
3D Model Slicing for Color 3D Printing

Speaker: Chien-I Lin (林建易)

Adviser: Prof. Tzung-Han Lin (林宗翰)

National Taiwan University of Science and Technology

Graduate Institute of Color and Illumination Technology

m10325015@mail.ntust.edu.tw

Personal Data

Name: Chien-I Lin (林建易)

E-mail: m10325015@mail.ntust.edu.tw

Project expericnr:

3D printer & 3D Scanner WorkShop **Speaker**



System implementation and development of a photo curable Color 3D Additive Manufacturing Technique (MOST104-2218-E-011-003)

Slicing software project

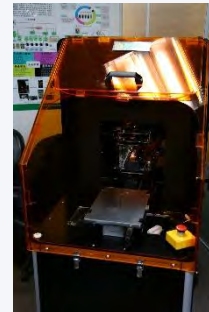
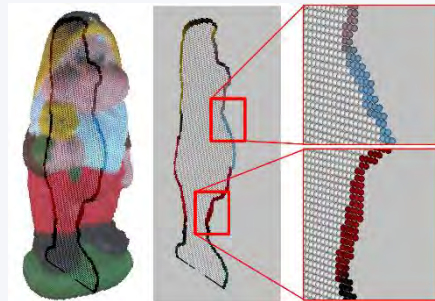
How 3D Printer Works?

3D digital
model

Slicing

3D printer
control

Duplicated
3D object



How 3D Printer Works?



File format	Color resolution	Surface color representation	Note
PLY	32 bit on vertex	Interpolate in triangle	PLY (Stanford triangle format)
OBJ	32 bit on vertex 32 bit texture map	Interpolate in triangle Interpolate in image space	OBJ (wavefront object)
STL	16 bit on facet	Uniform color in a triangle	STL (stereo lithography)
VRML	Similar to OBJ	Similar to OBJ	Virtual Reality Makeup Language

How 3D Printer Works?

3D digital model

Slicing

3D printer control

Duplicated 3D object

3D printer type

Layer Information

Sprinkler Head Path

Ex:

- DLP

Layer Information with no color

Layer Information With Color

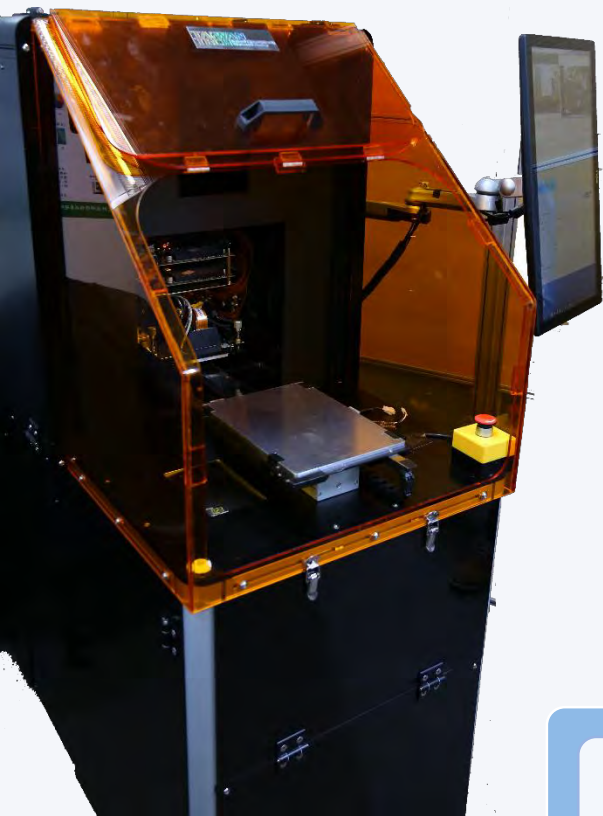
Ex:

- 3DP

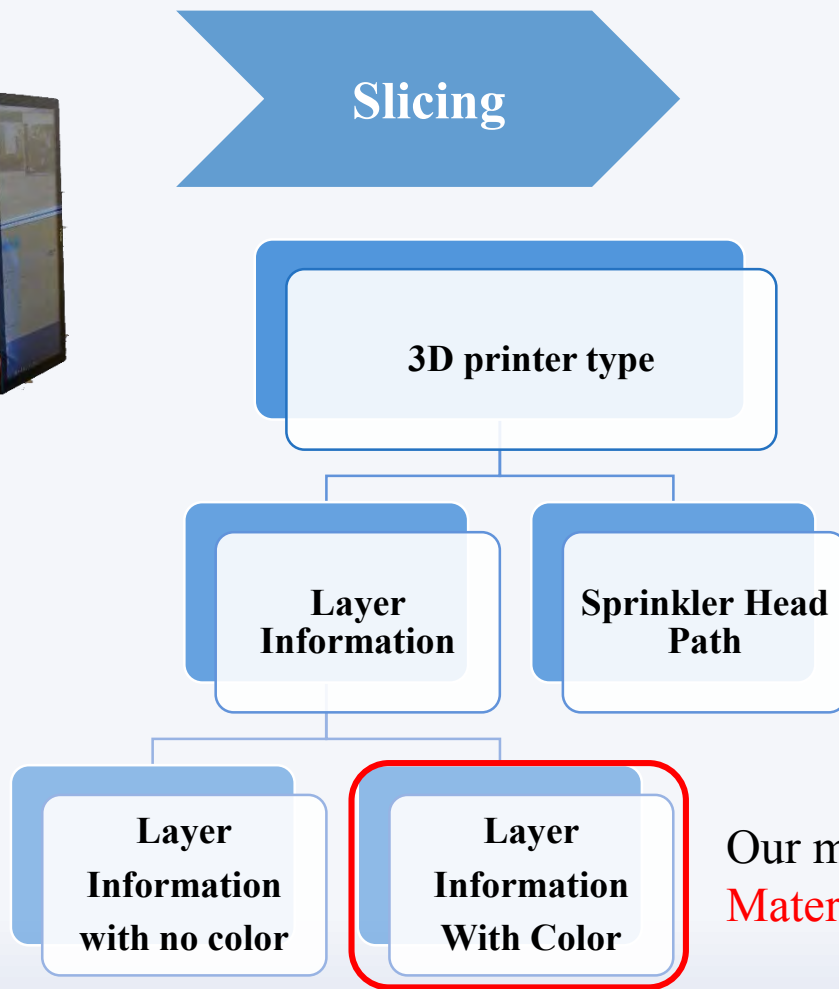
Ex:

- FDM
- SLA

How 3D Printer Works?



Material Jetting 3D printer
(NTUST prototype)



Our method is define on
Material-jeting 3D printer

How 3D Printer Works?



- XYZ Axis Control
 - Material Feeding Control
 - Sprinkler head Control
- etc.....

How 3D Printer Works?

3D digital
model

Slicing

3D printer
control

Duplicated
3D object



PLA material
by FDM

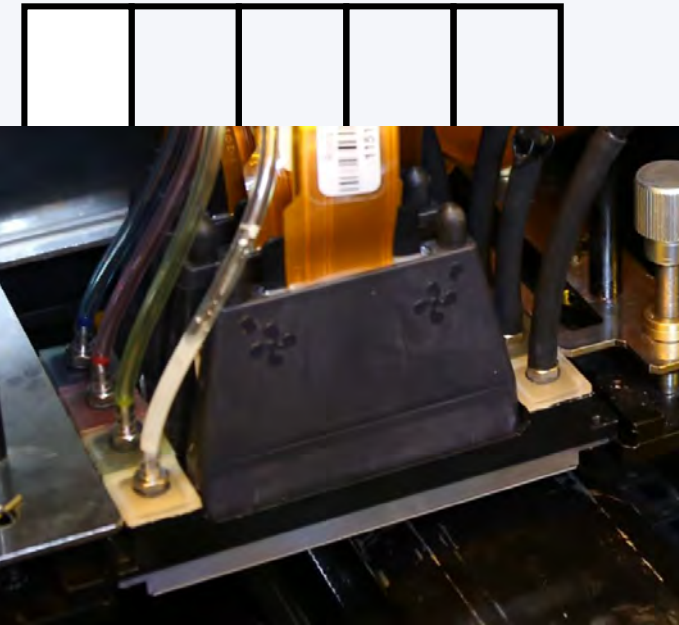


Powder material
by 3DP



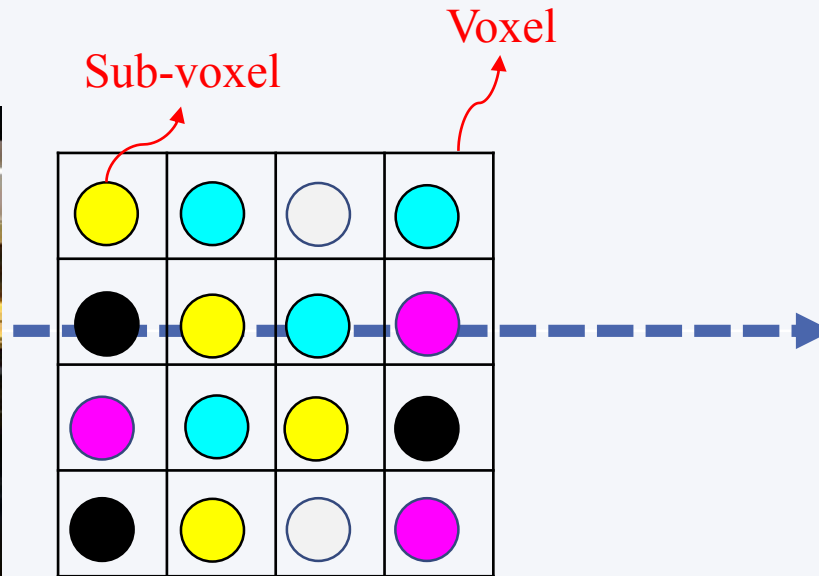
Light-Curable material
by Material Jetting

How Color 3D Printer Works?



Must prototype Sprinkler

Sprinkler head



After RGB transform to CMYKW

Material Spectrum

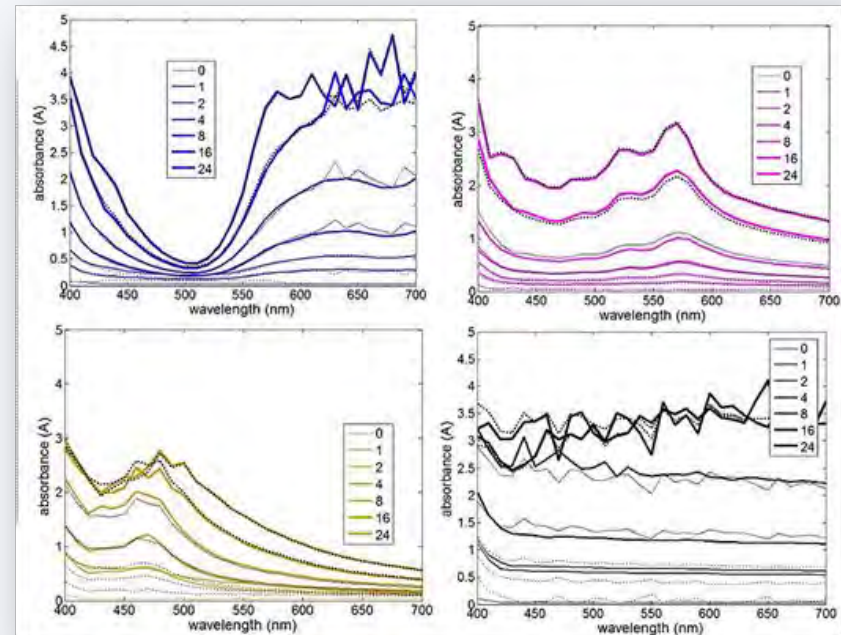
Light-curable material



Layer: 24 16 8 4 2 1

Different thickness result

Material spectrum

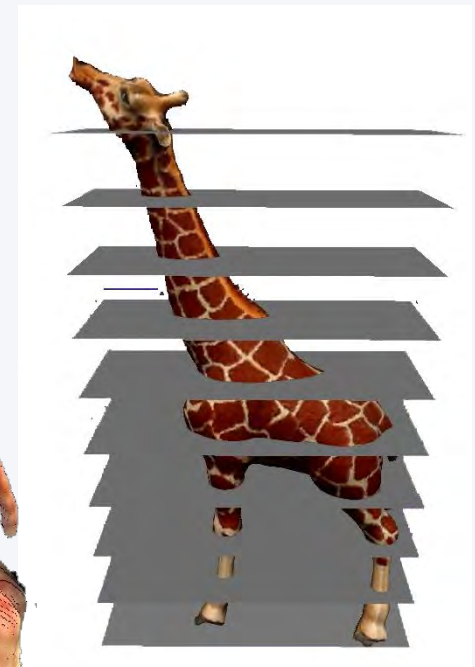
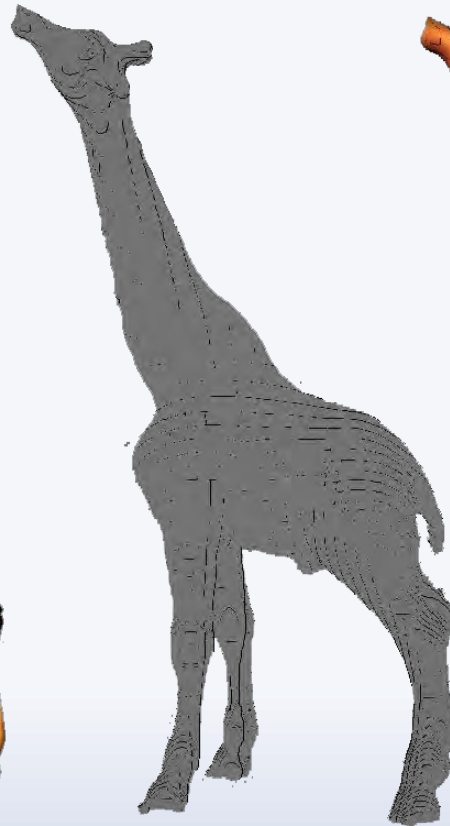
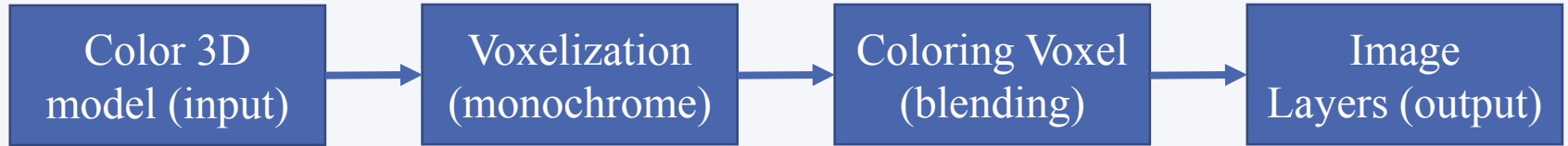


Different layer spectrum

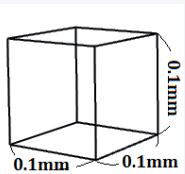
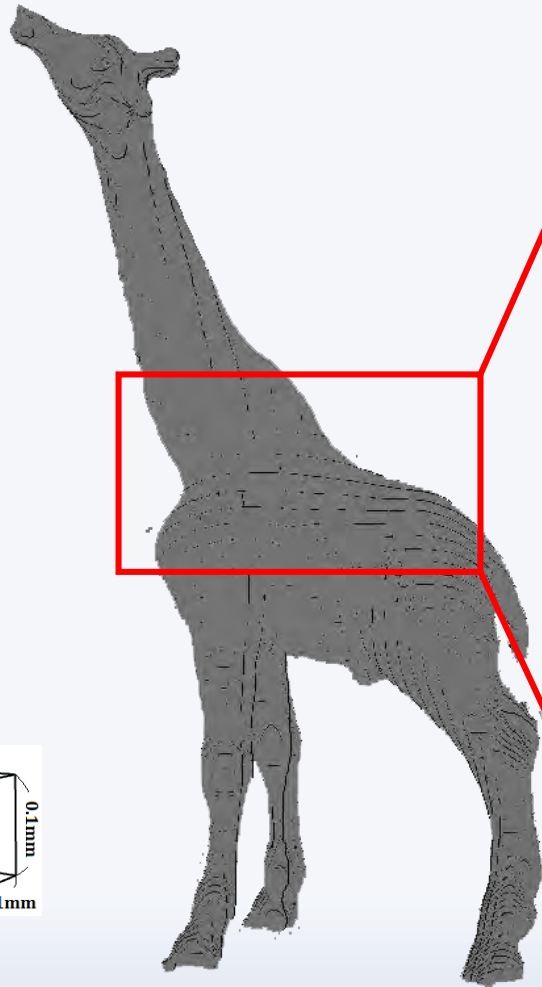
Exceed 8 layer the spectrum almost the same

One layer about 0.1mm

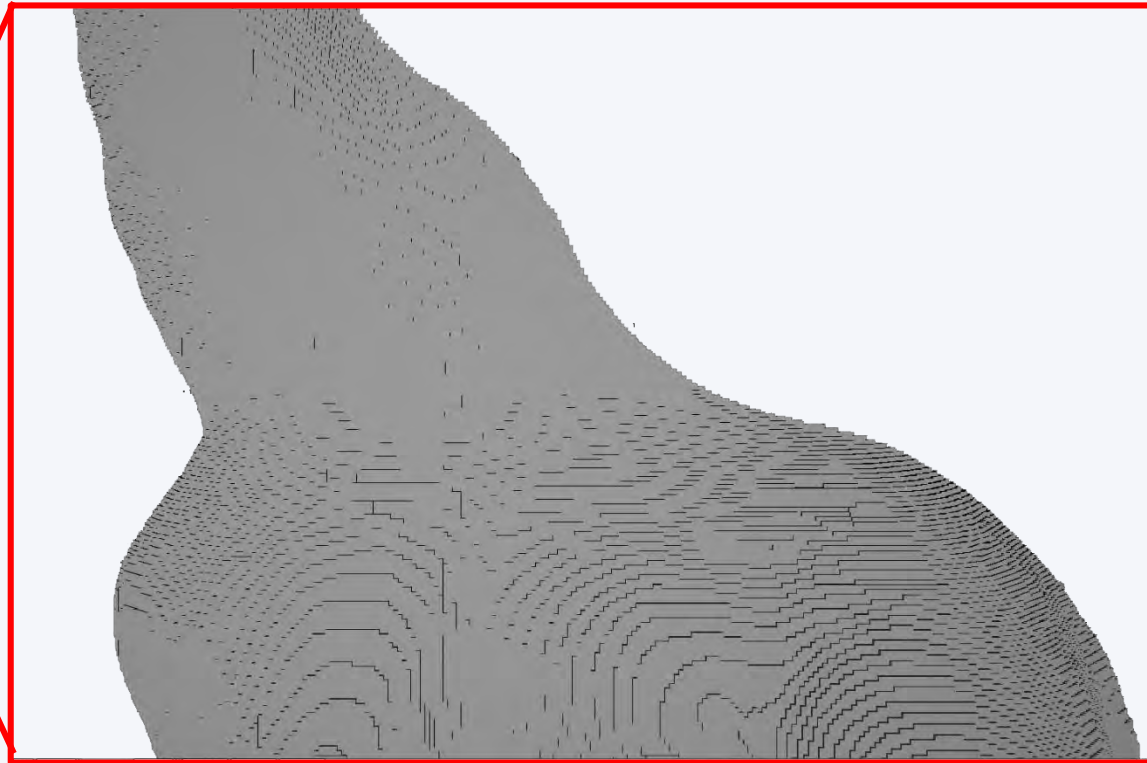
Our Slicing Procedure



Voxelization (monochrome)

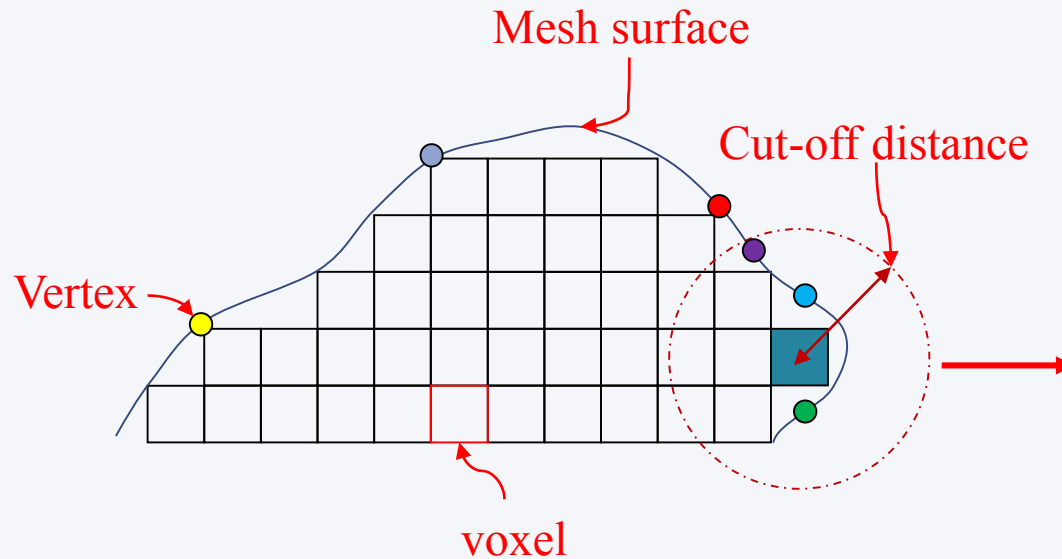


Voxel



Zoom in for a part of voxels (monochrome)

How To Decide Voxel Color



EX:

		+		+		=	
R	0		112		0		33
G	176		48		176		133
B	240		160		80		160

Color of a vertex

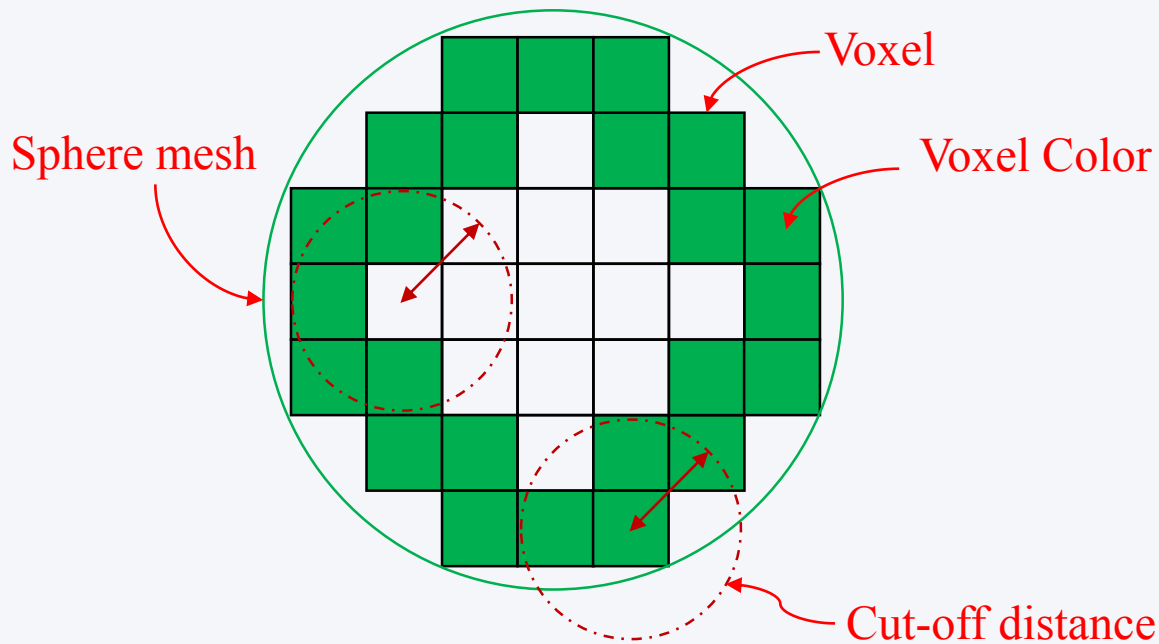
Average color

The color of a voxel is assigned by blending all colors of all vertexes, which are within the cut-off distance.

Voxel Color Far From Mesh Surface

Similar to traditional printing, the substrate affect the color.

So our method set the voxel with white color which is far from mesh surface.



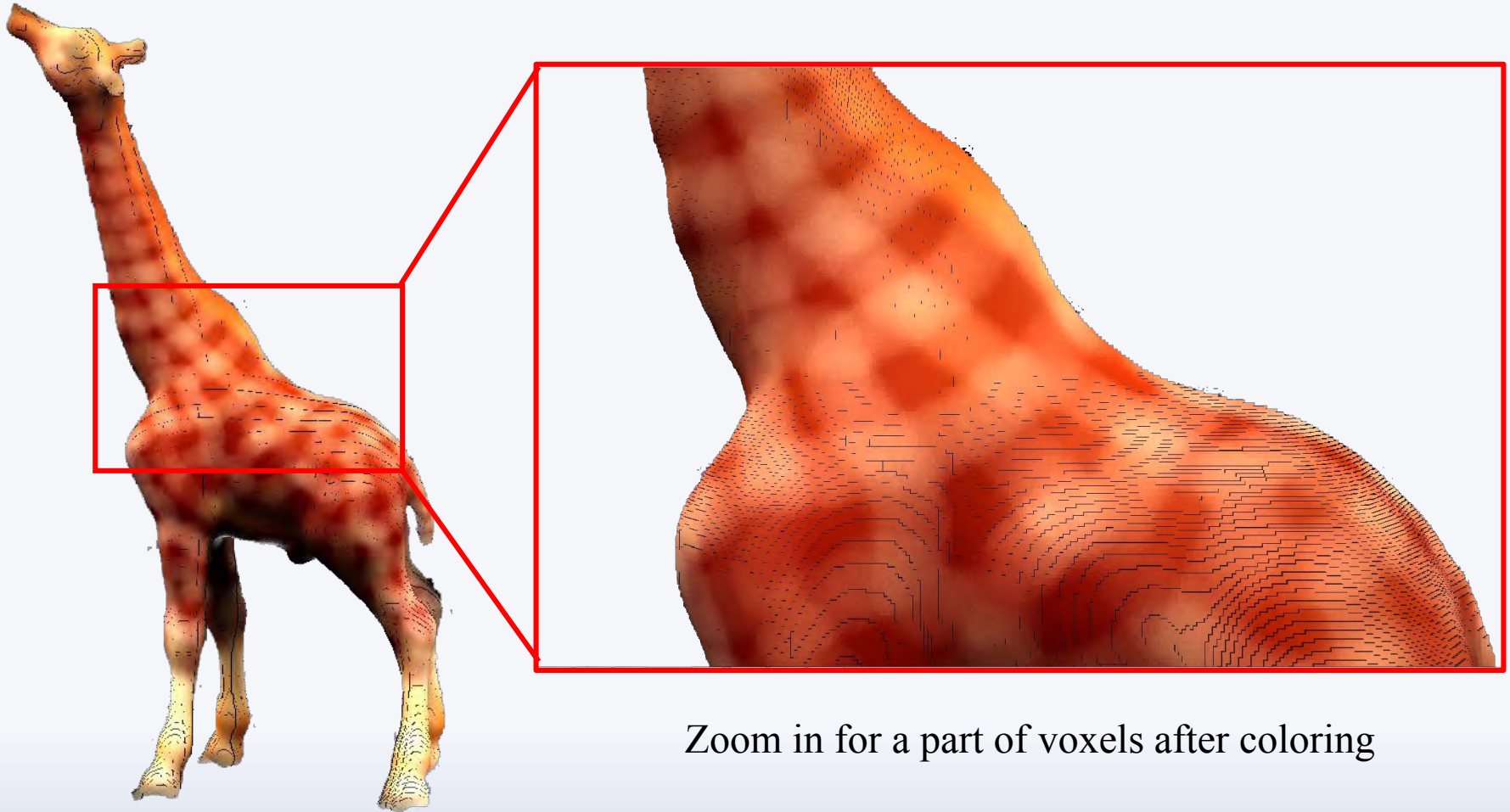
An example with A green sphere mesh

Hint:

Because of material is **translucent**.
If people observe material from **different direction** that may cause **different result**.

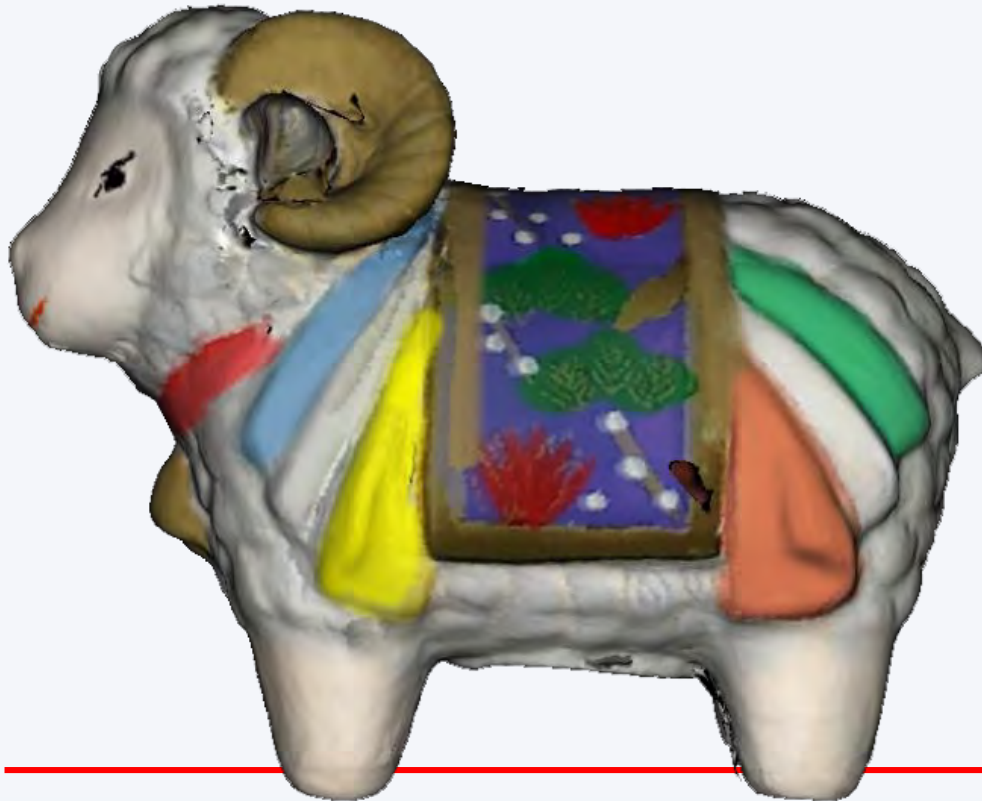
That's why test this method.

Voxelization – After Coloring Voxel



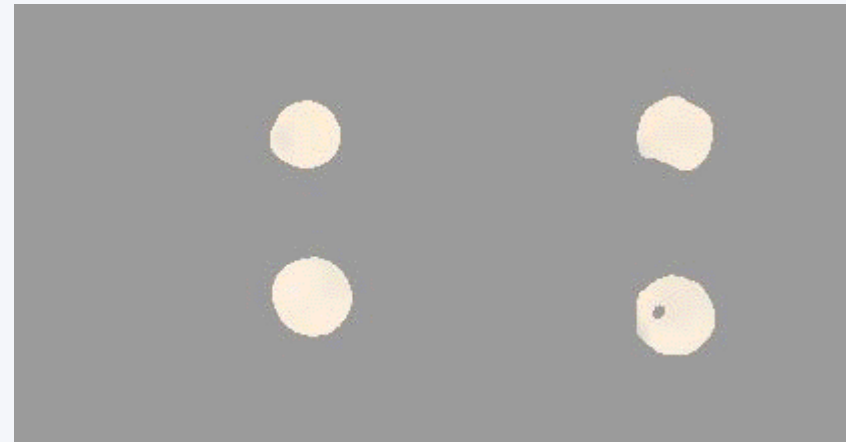
Zoom in for a part of voxels after coloring

Slice Result



Original input 3D model
(3D mesh)

Slice
Plane



Outcome of voxel
(store as color bitmaps)

Experiment Parameters

Two factors for color blending are considered:

- Color variety
- Pattern Repeatability

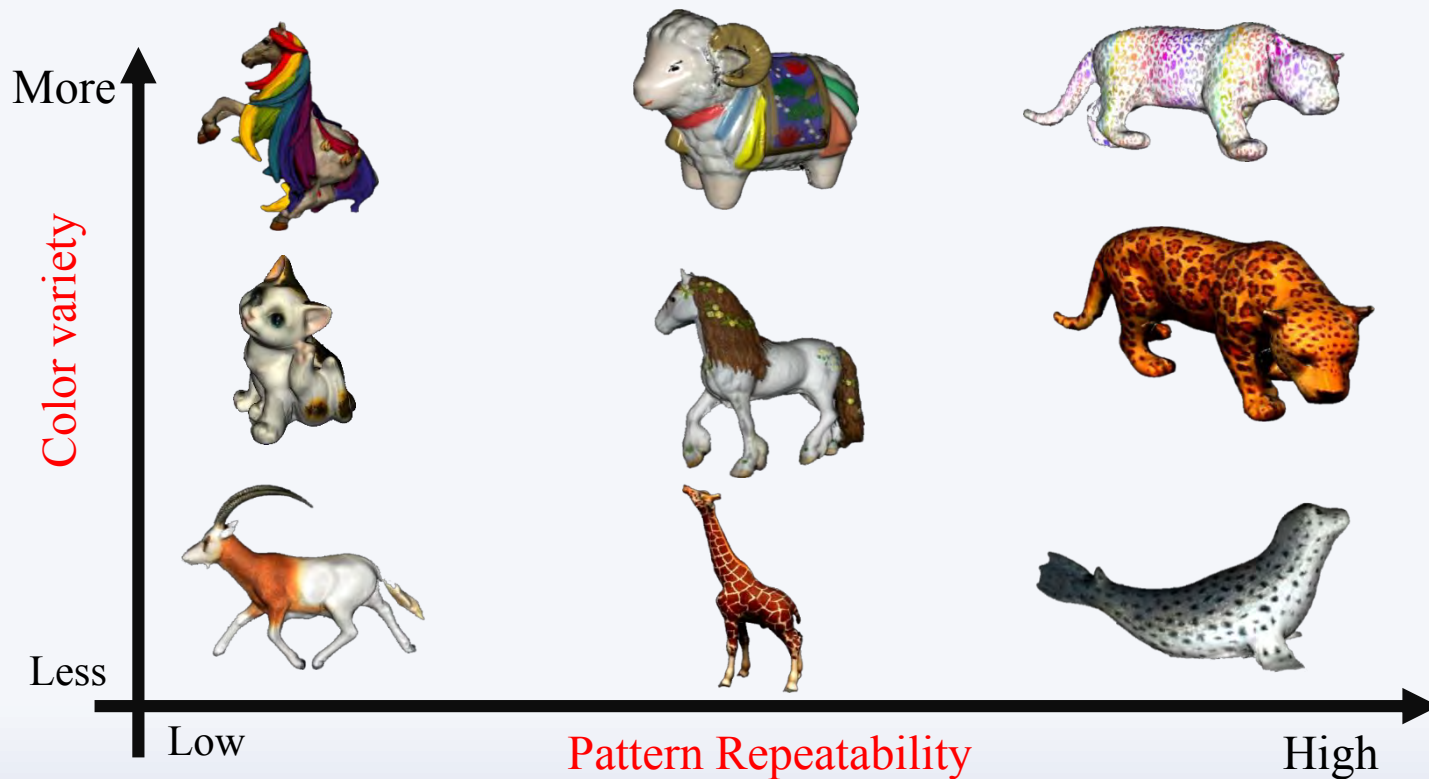
Each model has three parameters in selecting cut-off distance

- 0.5 mm (cut off distance)
- 1 mm (cut off distance)
- 2 mm (cut off distance)

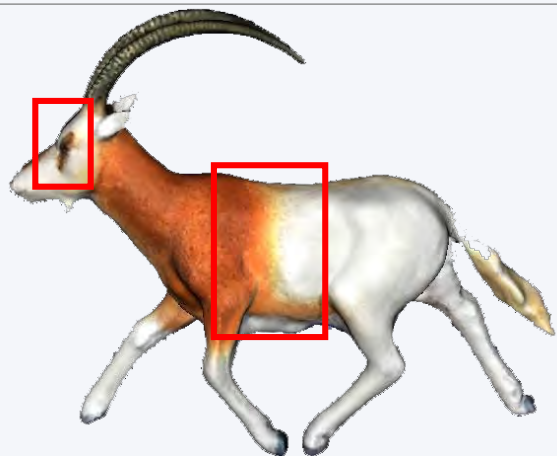
Hint: It should be at least greater than five times of average edge length.

Testing Model in Our Experiment

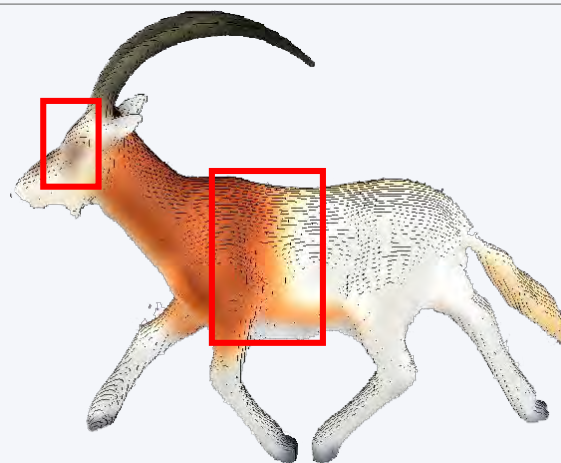
Totally, nine different types color models are used



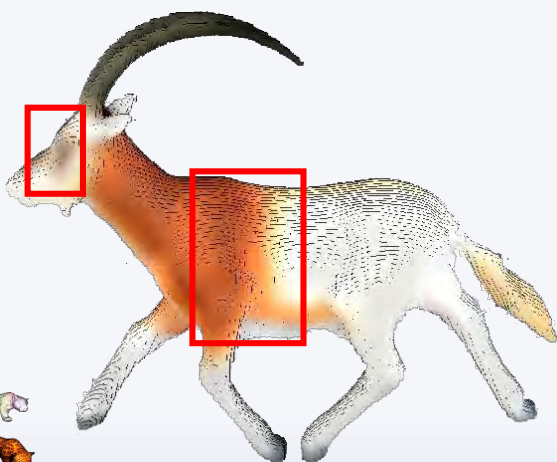
Goat



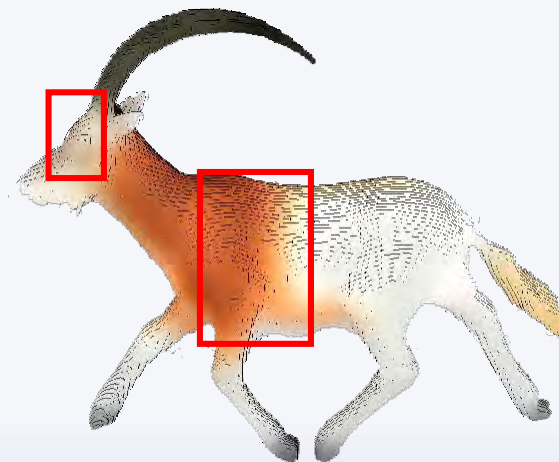
Original



0.5mm



1mm

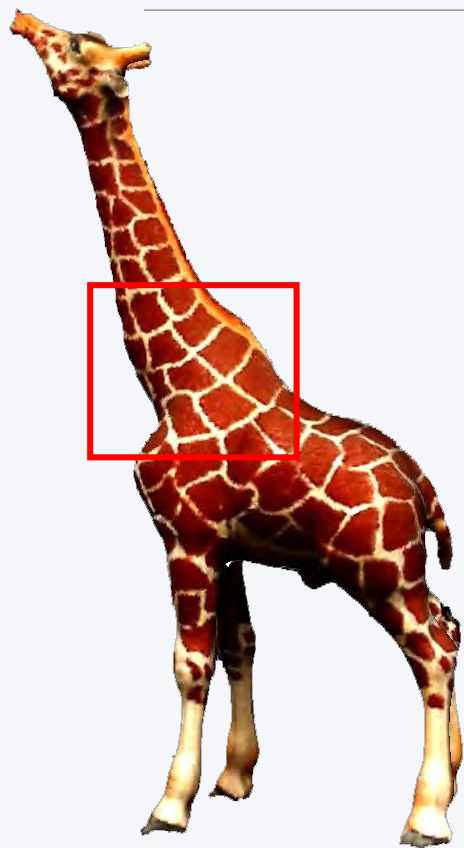


2mm

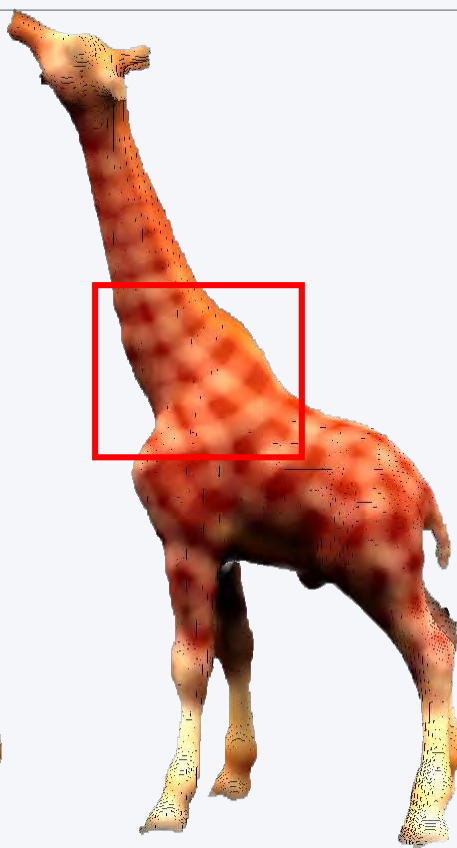
Average edge length in 3D model: 0.214mm



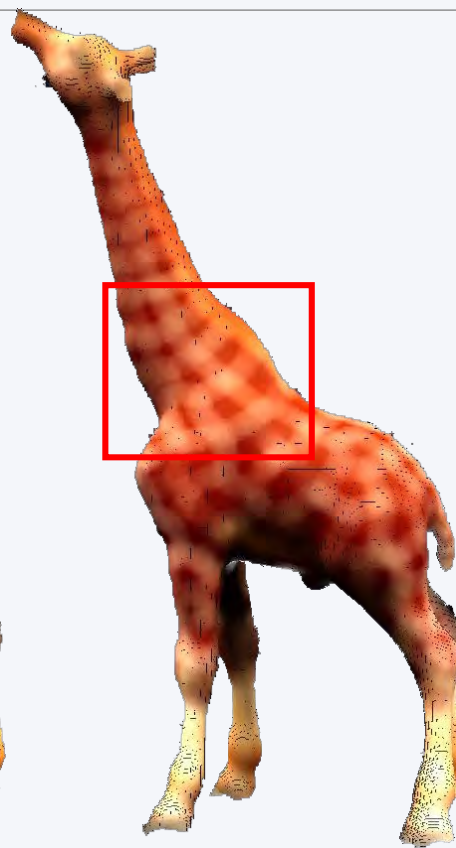
Giraffe



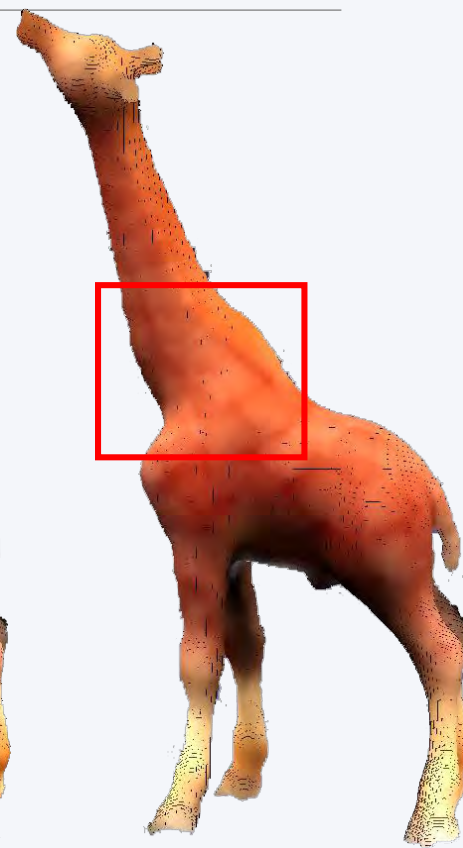
Original



0.5mm



1mm



2mm

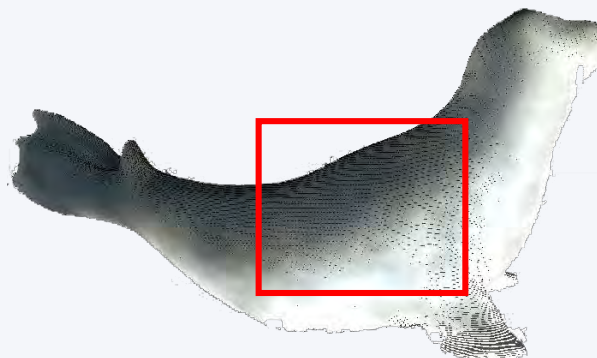
Average edge length in 3D model : 0.232mm



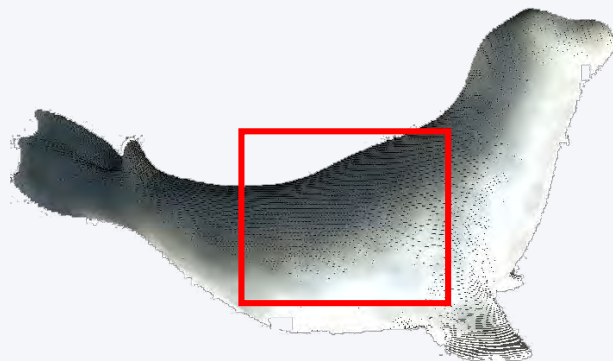
Seal



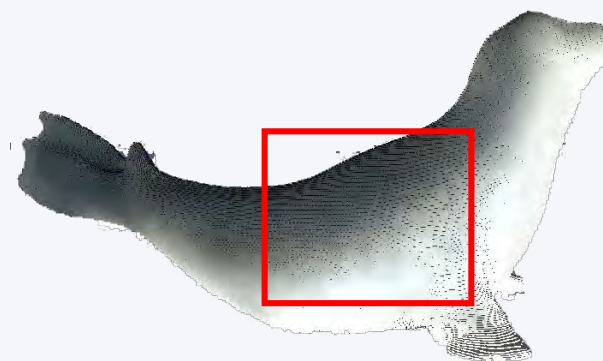
Original



0.5mm



1mm

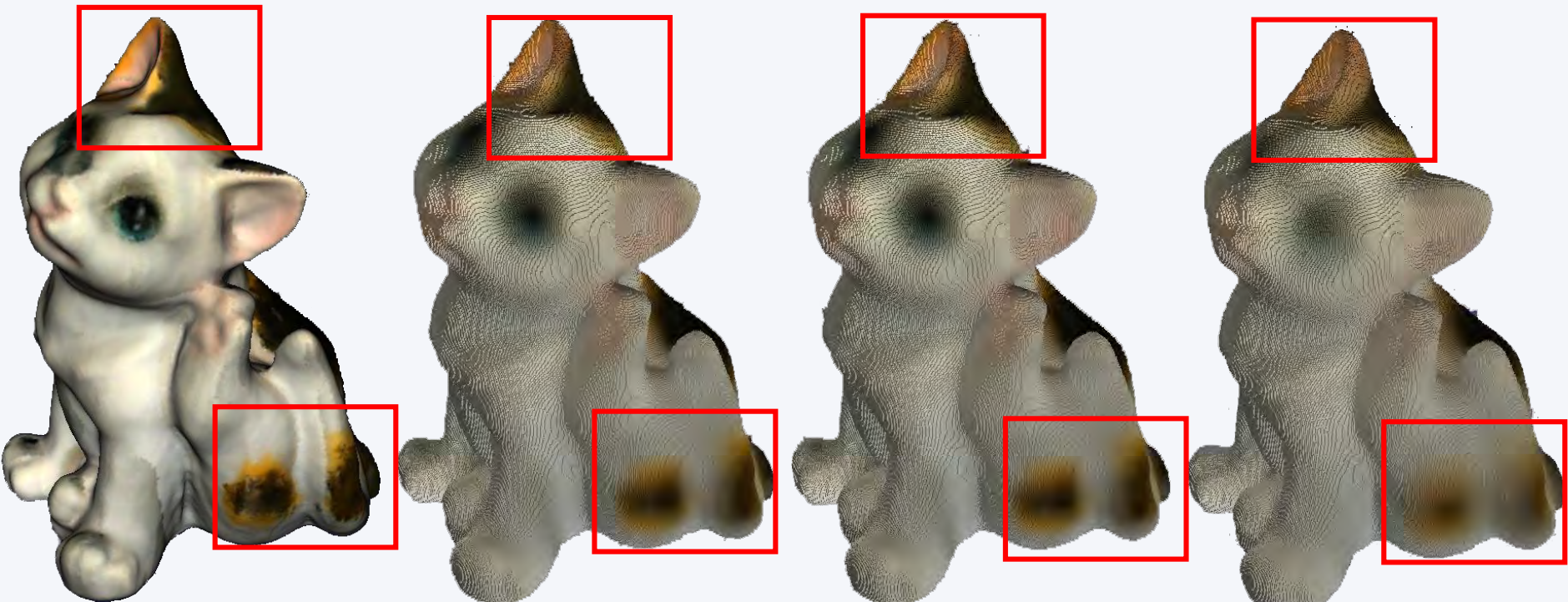


2mm

Average edge length in 3D model : 0.270mm



Cat



Original

0.5mm

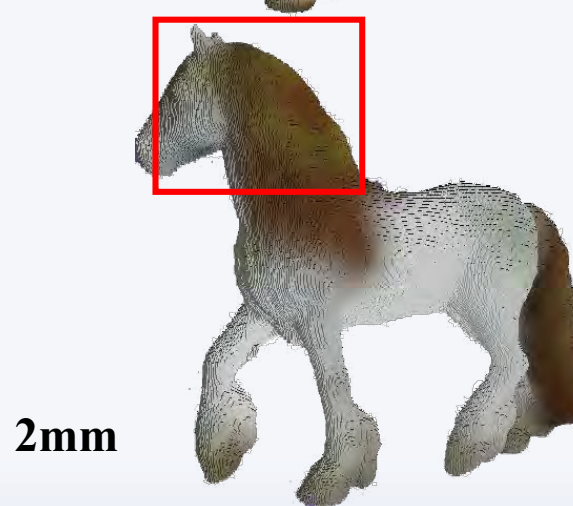
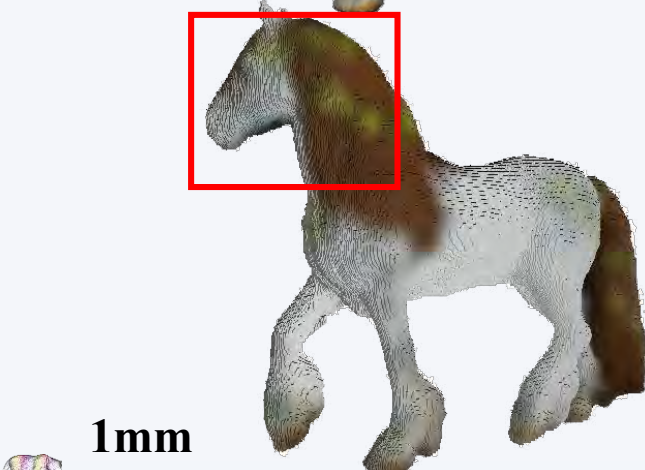
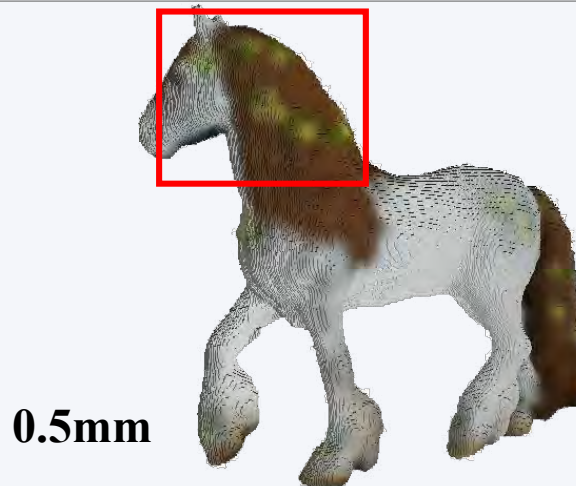
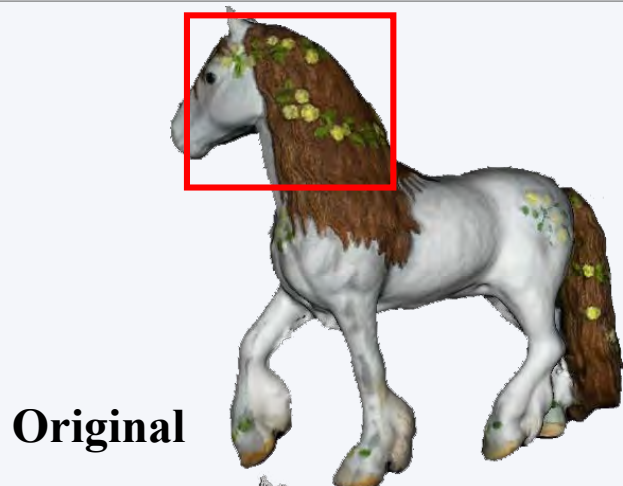
1mm

2mm

Average edge length in 3D model:0.206mm



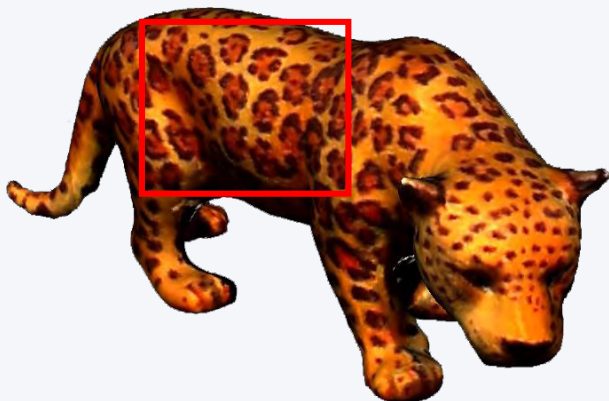
White Horse



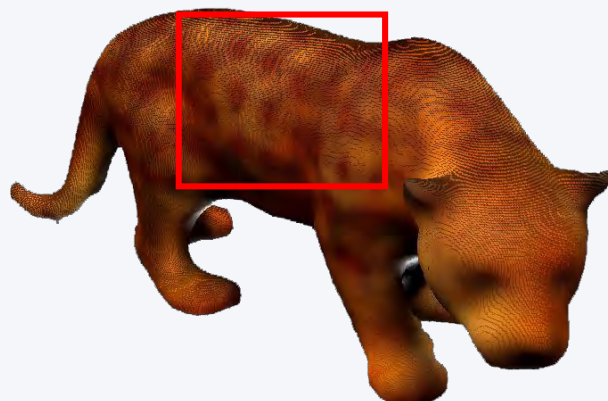
Average edge length in 3D model: 0.147mm



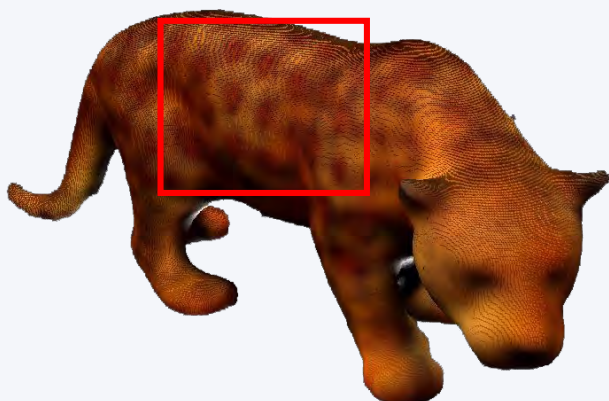
Leopard



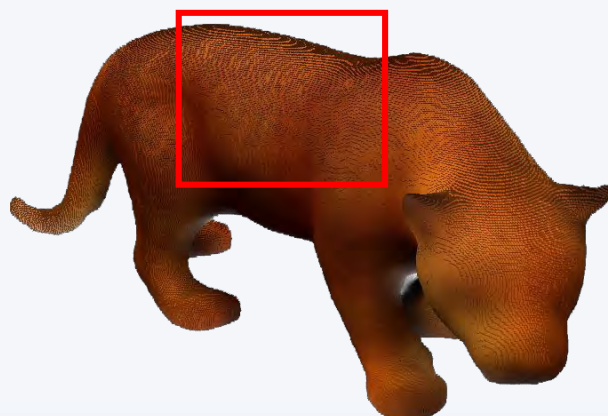
Original



0.5mm



1mm

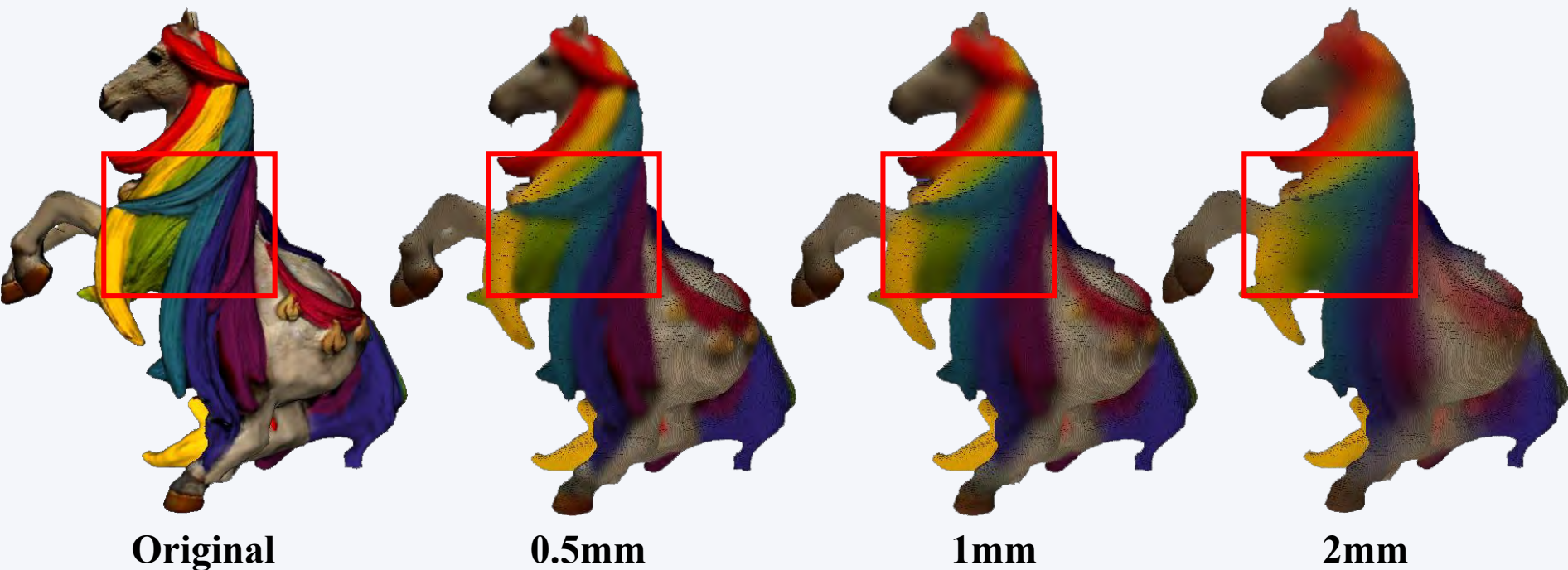


2mm

Average edge length in 3D model: 0.174mm



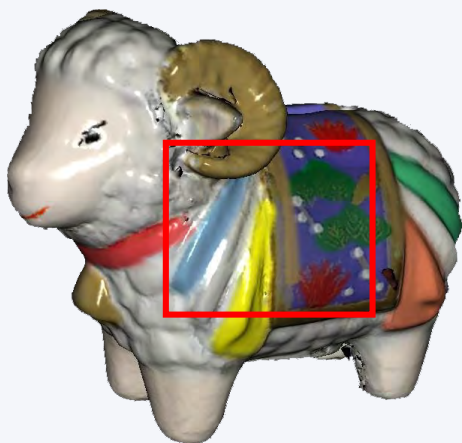
Color Horse



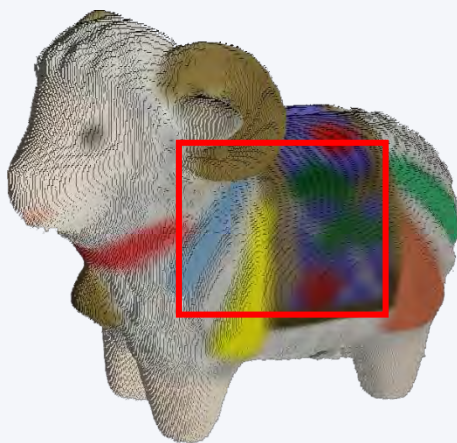
Average edge length in 3D model: 0.111mm



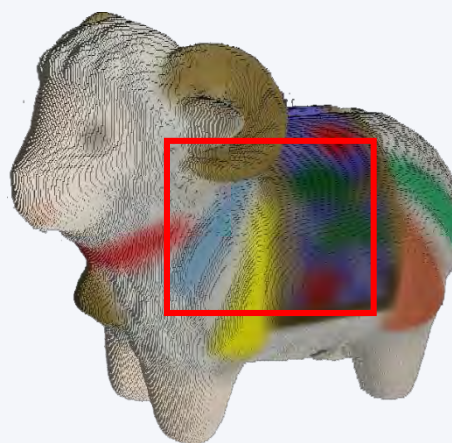
Sheep



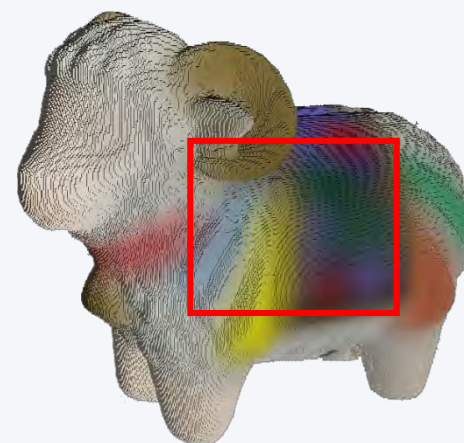
Original



0.5mm



1mm

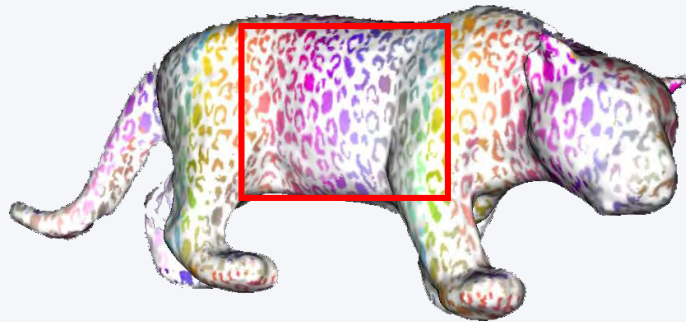


2mm

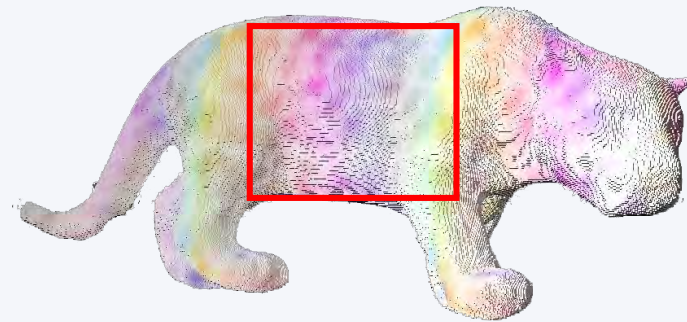
Average edge length in 3D model: 0.157mm



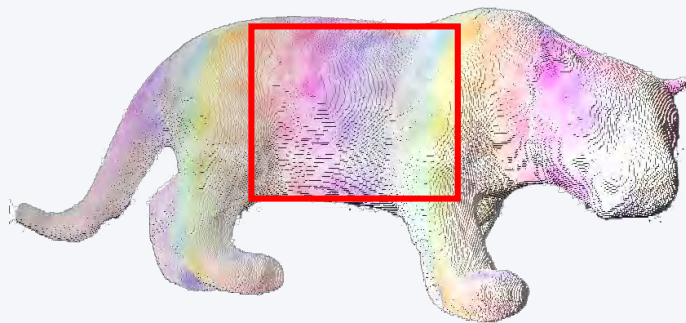
Color Leopard



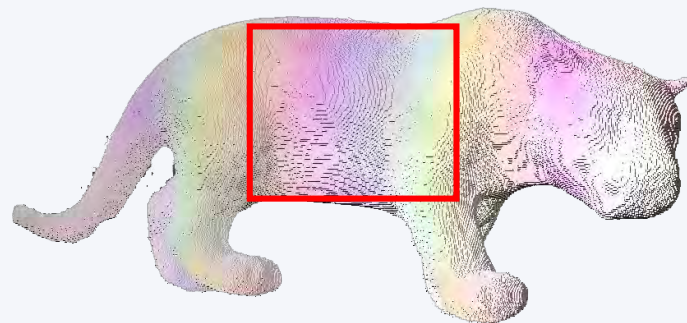
Original



0.5mm



1mm



2mm

Average edge length in 3D model: 0.174mm



Conclusion

- We can find good result on low pattern repeatability, but the result on high pattern repeatability will let model spot become blur or disappear.
- Color variety is less impact to our method
- Long cut-off distance cause blurrier than short cut-off distance
- We can solve the blur and disappear influence for future work.

Thank You!
