming environment "Processing". Our environment is mainly designed not for users but for makers, that means it should be open for anyone to add/modify their own effects.

In 3D processing, there are two popular data representations. One is triangular mesh format (STL), the other is voxel format. STL is essentially "surface" model while voxel is volumetric. STL and voxel can be converted each other anytime. So we divided small scripts into two different threads, and structured our 3D effect box as a following figure.

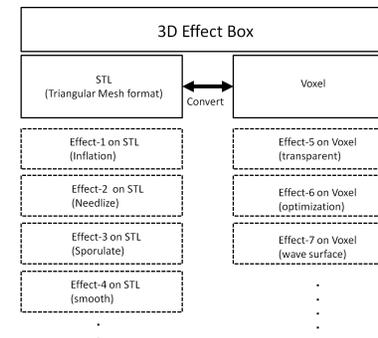


Figure 2. Overall structure of 3D Effect Box

3. Implementation

Here we introduce basic 3D effects which we developed so far. We chose "Stanford bunny" as a model to which effects are applied, since Stanford bunny has been well-known for testing in 3D graphics.

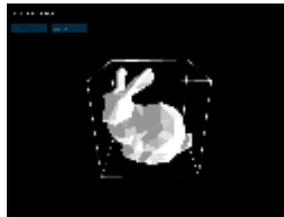


Figure 3. Basic "Stanford Bunny" in STL

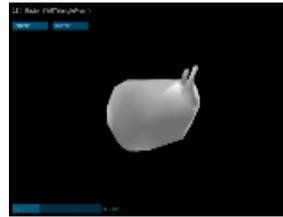


Figure 4. Inflation



Figure 5. Needlize

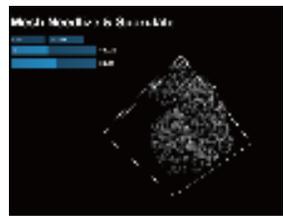


Figure 6. Sporulate

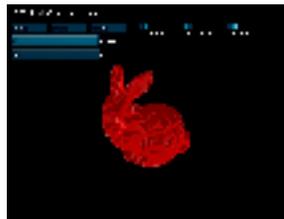


Figure 7. Bunny in Voxel

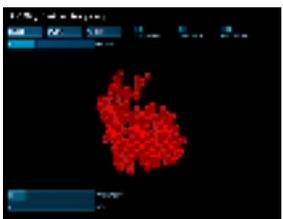


Figure 8. transparent

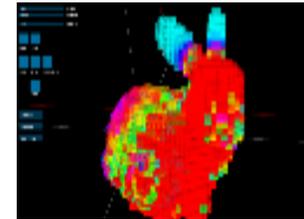


Figure 9. FEM(1)

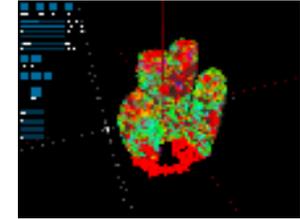


Figure 10. FEM(2)

Inflation (Fig.4), *Needlize* (Fig.5) and *Sporulate* (Fig.6) are effects for mesh-based STL data. Mesh-based representations are easier than voxel-based, because the surface is always continuous. *Transparent* (Fig.8) and *FEM* (Fig.9) are effects for volumetric data. Those are complex and give us new problems to be addressed. When we want to make a model transparent, we have to think about the difference between pixel and voxel. Voxel in this case is supposed to be converted into physical object through 3D printing (in other words, be *materialized* in the physical world), thus we cannot control alpha parameters like the case of 2D images on the screen. In order to realize the pseudo-transparency, we came up with the idea of getting rid of the certain number of voxels randomly (Fig.8). For some cases, models are collapsed or broken once they are materialized. That's because a model doesn't satisfy any features under constraints of physical world-gravity and material strength. Geometric and structural features should be considered. So we implemented physical simulation scripts such as FEM (Finite Element Method, Fig.9 and Fig.10), which tells us physical validity and invalidity. FEM also gives us a function of optimization of the shape.

4. Application



Fig.11 3D print of Stanford bunny with *Sporulate* effect

Fig.11 shows the result of a 3D printing object with the effect *Sporulate*. We think "3D figure" community are potential users of our system. Fig.12 implies advanced usages of our system. One design student tried to collect 3D texture of the surface of fruits (in this case, a melon), and print it after applying "sharp" effect. But for this case, 3D printed object is not a final achievement, but supposed to be worked as a mold. After printing, he used a metal press machine for transferring textures from 3D printed object to a metal sheet. The final outcome is a dish-plate made of copper. We think this kind of integrative design process will be our next scope.

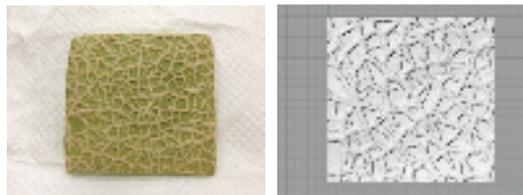


Fig.12 Integrative process of scanning, processing, printing and finishing

5. Conclusion

In this paper, we describe our basic research on 3D effects. You can see and test our effect box through our Computational Fabrication Group Website (<http://cfg.sfc.keio.ac.jp/>).

Our next focus is the integration of scanning, processing, printing and finishing both for non-professional and for professional users. And we are sticking to make our project open source. Photoshop and GIMP offered us a lot of beautiful 2D effects, but those are "black boxes". We think open-source culture is the other side of the core essence of personal fabrication. Thus, we should consider collaborative/collective 3D effects creation through the web.

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