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# SurfaceLevel 2.0

## Overview

SurfaceLevel 2.0 is a texture converter and basic image editor. It loads many image file formats, converts to and from almost every video-game API texture (OpenGL, Vulkan, Metal, and Direct3D 12), offers a fast and high-quality resampler, and saves to many file formats. It is useful for performing nearly all video-game–related texture operations, such as compression, pre-multiplying alpha, generating normal maps, resampling/generating crisp mipmaps, etc., and for general-purpose image resampling, colorspace conversion, format conversion, etc. SurfaceLevel 2.0 is meant to gather a large quantity of features together and to provide more options for those features than you will find in any other tool. For example, when resampling, it is possible to specify different samplers for your image width, height, and depth, and different samplers for the RGB colors and the alpha channel—the sharpest resamplers often create ringing, which is particularly bad for the alpha channel; here you can using a ringing filter for the colors but a non-ringing filter for alpha (while specifying the same or different filters for both the color and alpha widths, heights, and depths).

SurfaceLevel 2.0 seeks to be useful in the level of detail for each feature, the number of features, and the performance of each feature. Supports volume (3-D) textures, texture arrays, cube maps, and mipmaps.

## Control Flow

SurfaceLevel 2.0 doesn’t try to be overly smart, so as long as you understand the basic internal workflow it should be easy to predict what it will do in any edge cases. Internally it performs the following operations in order:

1. Loads the image file.
2. Performs a conversion to the desired target format.
   1. Converts to RGBA64F.
   2. Converts to linear, applying any applicable colorspace conversions and gamma corrections necessary.
   3. Applies requested transforms, such as swapping, swizzling, flipping, pre-multiplying, etc.
   4. Generates mipmaps.
   5. Converts to the requested texture format, applying gamma-correction as necessary, etc.
3. Saves to the desired file.
   1. If the current format is not directly supported by the file, it is converted to the nearest format that is supported by the file.

The ways it tries to be smart:

1. By default, it will try to ensure only 1 gamma transform occurs from source to linear and from linear to destination. If images do not contain gamma data, they are assumed to be sRGB (-g, -gamma, -srgb, -rgbe, and -linear to change this assumption). If they contain gamma data, whether implicit by the format (VK\_FORMAT\_B8G8R8\_SRGB, for example) or from an embedded ICC profile, that is used instead. However, if you manually supply a source gamma value with -g, -gamma, -srgb, -rgbe, or -linear, your supplied gamma will be stacked with any contained/embedded gamma data. This can allow you to correct images that may have been saved with incorrect gamma. To specify your own gamma curve to be used *in-place* of any embedded or selected colorspace profiles, use -g, -gamma, -srgb, -rgbe, or -linear to define your own gamma curve and -ignore\_input\_colorspace\_gamma to ignore the gamma curve in any colorspace profiles being used.
2. To simplify the process, it is not necessary to specify the export format. If your conversion format is not supported, it will find the closest match that is supported. It will try to ensure a lossless conversion, but the option to specify the export format is always available if needed. This only applies to general image formats. For specialized GPU-leaning formats, such as DDS, PVR, etc., a conversion to a file-supported format must be made.

# Commands

## File

|  |  |  |
| --- | --- | --- |
| Command | Parameter | Description |
| -file | <file\_path> | A path to an image file to load and convert.  The **-file** and **-outfile** commands can be used multiple times to load and save multiple files. |
| -outfile  -out\_file | <file\_path> | The path to which to save the file supplied with the last **-file** command.  The destination file format is determined by the file extension. Currently supported formats: PNG BMP TGA JPG J2K JP2 EXR DDS KTX PVR |

## Gamma/Colorspaces

|  |  |  |
| --- | --- | --- |
| Command | Parameter | Description |
| -gamma  -g | <gamma> | Sets the input gamma power. Defaults to -0.454545454545 (precise sRGB). |
| -targetgamma | <gamma> | Sets the output gamma power.  Defaults to -0.454545454545 (precise sRGB). |
| -rgbe  -linear |  | Sets the source and output gamma to 0.0. |
| -srgb |  | Sets the source gamma to -0.454545454545 (precise sRGB). |
| -target\_srgb |  | Sets the output gamma to -0.454545454545 (precise sRGB). |
| -input\_colorspace | sRGB  sRGB\_precise | Sets the source colorspace profile to an accurate no-gap sRGB. |
| sRGB\_std  sRGB\_standard | Sets the source colorspace profile to the standard sRGB. |
| smpte\_170  smpte\_170m  170m | Sets the source colorspace profile to an accurate no-gap SMPTE 170M-1999. |
| smpte\_170\_std  smpte\_170m\_std  170m\_std  smpte\_170\_standard  smpte\_170m\_standard  170m\_standard | Sets the source colorspace profile to the standard SMPTE 170M-1999. |
| rec709  rec.709  bt709  bt.709  itu\_bt709  itu\_bt.709 | Sets the source colorspace profile to an accurate no-gap ITU-R Recommendation BT.709-5. |
| rec709\_std  rec.709\_std  bt709\_std  bt.709\_std  itu\_bt709\_std  itu\_bt.709\_std  rec709\_standard  rec.709\_standard  bt709\_standard  bt.709\_standard  itu\_bt709\_standard  itu\_bt.709\_standard | Sets the source colorspace profile to the standard ITU-R Recommendation BT.709-5. |
| adobe  adobergb  adobe\_rgb | Sets the source colorspace profile to Adobe RGB (1998) Color Image Encoding Version 2005-05. |
| bt2020  bt.2020  itu\_bt2020  itu\_bt.2020 | Sets the source colorspace profile to an accurate no-gap ITU-R Recommendation BT.2020. |
| bt2020\_std  bt.2020\_std  itu\_bt2020\_std  itu\_bt.2020\_std  bt2020\_standard  bt.2020\_standard  itu\_bt2020\_standard  itu\_bt.2020\_standard | Sets the source colorspace profile to the standard ITU-R Recommendation BT.2020. |
| dcip3  dci-p3  dci\_p3 | Sets the source colorspace profile to SMPTE RP 431-2:2011. |
| smpte\_240  smpte\_240m  240m | Sets the source colorspace profile to an accurate no-gap SMPTE 240M-1999. |
| smpte\_240\_std  smpte\_240m\_std  240m\_std  smpte\_240\_standard  smpte\_240m\_standard  240m\_standard | Sets the source colorspace profile to the standard SMPTE 240M-1999. |
| ntsc\_1953  ntsc1953 | Sets the source colorspace profile to an accurate no-gap NTSC 1953. |
| ntsc\_1953\_std  ntsc1953\_std  ntsc\_1953\_standard  ntsc1953\_standard | Sets the source colorspace profile to the standard NTSC 1953. |
| tech\_3213  tech3213 | Sets the source colorspace profile to an accurate no-gap EBU Tech. 3213. |
| tech\_3213\_std  tech3213\_std  tech\_3213\_standard  tech3213\_standard | Sets the source colorspace profile to the standard EBU Tech. 3213. |
| displayp3  display-p3  display\_p3 | Sets the source colorspace profile to an accurate no-gap Display P3 Color Encoding (v 1.0). |
| displayp3\_std  display-p3\_std  display\_p3\_std  displayp3\_standard  display-p3\_standard  display\_p3\_standard | Sets the source colorspace profile to the standard Display P3 Color Encoding (v 1.0). |
| rec601  rec.601  bt601  bt.601  itu\_bt601  itu\_bt.601 | Sets the source colorspace profile to an accurate no-gap ITU-R Recommendation BT.601 (525). |
| rec601\_std  rec.601\_std  bt601\_std  bt.601\_std  itu\_bt601\_std  itu\_bt.601\_std  rec601\_standard  rec.601\_standard  bt601\_standard  bt.601\_standard  itu\_bt601\_standard  itu\_bt.601\_standard | Sets the source colorspace profile to the standard ITU-R Recommendation BT.601 (525). |
| rec601\_pal  rec.601\_pal  bt601\_pal  bt.601\_pal  itu\_bt601\_pal  itu\_bt.601\_pal | Sets the source colorspace profile to an accurate no-gap ITU-R Recommendation BT.601 (625). |
| rec601\_pal\_std  rec.601\_pal\_std  bt601\_pal\_std  bt.601\_pal\_std  itu\_bt601\_pal\_std  itu\_bt.601\_pal\_std  rec601\_pal\_standard  rec.601\_pal\_standard  bt601\_pal\_standard  bt.601\_pal\_standard  itu\_bt601\_pal\_standard  itu\_bt.601\_pal\_standard | Sets the source colorspace profile to the standard ITU-R Recommendation BT.601 (625). |
| generic\_film  film | Sets the source colorspace profile to generic film. |
| bt470\_ntsc  bt470\_m\_ntsc | Sets the source colorspace profile to an accurate no-gap Rec. ITU-R BT.470-6 (M/NTSC). |
| bt470\_pal  bt470\_m\_pal | Sets the source colorspace profile to an accurate no-gap Rec. ITU-R BT.470-6 (M/PAL). |
| bt470\_b  bt470\_b1  bt470\_d  bt470\_d1  bt470\_g  bt470\_h  bt470\_k  bt470\_k1  bt470\_l  bt470\_n\_pal  bt470\_secam  bt470\_l\_secam | Sets the source colorspace profile to an accurate no-gap Rec. ITU-R BT.470-6 (B, B1, D, D1, G, H, K, N/PAL, K1, L/SECAM). |
| ntsc\_1987  smpte\_c | Sets the source colorspace profile to SMPTE C with a pow(2.2) curve. |
| ntsc\_1987\_std  smpte\_c\_std | Sets the source colorspace profile to the standard SMPTE C. |
| romm\_rgb  rommrgb | Sets the source colorspace profile to Reference Output Medium Metric RGB (ROMM RGB). |
| rimm\_rgb  rimmrgb | Sets the source colorspace profile to Reference Input Medium Metric RGB (RIMM RGB). |
| erimm\_rgb  erimmrgb | Sets the source colorspace profile to Extended Reference Input Medium Metric RGB (ERIMM RGB). |
| plasa  plasa\_ansi | Sets the source colorspace profile to PLASA ANSI E1.54. |
| protune  gopro | Sets the source colorspace profile to Protune Native (GoPro). |
| s-gamut  sgamut  s\_gamut | Sets the source colorspace profile to S-Gamut. |
| s-gamut3  sgamut3  s\_gamut3 | Sets the source colorspace profile to S-Gamut3. |
| s-gamut3cine  sgamut3cine  s\_gamut3cine  s-gamut3\_cine  sgamut3\_cine  s\_gamut3\_cine | Sets the source colorspace profile to S-Gamut3.Cine. |
| -target\_colorspace | Same as for  **-input\_colorspace**. | Sets the output colorspace profile. |
| -input\_colorspace\_file | <file\_path> | Sets the input colorspace profile. Loads .ICC and .ICM files. |
| -target\_colorspace\_file | <file\_path> | Sets the output colorspace profile. Loads .ICC and .ICM files. |
| -dont\_embed\_icc |  | No colorspace profile will be embedded into files with colorspace-profile support. |
| -embed\_icc |  | Any specified output colorspace profiles will be embedded into files with colorspace-profile support. This is the default. |
| -ignore\_input\_colorspace\_gamma |  | The gamma in any supplied or embedded input colorspace profile will be ignored. |
| -rendering\_intent  -render\_intent | perceptual | All colors are scaled to fit into the target colorspace. Useful for converting from wide colorspaces to more narrow ones. |
| relative\_colorimetric | Colors in gamut are unchanged, but colors outside of gamut are clipped to the nearest in-gamut color.  This is the default. |
| saturation | Like **perceptual**, but tends to make colors more saturated. |
| absolute\_colorimetric | Not intended for color conversion, but rather typically for digital inkjet proofing. |

## Resampling

|  |  |  |
| --- | --- | --- |
| Command | Parameter | Description |
| -filter | box  point | Applies the selected filter to all non-mipmap filters. |
| tent  linear | The default mipmap alpha filter. |
| quadraticsharp  quadratic\_sharp | The default non-mipmap filter. |
| quadratic |  |
| quadraticapprox  quadraticapproximate  quadratic\_approximate |  |
| quadraticmix  quadratic\_mix |  |
| kaiser |  |
| lanczos2 |  |
| lanczos3 |  |
| lanczos4 |  |
| lanczos6 |  |
| lanczos8 |  |
| lanczos12 |  |
| lanczos64 |  |
| mitchell | One of the best choices for upscaling. |
| catmul  catmulrom  catmul\_rom  catmul-rom |  |
| bspline  b-spline  b\_spline |  |
| cardinal  card  cardinaluniform  cardinal\_uniform | The default mipmap color filter. |
| hermite |  |
| hamming |  |
| hanning |  |
| blackman |  |
| gaussiansharp  gaussian\_sharp |  |
| gaussian |  |
| bell |  |
| -filterw | Same as for **-filter**. | Sets the non-mipmap color and alpha *width* filter. |
| -filterh | Same as for **-filter**. | Sets the non-mipmap color and alpha *height* filter. |
| - filterd | Same as for **-filter**. | Sets the non-mipmap color and alpha *depth* filter. |
| -filterw\_color | Same as for **-filter**. | Sets the non-mipmap color *width* filter. |
| -filterh\_color | Same as for **-filter**. | Sets the non-mipmap color *height* filter. |
| -filterd\_color | Same as for **-filter**. | Sets the non-mipmap color *depth* filter. |
| -filterw\_alpha | Same as for **-filter**. | Sets the non-mipmap alpha *width* filter. |
| -filterh\_alpha | Same as for **-filter**. | Sets the non-mipmap alpha *height* filter. |
| -filterd\_alpha | Same as for **-filter**. | Sets the non-mipmap alpha *depth* filter. |
| -mip\_filter | Same as for **-filter**. | Applies the selected filter to all mipmap filters. |
| -mip\_filterw | Same as for **-filter**. | Sets the mipmap color and alpha *width* filter. |
| -mip\_filterh | Same as for **-filter**. | Sets the mipmap color and alpha *height* filter. |
| -mip\_filterd | Same as for **-filter**. | Sets the mipmap color and alpha *depth* filter. |
| -mip\_filterw\_color | Same as for **-filter**. | Sets the mipmap color *width* filter. |
| -mip\_filterh\_color | Same as for **-filter**. | Sets the mipmap color *height* filter. |
| -mip\_filterd\_color | Same as for **-filter**. | Sets the mipmap color *depth* filter. |
| -mip\_filterw\_alpha | Same as for **-filter**. | Sets the mipmap alpha *width* filter. |
| -mip\_filterh\_alpha | Same as for **-filter**. | Sets the mipmap alpha *height* filter. |
| -mip\_filterd\_alpha | Same as for **-filter**. | Sets the mipmap alpha *depth* filter. |
| -prescale | <new width> <new height> | Resamples the image to the given width/height using the selected non-mipmap filters. |
| -prescale3  -resample\_size | <new width> <new height> <new depth> | Resamples the image to the given width/height/depth using the selected non-mipmap filters. |
| -resample\_to | nearest | Resamples to the nearest power of 2 in each dimension. |
| lo | Resamples to the next power-of-2 down. |
| hi | Resamples to the next power-of-2 up. |
| -rel\_scale | <width multiplier> <height multiplier> | Resamples by the given width and height multipliers. |
| -rel\_scale3 | <width multiplier> <height multiplier> <depth multiplier> | Resamples by the given width, height, and depth multipliers. |
| -clamp2  -clamp | <width> <height> | Clamps the image to the given width and height. |
| -clamp3 | <width> <height> <depth> | Clamps the image to the given width, height, and depth. |

## Texture Addressing

|  |  |  |
| --- | --- | --- |
| Command | Parameter | Description |
| -textureaddressing  -ta | clamp | U, V, and W coordinates are clamped to the edge of the texture.  Equal to D3D12\_TEXTURE\_ADDRESS\_MODE\_CLAMP. |
| repeat  wrap | U, V, and W coordinates repeat beyond the 0..1 range. Equal to D3D12\_TEXTURE\_ADDRESS\_MODE\_WRAP. |
| mirror  reflect | U, V, and W are mirrored beyond the 0..1 range.  Equal to D3D12\_TEXTURE\_ADDRESS\_MODE\_MIRROR. |
| mirroronce  mirror\_once | U, V, and W are mirrored 1 time beyond the 0..1 range, after which clamping is used.  Equal to D3D12\_TEXTURE\_ADDRESS\_MODE\_MIRROR\_ONCE. |
| border  bordercolor  border\_color | The border color is used when U, V, and W go outside of 0..1.  Equal to D3D12\_TEXTURE\_ADDRESS\_MODE\_BORDER. |
| no\_border  nul\_border | Nothing is considered to exist beyond the U, V, and W texture edges. This is the default. |
| -textureaddressingw  -taw | Same as **-ta**. | Applies only to the U coordinate. |
| -textureaddressingh  -tah | Same as **-ta**. | Applies only to the V coordinate. |
| -textureaddressingd  -tad | Same as **-ta**. | Applies only to the W coordinate. |
| -textureaddressingw\_opaque  -taw\_opaque | Same as **-ta**. | Applies only to the U coordinate and to color channels. |
| - textureaddressingh\_opaque -tah\_opaque | Same as **-ta**. | Applies only to the V coordinate and to color channels. |
| - textureaddressingd\_opaque  -tad\_opaque | Same as **-ta**. | Applies only to the W coordinate and to color channels. |
| - textureaddressingw\_alpha  -taw\_alpha | Same as **-ta**. | Applies only to the U coordinate and to the alpha channel. |
| -textureaddressingh\_alpha  -tah\_alpha | Same as **-ta**. | Applies only to the V coordinate and to the alpha channel. |
| -textureaddressingd\_alpha  -tad\_alpha | Same as **-ta**. | Applies only to the W coordinate and to the alpha channel. |
| -border\_color | <r> <g> <b> | Sets the border color for the U, V, and W coordinates. Defaults to **0.0 0.0 0.0**. |

# Notes

## Texture Addressing

* Texture addressing is used during resampling and normal-map creation.
* For standard image resampling, **nul\_border** is appropriate, as it will only sample from in-image texels, meaning no influence from outside 0..1 at all. For in-game textures, select the addressing mode that matches how it will be addressed in the game.