AnaBuilder

3-D Image Rendering Guide

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http://anabuilder.free.fr/welcomeEN.html

Be careful : the following explanations are for the old windows-only version. Major features are also common to the new java version, but you can find few differences here or there. Particularly, the stereo-morphing is specifique to the old windows version. The new Java version offers a new experimental tool : see http://anabuilder.free.fr/2D3DSculptor/index.html

Anaglyph

To see depth each eye needs a different image, corresponding to the shifted position of the eyes at the time of observation (about 6 cm) An anaglyph is an image obtained by the superposition of these 2 images in complementary colors, for example Red and Cyan. By looking at this image with a Red/Cyan glasses, the left eye sees the Red image (original left), while the right eye sees the Cyan (original right) image. The brain recomposes the full colors and gives the impression to see an image having all the colors the originals... and with depht !

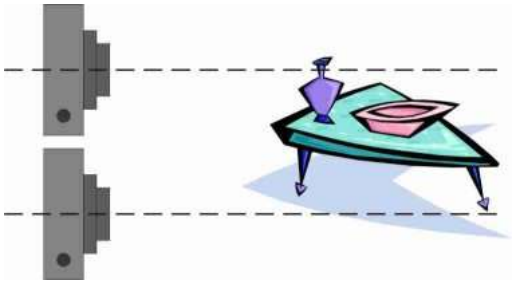
That goes very well for all the colors which are not too close to the Red or the Cyan. Because if not, there is only one eye which sees the part of the image of this color : a bush of roses with red flowers does not look very well in Anaglyph. In this case, the automatic function of desaturation of reds and cyans of AnaBuilder will enable you to correct the colours so as to make the Anaglyph observable : the flowers will not be red any more, but they will be visible in the colour of your choice (violets, yellows, black.. pink?).

It should not be forgotten that 3D photography, is above all photography. So, AnaBuilder integrates some basic functions which will enable you to improve the quality of the result. Some of these functions have a direct influence on the quality of the 3D perception (as the filter of vertical edges improvement), others make it possible to catch up with certain errors made during photoshooting : luminosity, colors, etc...
Learn to use them sparingly, because nothing will replace good shots.

If one does not have a camera with 2 objectives, it is only possible to photograph motionless subjects. Even a minimal displacement of the subject completely distorts the 3D result. But with a camera with 2 objectives, it is possible to shoot in 3D all the drops in suspension of a fountain (splendid!).

Photographs

Take 2 shifted photographs :



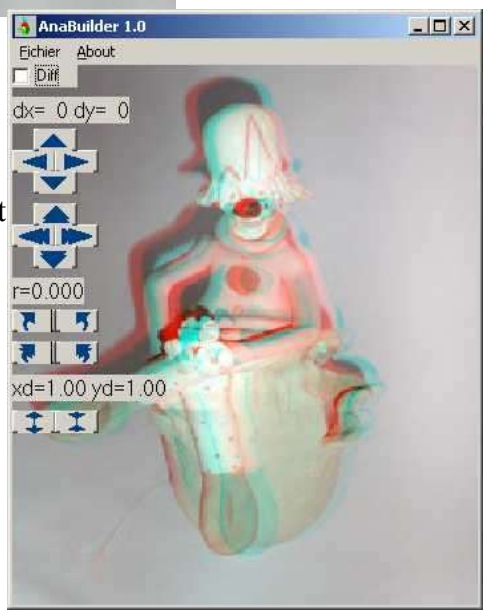
- The camera must be moved horizontally, from left to right, without rotation, advancing or back move.
- The shift can be of 3 or 4 cm for a close object, and 7 or 8 cm for a landscape with near objetcs, and more for a far landscape. At the beginning, there is always tendency to shift too much. In my tests, I note that with a weak shift the result is always correct in Anaglyph, but if the shift is too important, the Anaglyph is not really observable any more . I read rules of the kind : it is possible to shift until 1/100th or 1/30th of the distance between the camera and the nearest object in the scene. It's up to you to test..
- It is possible to refocus slightly on a near isolated object, but make sure that there are no eyecatching distant objects. Best is to leave the apparatus in the same frontal direction, well parallel to the scene (somebody proposes to use a roller skate).

The ideal is to have a camera (numeric) that can take photographs in burst. It should be used without flash to avoid having to wait during recharging. Launch the catch in burst and move the apparatus from left to right to make a series. Take a stronger sensitivity (or numerical equivalent) to avoid blurring. AnaBuilder then makes it possible to test in a very flexible way the combinations of photographs, to find the best suited pair.

Important : if a picture is taken with a flash on the camera, the shade moves with its position, and will not caught in 3D. It is the case of my clown, but I did not know it when I took the pictures. Note the displacement of the shade of the flowers on the hip.

Example :

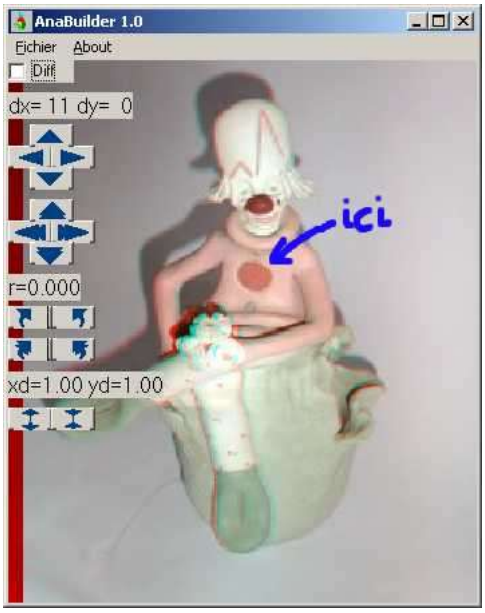
First assembly



Launch AnaBuilder :
Load the left image, then the right. The composit Red/Cyan image should appear. Resize the window to have the good proportion. The larger the image, the easier precise retouching, but more time will be spend during processing of the changes. It is possible to adapt the width and/or height of the image to allow easier correcting.

To optain optimal depth, the 2 images must overlap as complete as possible.

Horizontal and vertical fitting



Choose an object of the image, about in the center of the image, which will have to appear at the depth of the screen in the 3D image (neither in front, nor behind). This reference object will be used during the whole assembly process.

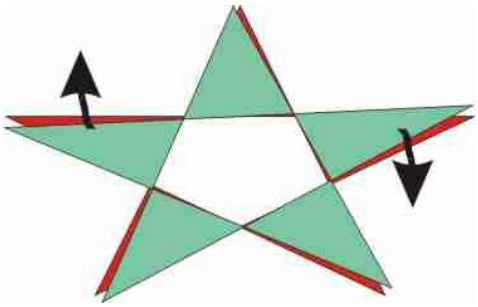
Example : the large button of the sweater of the clown.

Click on the image with the left button of the mouse. Keeping the button pressed, shift the Cyan image to superimpose the reference object as good as possible :

Click on "Diff" at the top left. The difference image can be used to finetune the shifting process. All well fitted parts of the image become black, and the shifted are colored.But keep in mind that, as the images are different, coloured zones will appear inevitably: some are due to a bad fit, and others due to the 3d (perspective) shift.

Use the buttons on the left side, to make the reference object as black as possible. You can alternatively pass from the color image to the difference image to refine the result.

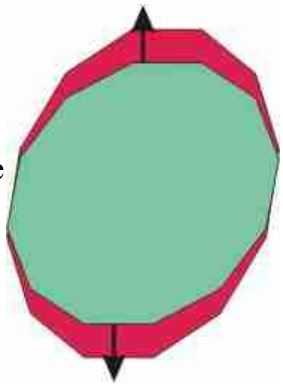
Rotational fitting



An object seen the 2 images (left,right) can show horizontal shift between its red and cyan components depending on its position relative to the reference object which has just been adjusted. but they should not present vertical shifts !!. Therefore horizontal edges of objects should not show color(red/cyan) shifts:

On the color image, there should not appear Red or Cyan shift on horizontal edges.
On the difference image, horizontal edges must disappear to become completely black.
Locate a horizontal edge on the right of the image and an other on the left of the image to locate a possible rotation defect. Use the rotation buttons on the left to eliminate the rotation defects. If need, refit the image horizontally or

vertically as explained before (using the reference object).



Expansion Adjustment fit

Find an horizontal edge on the top of the image, and one other on the bottom, to find a possible size defect. As for the rotational fitting, use the enlargement and contraction buttons to eliminate the homothety defects. If required, refit the image horizontally or vertically as previously, using the the reference object (or any other one if that is easier).

Finalisation

Put the Red/Cyan glasses on. When the fitting is successful, the image should seem to exist in space, and the presence of the 2d screen should not be noted. Do not forget that it is best to look at the image in its original proportions so, save the image en reopen it fullscreen in a dedecated imageviewer program.

For a good appreciation, wait a few seconds so that your eyes get accustomed to the anaglyph.

The larger the distance to the screen, the easier for the eyes to focus and to deduce the depth. Therefore, if initially you find it hard to see the depth, move away from the screen to 2 or 3 m, and gradually get closer again.

It is possible to accentuate the position of objects behind the screen by moving the Cyan image to the left. On the other hand, it is possible to accentuate the position of objects in front by moving the Cyan image to the right. If the rotation and dilatation fits are successful, the eyes accept a rather important left/right displacement. If not, the observation quickly becomes unpleasant, and the image loses of its depth.

You can make an object 'jump' out of the screen, by shifting the cyan part of the image but care should be taken not to let object touch the border of the screen. The eye locates very well the borders of the image at the distance corresponding to the screen. The interaction of an object thought to be in front of the screen with the border of the image breaks completely the depth impression. This is true for the top and bottom borders, but that is even more for the left and right borders. To have an object on the front of the screen, one needs an important left/right shift between the 2 images. Because of this shift, one of the 2 images finishes inevitably earlier on the border than the other. There is thus a piece of image which will be seen only by one eye, which breaks the stereoscopic effect.

Color Filtres

Luminosity : value between -255 and +255, the value with no effect is 0

For a positive value: this filter shifts all colors in the same way to the white. The palest colors are saturated to the white. The blacks become grays.
For a negative value : this filter shifts all colors in the same way to the black. The darkest colors are saturated to the black. The whites become grays.

Contrast : value between 0 and +255, the value with no effect is 1

For a value > 1 : this filter dilates the color histogram from the center to the extremities. The palest colors are saturated to the white. The darkest colors are saturated to the black.
For a value < 1 : this filter compresses the color histogram from the extremities to the center. The whites become grays. The blacks become grays.

Gamma : values between 0 and +255, the value with no effect is 1 (an increment corrects the global value for each RGB component)

For a value > 1 : this filter shifts all colors to the white. The whites and blacks are preserved.
For a value < 1 : this filter shifts all colors to the black. The whites and blacks are preserved.

White balance : values between 0 and +255, the values with no effect are +255

The 3 RGB components are rescaled to set the white color to the indicated value. The blacks stay blacks. The colors paler than the one indicated become white.

L/R exposure correction : values between 0 and +255, the value with no effect is 1

The 3 RGB components of the right image are rescaled in order to make the global luminosity identical to the left image. The blacks are preserved. The palest colors become either whiter or darker, according to the sense of the correction. The "auto" button calculates this value.

If the two views are not of the same luminosity, it gives a red shift, and on the contrary a cyan shift :

The left view is darker. The anaglyph shifts to cyan.

The left view is less dark. The anaglyph shifts to red.

Shift R/G at right:

This transformation changes reds to yellows in the right image to avoid flashing on the anaglyph. This transformation is not always possible, for esthetics reasons, but may produce good results in certain cases.

Desaturation of reds and cyans

The explaination from Frans Van de Poel to chase ghosts.

It may happen that in your scene there are objects with colors very close to the pure red or the pure cyan. In this case, one of the 2 eyes sees the color, and the other sees black. This produces a very unpleasant flashing effect. To correct that, AnaBuilder uses a tunable technique to rebalance the colors. To use it, it is necessary to quickly explain how it works:

1. for each point, the software estimates the contribution of the red to the luminosity.
2. if this contribution exceeds a threshold, the red is gradually reduced to be added to the green and blue components.
3. if this contribution goes below another threshold, the green and blue are gradually reduced to be added to the red.

The default settings result in a constant luminosity, and equal treatment of the green and blue parts. I adjusted them at my best. By modifying them, one can obtain a result either more luminous, or darker, or more red, or more blue, or more green, etc.

The following principles are always true:

1. in a band of "balanced" hues determined by the two thresholds, all colors remain unchanged.
2. outside of this band, the filter action is progressive (linear) so as to preserve the color nuances.

Click on the check box "desat". The parameters window of the desaturation filter appears.

1. The first parameter can take any value. It is used to make the 2 thresholds symmetrical.
2. The 2 thresholds are in theory between 0 and 1.
3. The contributions of rebalancing can take any values and are to be thought "for 1".

While tuning the parameters of rebalancing you can obtain almost any color starting from the color which causes the problem. Find below an example of possible variations. The colors are voluntarily exaggerated, and also illustrate the kind of somewhat undesirable consequences one can obtain (see the pot and the tiling). I insist on the fact that these images were realized without other intervention than the desaturation function!

(Original image)

(With the default settings)

Psychopathic variations:

Some concepts for the use of the matrix filters

For the mathematicians among us: it acts as a convolution between the image and the matrix.

I suppose that all the image softwares that processing with a higher level than "luminosity - contrast" use these filters. Except that the user sees only one simple panel with some explicit cursors of adjustment instead of a strange matrix.

The principle is as follows:

The filter recomputes the value of each pixel according to its neighbors. The matrix explains how each neighbor is taken into account. The recomputed pixel is in the center of the matrix, for this reason the number of lines, or columns must be odd (or else it becomes less easy to understand).

Let us take a simple case: a matrix of one line and three columns:

1 1 1

The value of the recomputed pixel (in the center) is equal to:

the right pixel + the center pixel itself + the left pixel

The result: one makes a horizontal blur by spreading out the colors. Like this, this matrix multiplies the total luminosity by 3, since one adds 3 times the image with itself.

To avoid that, one normalizes, so that the total sum of the values equals 1 (the program does that by itself):

0.33 0.33 0.33

The value of the recomputed pixel is equal to:

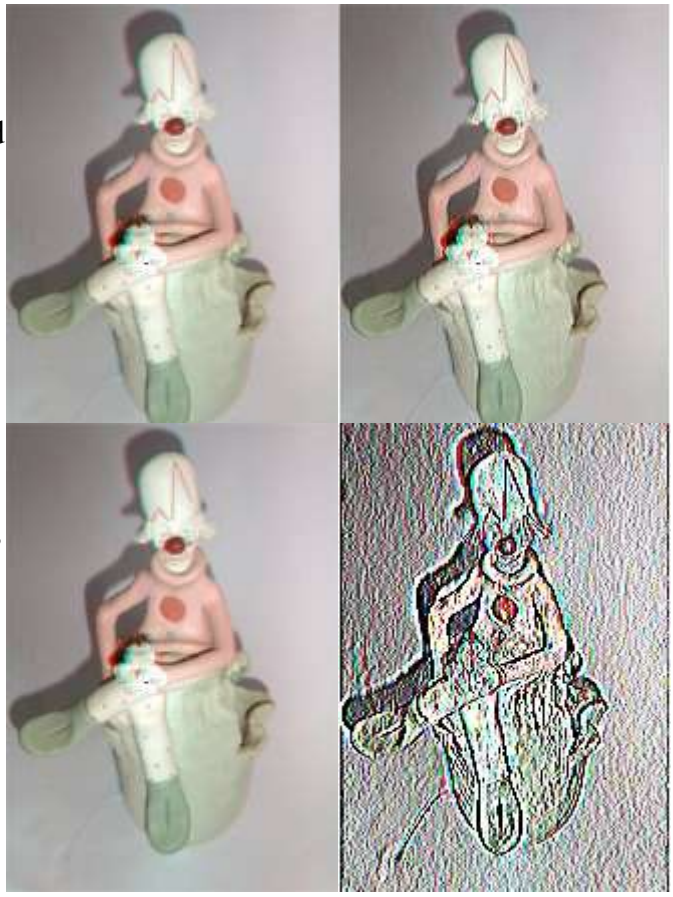
0.33 * the right pixel +0.33 * the center pixel itself + 0.33 * the left pixel

If you want a less blurres effect, it is necessary to lower the left and right values, and to increase the central value. Like that, the recomputed pixel is less modified :

0.1 0.8 0.1

The value of the recomputed pixel is equal to:
1/10 * the right pixel + 8/10 * the center pixel itself + 1/10 * the left pixel

Then, all is a question of math formulas, but one can test to see.



The following filter calculates a second horizontal derivative, therefore "strongly reacts" on the horizontal variations. It is used to reinforce the vertical edges:

-0.5 2 -0.5

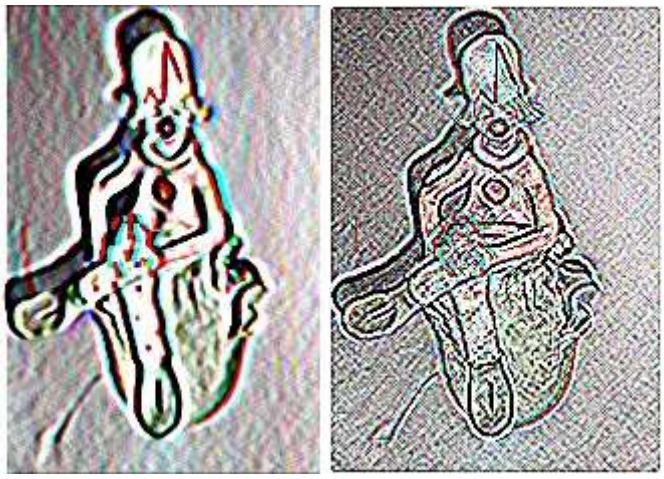
The maximum intensity of the filter is obtained by lowering the central value to obtain an nearly null sum before normalization (and in the limit case one cannot normalize any more), for example:

-0.50 1.01 -0.50

It is hard to obtain a complex result with only one filter. For this reason AnaBuilder gives the possibility to chain several filters.

For example, if there is a very noisy image, it is possible to eliminate a good part of the noise by chaining 2 filters: a filter of smoothing, and a filter of sharpening. The filter of smoothing spreads out the colors so that the variations due to the noise are compensated between a pixel and its neighbors. But, this operation gives a blur. The 2nd filter sharpens the edges to eliminate this blur:

Smoothing 3x3:
+0.1 +0.1 +0.1
+0.1 +1.0 +0.1
+0.1 +0.1 +0.1
Reinforcement 3x3:
-0.1 -0.1 -0.1
-0.1 +2.0 -0.1
-0.1 -0.1 -0.1



To go further, it would need pages...

Here are another two examples. The first is obtained with 2 filters, and the second is obtained with only one filter:

Saving
Before saving the image AnaBuilder recomputes the image in its original dimensions, and trims the borders by cutting off defects caused by rotations or dilations. This can take some time.

Here the result which I obtained starting from the 2 images given at the beginning:

Drawing functions
Click on the box "Pix".

To paint with the brush
It is the default mode.

- the depth of the cursor, which also corresponds to a shift between the left sight (red) and the right sight (cyan), can be fixed by turning the mousewheel (if present), or by filling in a value in the "Depth" field. The depth of the cursor influences directly the drawing result: a zero value will post the result on the level of the screen, without shift. A positive value will draw behind the screen, and a negative value will draw in front of the screen.
-
- click with the left button of the mouse on the image to draw a point.
- click and hold, then draw to create lines.
- double-click to load a color from on the image (eyedrop). The value of the color can be taken from its RedGreenBlue composition (RGB value).

To insert text
When inserting text, the brush mode is disactivated as long as the text input field contains data.

- enter text in the input field.
- click on the button "Font", and choose the font type and size.
- choose a color (it is the color of the brush, not that which appears in the input field).
- move the cursor to the image to choose the place where you want to put the text.
- with mousewheel, or via the the depth box, choose if you want to bring the text in front of, behind or onto the screen (zero level).
- click (only once) to put the text on the image...

Using image-brushes
When using image-brushes, the brush mode is disactivated as long as image-brushes exist.

- click on "Load 2d image brush" and choose a file which contains an image, or
- click on "Load 3d image brush" and choose a file which contains an image in left sight, then a file which contains the same image in right sight.
- move the cursor to the image and choose the place where you want to insert image-brushes.
- with the mousewheel, or via an entry in the depth box, choose if you want to bring the text in front of, behind or onto the screen (level zero).
- click with the left button of the mouse on the image to drop a brush image.
- click and hold, then drag to draw continuous brush images.
- it is possible make the background of brushimages transparent allowing insertion of finely cut images, by clicking on "transparent Color". The transparent color is the one held by the brush (white by default) Otherwise, non-transparant color the object will always be painted as a rectangle and with its original background.

When you use the image-brush, it is not possible to change the dimension of image-brush. On the other hand, it is possible to change the dimension of the image you are working with, giving the same result.

Extraction of objects
Click on the tool "Saws"
- then click on the image and point by point describe the contour of an object to extract. For that, regulate the depth of the pointer corresponding to that of the object (see above).
- the object gradually takes shape in the window "Creation of 3d objects"
- in this window, click on "save" and give a name to the left and right images
- the option "only Forms" makes it possible to save time by showing only the form and no color.
- the object thus created can be reloaded as brushimage

If you want to be able to use the function of transparency to insert the object in another scene, save it in BMP format. (thus avoiding artifacts resulting from JPG compression).

The background of the images thus generated is black. To use the function of transparency of brushimages, you have to

enter these values (R=0, V=0, B=0) in the colorbox, because the default color is the white (R=255, V=255, B=255).

It is possible of redifine the dimensions of the extracted left and right images to be able to insert them elsewhere in other proportions.

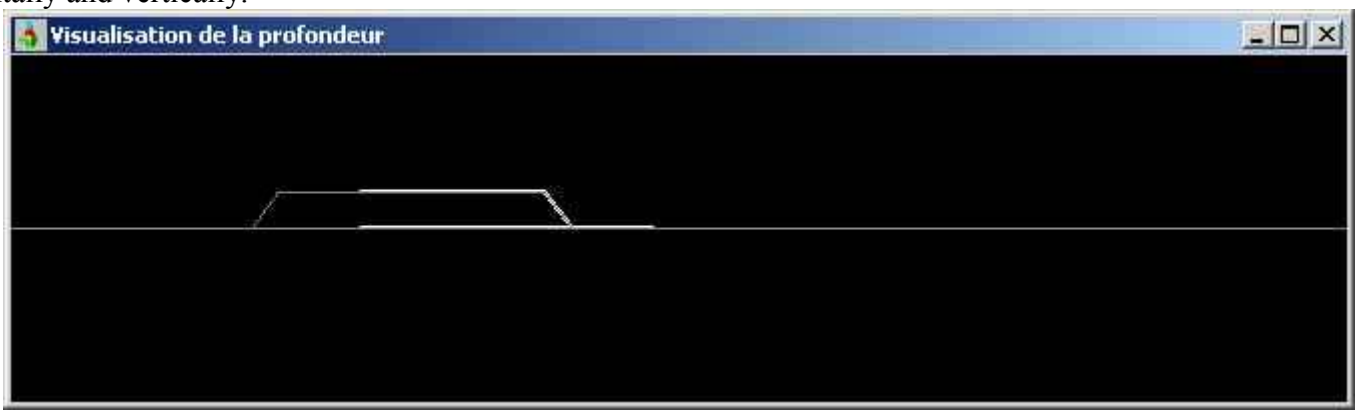
Stereo-Morphing
Basic concepts

The stereo-morphing makes it possible either to convert a 2d image into a 3d image, or to change the depth of an existing 3d image. To work on a 2d image, it is sufficient to load 2 times the same image: once as the left image, and as the right image.

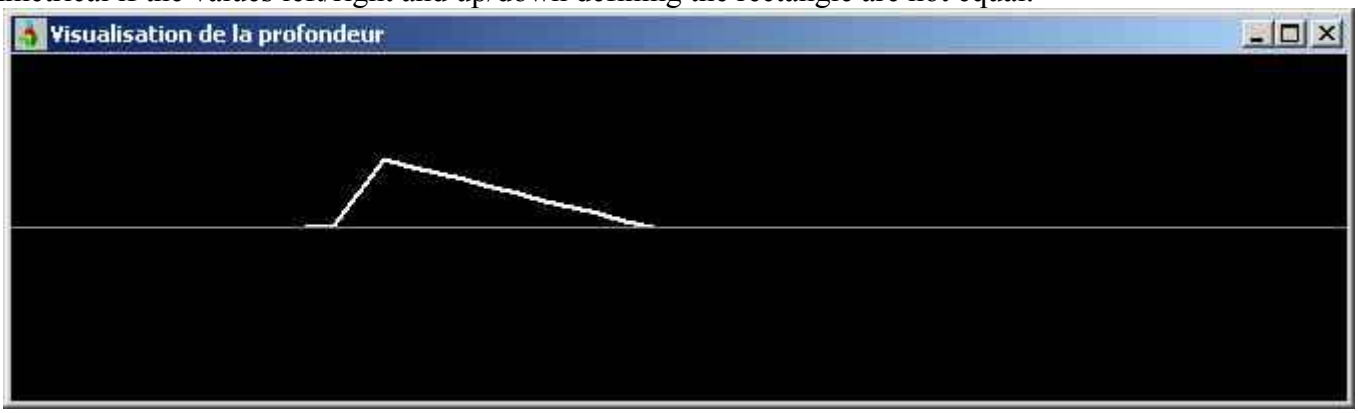
When the tool is open (by clicking on the box "morph") the loaded image is shown on a grid. This grid makes it possible to define the deformations to be applied to each of the 2 images left and right to change the depth of each point of the image:

- position the cursor on the image: the zone to be modified appears in bold.
- modify the grid with the mousewheel, or with the arrow keys on the keybboard.
- the modifications of depth are displayed in a window on top and on the right of the image.
- click on "morph" in the menu to calculate the transformation of the original image.

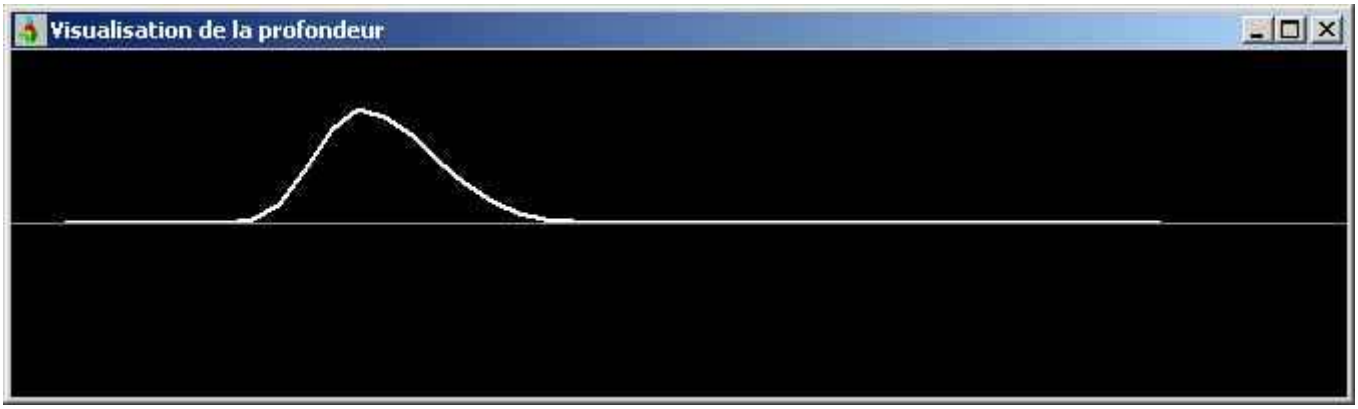
By default, AnaBuilder applies the deformations to a square of 5x5 grid boxes, constant to all the points of the square. It is possible to vary at the same time the dimension of the rectangle and the way in which the deformation is applied horizontally and vertically.



The "linear" option makes it possible to produce a deformation of depth in a triangle. This triangle can be nonsymmetrical if the values left/right and up/down defining the rectangle are not equal.



The "Gaussian" option makes it possible to produce a deformation in bump form. This bump can be nonsymmetrical if the values left/right and up/down defining the rectangle are not equal.
It is possible (and even recommended) to apply a deformation which is different vertically and horizontally.



One limits the zone of deformation by describing a selection with the left button of the mouse surrounding the desired zone. When the rectangle of deformation is larger than the selected zone, the deformation is applied only to the selection. This selection can be reversed to work on the contrary on the remainder of the image without touching the surrounded contents.

By adapting the selection, the range of the transformation can be controlled by adjustment of the left/right and up/down limits allowing a fine definition of the wanted depth.

Caution: when a deformation is applied to a single point of the grid, AnaBuilder tends to move also the neighbouring points to avoid overlappings (the morphing would be then more difficult to calculate). These 'forced' deformations are not easy to undo later. It is then possible to uniformly bring back the points of the selection to their zero level, so as to take again their in-depth setting starting from a clean configuration.

Example of 2d - > 3d convertion
Load the following 2d image on the left and on the right, and click on "morph".

Select with the mouse the 2 fencers, and reverse the selection so as to work on the background without modifying them.

Choose horizontal transformation:

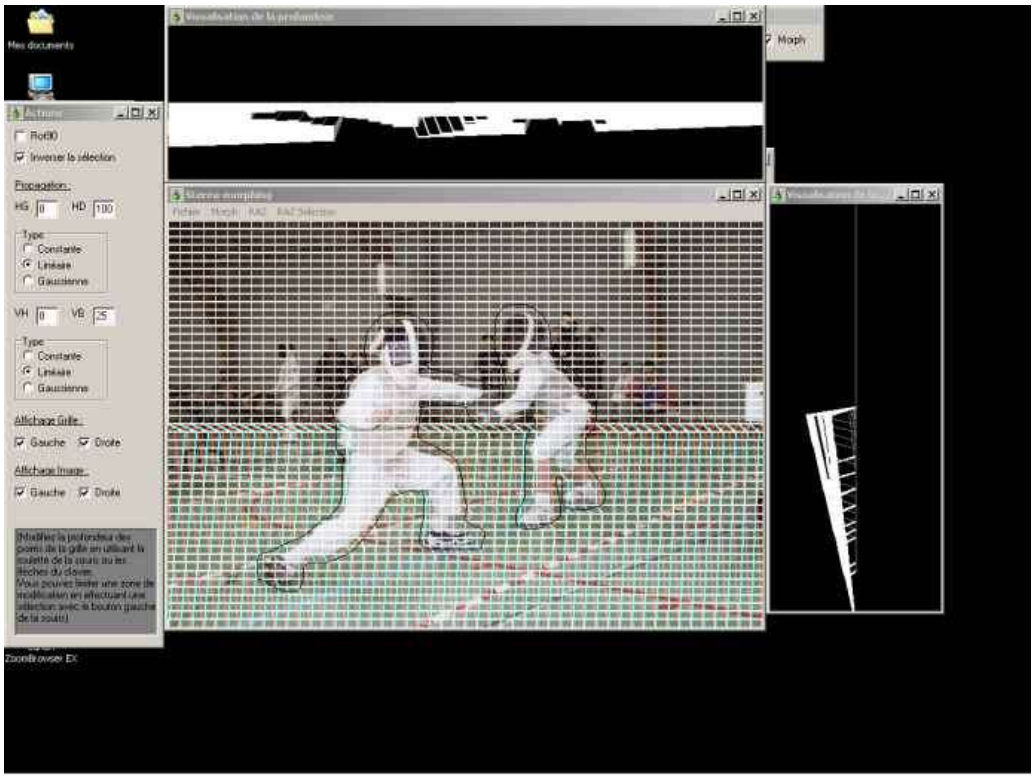
- linear to produce a progressive variation
- 0 on the left
- 100 on the right so that the zone is 2 times larger than the image (all points will be modified)

Choose vertical transformation:

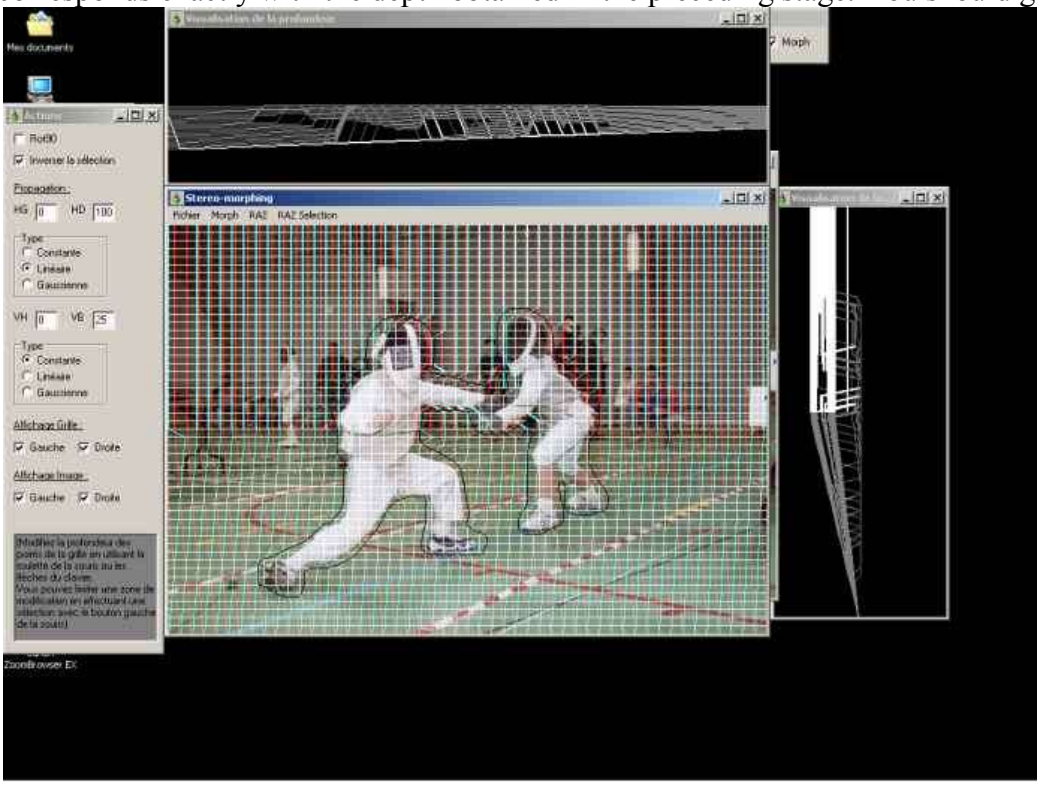
- linear to produce a progressive variation

- 0 on top
- 25 at the bottom so that the zone touches the bottom of the image, with a null deformation on the lower border of the image.

Place the cursor on the left at half height (on the level of the table). Press on the downward arrow of the keyboard (or use the wheelmouse) until a maximum depth is obtaining at semi-range (see visualization) in the window in top and on the right). You should get following result:



Keep the same parameters, using this time a constant vertical deformation. Place the cursor in top of the image so that the bottom of the selection comes just on top of the preceding deformation. Press on the 'down' arrow on the keyboard (or use the mousewheel) until obtaining a maximum depth with semi-range (see visualization in the window in top and on the right) which corresponds exactly with the depth obtained in the preceding stage. You should get following result:



The floor and the wall at the back are thus in place.
Reverse the selection again, so as to modify the fencers. Click on "Reset selection" to eliminate the imperfections introduced by the preceding modifications.

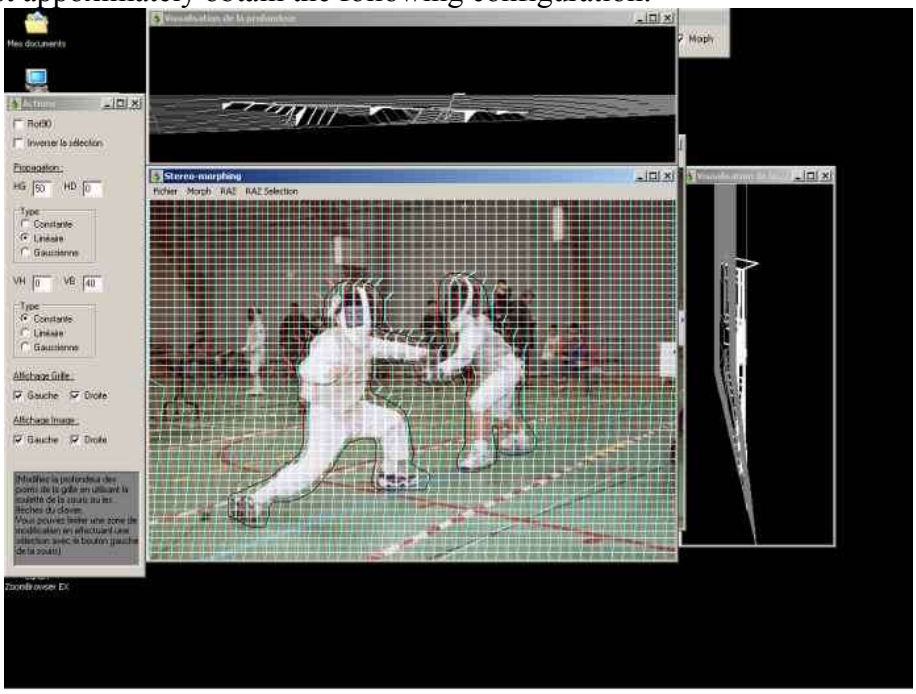
Choose horizontal transformation:

- linear to produce a progressive variation
- 50 to have a width more important on the left than that of the fencers
- 0 to the right

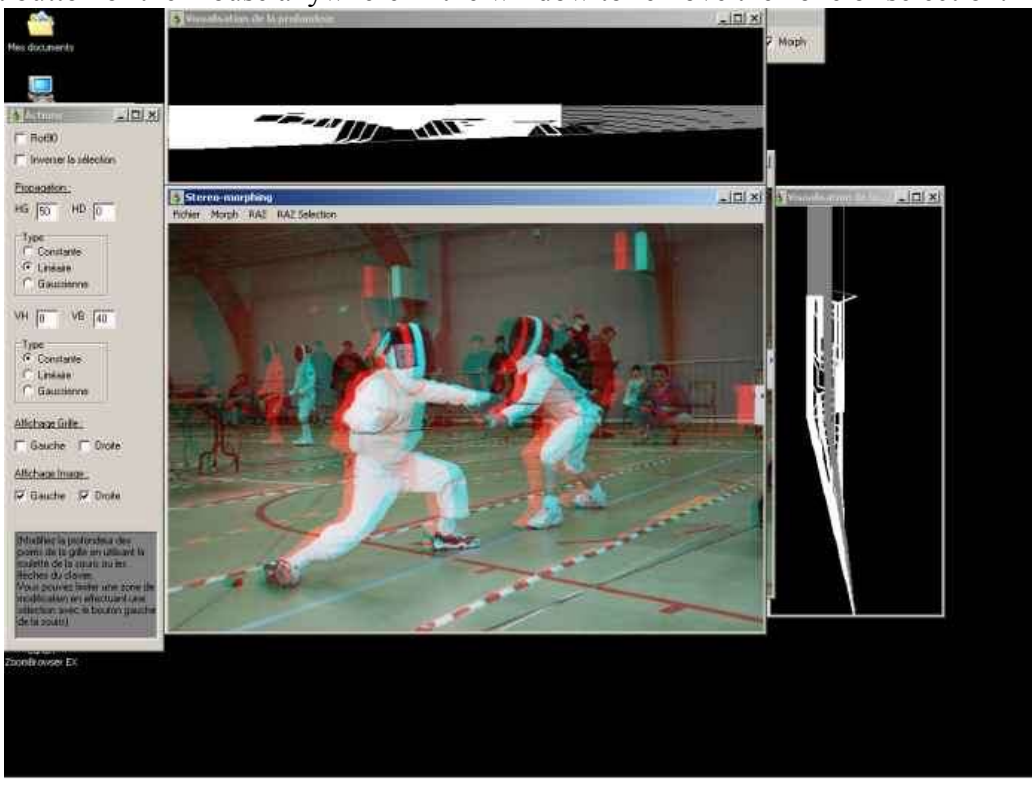
Choose vertical transformation:

- constant
- 0 on top
- 40 below to cover the height of the fencers

Place the cursor on top of the right of the 2 fencers. Press the 'down' arrow of the keyboard (or use the mousewhell) until obtaining a depth which as good as possible adjusts the vertical lines which cover the fencers in accordance with the vertical lines which run towards the bottom. If these lines are well aligned, the fencers will be well in their place, with the good depth. You must appoximately obtain the following configuration:



The main part of the job is finished. Click on "morph", then remove the grid by stripping the options of left and right boxes. Click on the left button of the mouse anywhere in the window to remove the zone of selection. Admire the result:



Enable the grid again, or left/right only. Eventually show only one of the two sights left/right to better see the deformations. Set a rectangular transformation of 0x0 so as to move only one intersection of the grid at the same time. Correct the small defects of morphing, while avoiding breaking the great parts.

Via selections You can treat objects of average size: characters in the background, pillars, etc...

Example of vertical correction
It is possible to have vertical shifts even on a otherwise perfect couple. In addition, if one makes stereoscopy as a tourist (without stable support) vertical shifts are easilycreated. The foregrounds move more quickly than the plane backs. Therefore, these shifts are not homogeneous, and one cannot correct them with a global transformation, one needs a transformation particular to each object of the image.

It is what one can do by using the stereo-morphing, after having turned the image 90°.

In this example, I introduced voluntarily a vertical shift between the 2 takes of the couple which was used to assemble the anaglyph on the left. Whereas the background is rather well fixed (I made it quickly), the foreground presents a more or less important vertical shift affecting the depth. These shifts completely break the depth of the flower (in any case, I see it as flat). I made a progressive correction (also rather quickly), on the anaglyph of right-hand side. This time, I see the flower very clearly leaving the screen.

Now it's yout turn to play...

Composed into PDF format by Quang Vo
http://quangvo.webpal.info/

http://anabuilder.free.fr/welcomeEN.html