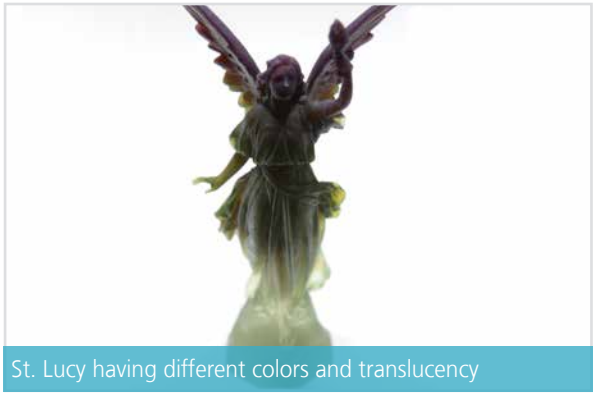
Design guidelines
for creating joint color and translucency 3D prints from RGBA-textured 3D models

These design guidelines help you to create 3D prints with spatially-varying joint color and translucency from 3D models with RGBA textures.

Please use the OBJ file format to store the 3D model and the PNG file format to store the RGBA texture.

You can use standard software, such as Adobe Photoshop, to create and modify the RGBA texture.

Anatomy model with opaque and transparent halves



St. Lucy having different colors and translucency

Head model with translucency gradient and constant skin color

Design rules for RGBA:

- Color is encoded by sRGB, translucency by A [*]
- Each RGBA channel has the same range:
  Most commonly 0-255 (8 Bit/channel)
  but also 0-65535 (16 Bit/channel) is possible.
  Please check the bit-depth when creating / saving the file.
  The descriptions/examples below use 8 Bit/channel.
  16 Bit/channel are accordingly.
- A = 0 indicates complete transparency with a color specified by RGB
- A = 255 indicates complete opacity with a color specified by RGB
- 0 < A < 255 indicate some "milky" translucent appearance, whereas small A are less milky (more transparent) than large A (more opaque). The color is specified by RGB.
  Example 1: In the St. Lucy model three RGBA values are interpolated from bottom to top. The value of A is smallest at the bottom and largest at the top.
  Example 2: The head model contains a gradient in the translucency parameter A without changing the RGB color. From the ear to the back of the head A is decreasing revealing the brain.
- RGBA = [255, 255, 255, 0]
  corresponds to a colorless transparent object.
  Example: Half of the Anatomy model's skin texture was changed to RGBA = [255,255,255,0] for making it fully transparent to reveal internal structures.
- RGBA = [152, 0, 0, 0]
  corresponds to a transparent object with a reddish tinge.

[*] according to:
Philipp Urban, Tejas Madan Tanksale, Alan Brunton, Bui Minh Vu, Shigeki Nakauchi,
Redefining A in RGBA: Towards a Standard for Graphical 3D Printing (https://arxiv.org/abs/1710.00546)

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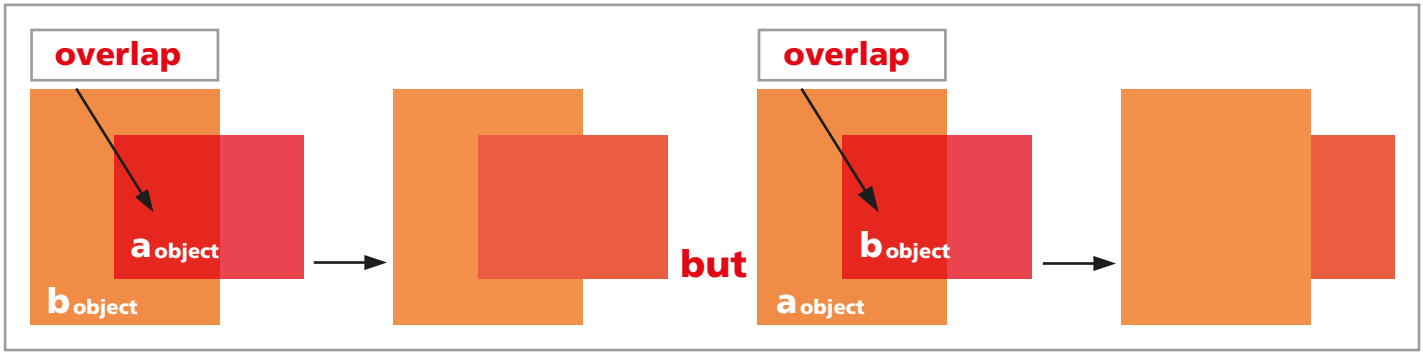
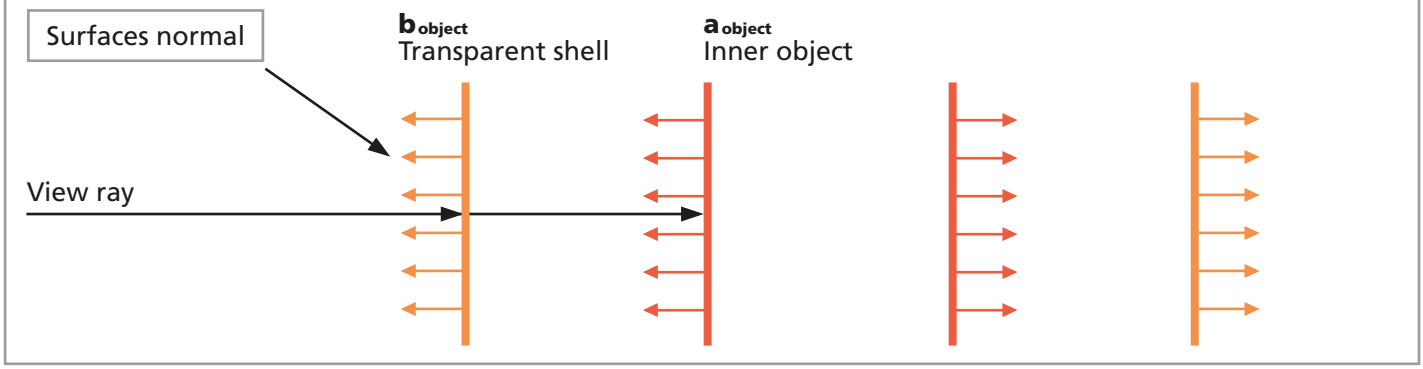
Design guidelines
Overlapping Object Priorities

- Each object shall be a saved in the same file as a seperate object. We recommend to use the OBJ file format
- Each object shall be named. The alphanumeric order of the names define the object priorities, e.g.
  - Assume two overlapping objects named **a** object and **b** object
  - **a** object has a higher prioritiy than **b** object since **a** object < **b** object (alphanumerically)
    i. e. voxel covered by **a** object and **b** object belong to **a** object

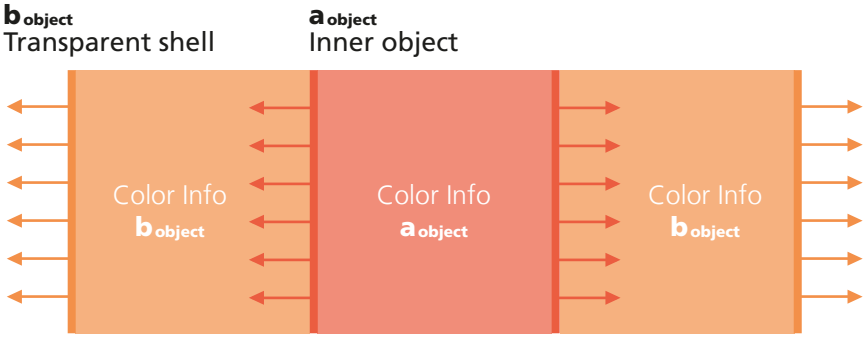


Definition of surfaces – Purpose: **a** object shall be visible through **b** object



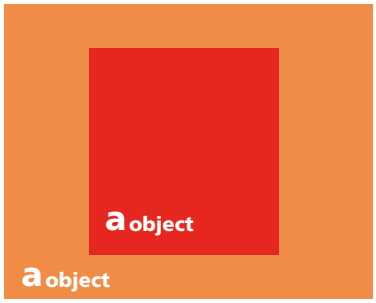
Definition of surfaces – Purpose: **a** object shall be visible through **b** object

RESULT:

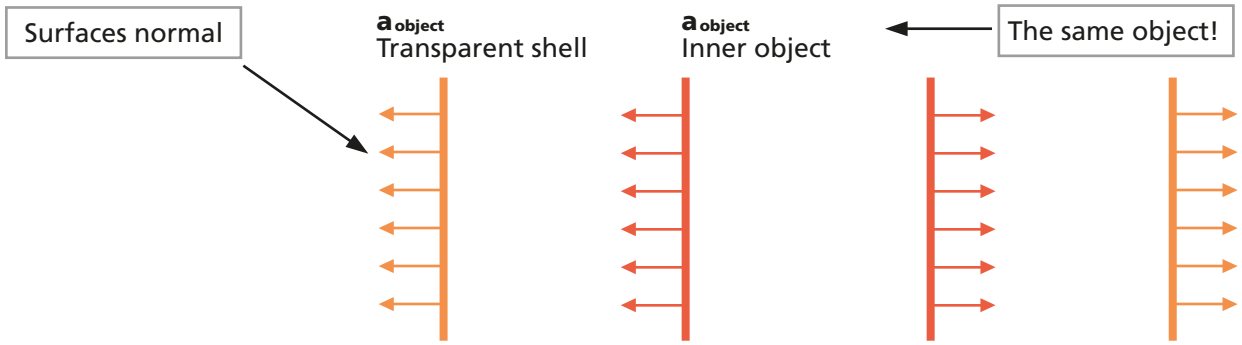


Design guidelines
Overlapping Object Priorities

Error Cases
Error 1: Defining just one Object

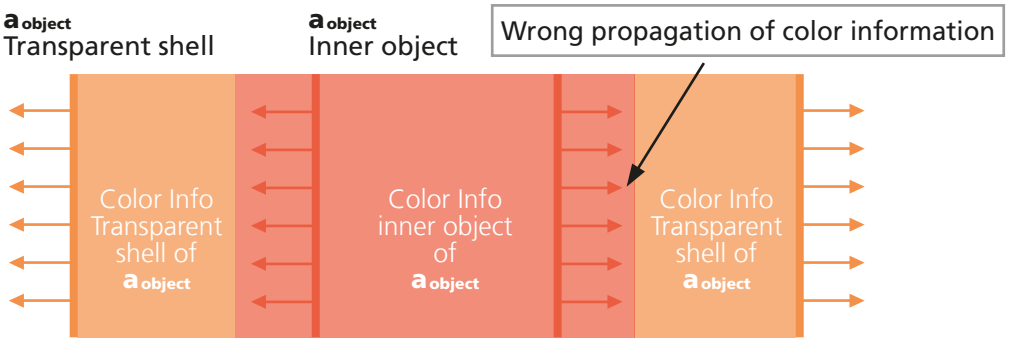


Definition of surfaces – Error "Only one object"



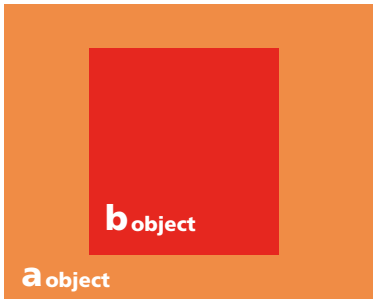
Volume interpretation – Error "Only one object"

RESULT:

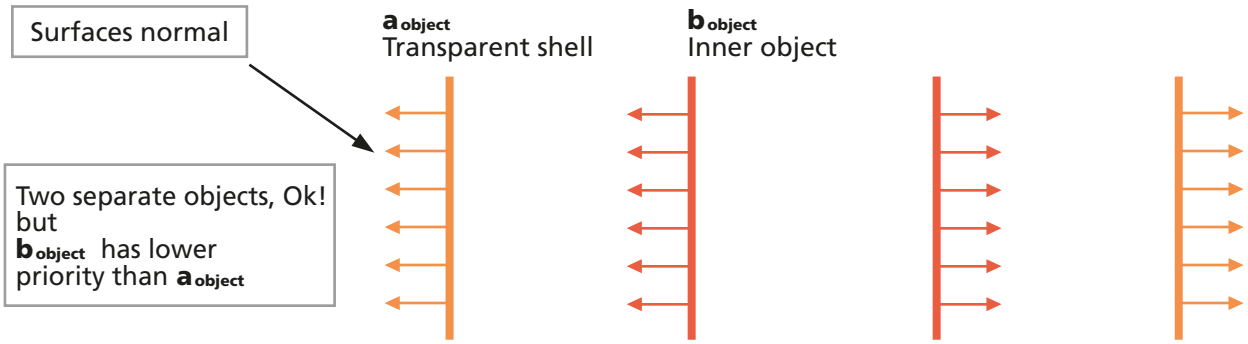


Design guidelines
Overlapping Object Priorities

Error Cases
Error 2: Wrong Priorities



Definition of surfaces – Error "Wrong priorities"



Volume interpretation – Error "Wrong priorities"

RESULT: