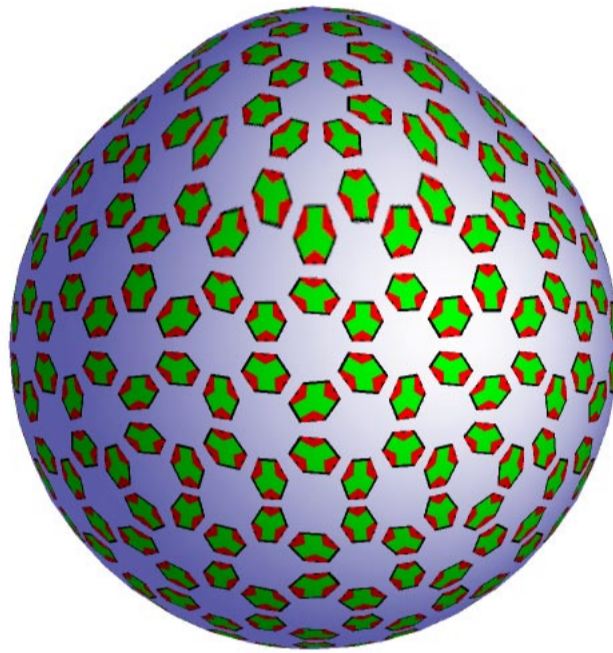


Gernot Hoffmann

Morphing



Contents

1. Introduction	2
2. Algorithms	2
3. Example	3
4. References	4

Settings for Acrobat

Edit / Preferences / General / Page Display (since version 6)

Custom Resolution 72 dpi / **View by zoom 100% or 200%**

Edit / Preferences / General / Color Management (full version only)

sRGB

Euroscale Coated or ISO Coated or SWOP

Gray Gamma 2.2

1. Introduction

Morphing means: shift all pixels in a 'relevant area' according to a vector field. It is used here for moderate corrections in photos, mainly portraits. It is not used for funny effects and for large areas. Typical applications are corrections for mouths, eyes and ears. Even moderate morphing will shift pixels considerably which results in interpolation problems.

Large area corrections like perspective rectifications are handled differently.

The morphing editor requires an understandable visualization of the intended effects and a fast undo function, here by right mouse click.

2. Algorithms

The morphing editor shows a center point, a pull point and a circle or ellipse as an indicator for the relevant area which is itself a square. For shifts the shift of the center is also shown by a vector. This is not necessary for magnifier functions (pin cushion or barrel distortion).

The execution of the operation works by these steps:

Make an upsampled copy of the relevant area in a copy frame buffer. The size of the frame buffer is limited. Small relevant areas are upsampled by a factor 16, larger by integer factors 15 to 1.

Upsampling is done with gamma correction and bilinear interpolation.

Apply vector field in copy frame buffer.

Replace relevant area in source image by downscaled nearest neighbours in copy frame buffer, using gamma correction.

Gamma correction means: source pixel values C' are copied as $C=C'^{2.2}$ to the frame buffer and interpolated there. Frame buffer pixels are copied as $C'=C^{1/2.2}$ to the source image.

The gamma correction works through tables. The correction is important for single pixel lines and transitions between complementary colors. A transition between magenta and green may deliver interpolated gray values 128 without gamma correction, which is far too dark. With gamma correction the gray value is 186 which looks better. For average photos the gamma correction is less important.

All vector field shifts are washed out or blended at the periphery of the relevant area with respect to the rest of the image.

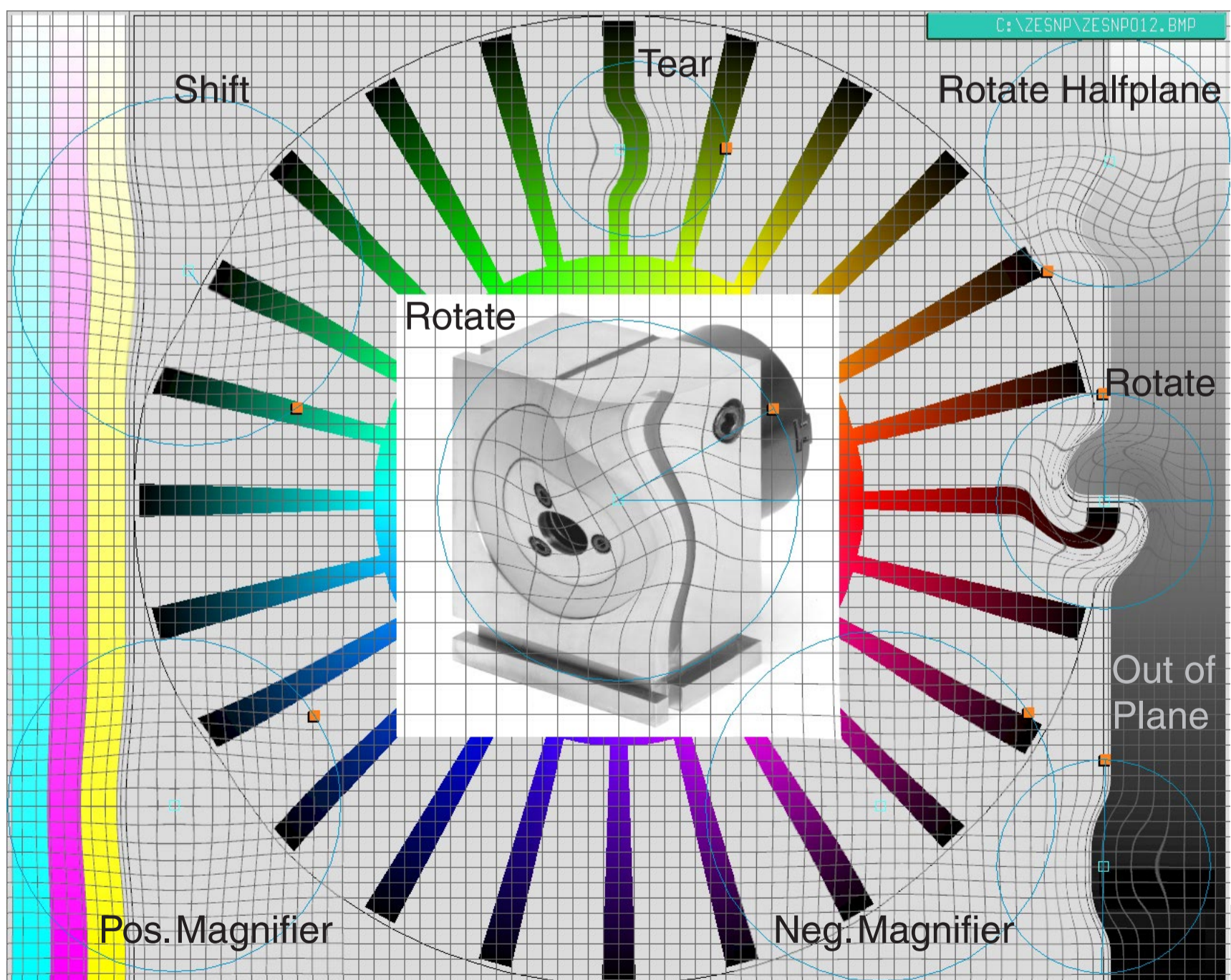
3. Example

Grids and single pixel lines are strong tests. The quality could be better. Because the actual morphing is an interactive process, it has to work very fast, the interpolation is limited to bilinear instead of bicubic or B-Spline. For photos the quality is satisfying.

The image shows different applications:

- Shift
- Tear
- Rotate
- Rotate Halfplane
- Positive Magnifier
- Negative Magnifier
- Out of Plane

Use zoom 200% for this image (see p.1)



4. References

- [1] G.Hoffmann
Bilinear, biquadratic, bicubic and bicubic B-spline Interpolation
<http://docs-hoffmann.de/bicubic03042002.pdf>

This doc:

<http://docs-hoffmann.de/morph27092003.pdf>