

# GenBrush

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## Introduction

GenBrush is a C library providing structures and functions for creating 2D/3D, bitmap/vector, still/animated graphics on various supports.

It can be use as a monolithic library, or as an interface with another graphical library (Cairo/GTK). The choice can be made through a single compilation option.

GenBrush is based on the following model: the scene to be represented graphically is composed of Objects viewed by an Eye, interpreted by a Hand and recreated with a Tool applying an Ink on a Surface made of Layers.

The currently available implementations for these entities are:

- Object: Point (VecFloat), SCurve, Shapoid
- Eye: Orthographic, Isometric
- Hand: Default

- Tool: PixelPlotter, Pen
- Ink: Solid
- Surface: Image (TGA), GBApp, GBWidget
- Layer: divided into background, inside and foreground layers; blending modes: Default (overwriting), Normal, Over

For details refer to the following sections.

The library can easily be extended to match the user needs. Foreseen extensions of the entities are for example:

- Object: BBody, ...
- Eye: Perspective, ...
- Hand: Human (approximation of the viewed object), ...
- Tool: Brush, ...
- Ink: Generic (BBody), UVMapping
- Surface: Full support of TGA, other image formats, ininterface with Cairo only, ...
- Layer: other blending modes, ...

A graphic can then be created with the GenBrush library by describing the scene as a set of Pods, which are combinations of an Object, an Eye, a Hand, a Tool, an Ink and a Layer. The rendering of each Pod processes sequentially the original Object through the other entities to generates pixels into the Layer. Once all the Pods have been processed, the Layers are blended to generate RGBA final pixels in the Surface. The scene description can be modified after creation. Pods use references to entities, meaning that if a parameter of, for example, an Ink is modified all the Pods attached to this Ink will be recalculated at the next rendering.

Several rendering of the same scene are optimized to recalculate only the final pixels affected by the entities which has been modified since the previous rendering. It is the responsibility of the user to notify GenBrush when an entity has been modified.

The user can apply post processing to the surface at the end of each rendering. Currently implemented post processing are:

- Normalization by hue
- Ordered dithering
- Floyd Steinberg dithering

Finally, the user can create scaled or cropped copies of a Genbrush.

The GenBrush library uses the `PBErr`, `PBMath`, `GSet`, `Shapoid`, `BCurve` libraries, and `GTK` if compiled as an interface for this library.

## 1 Definitions

### 1.1 Object

The scene to be represented graphically can be described using Points, SCurves and Shapoids.

#### 1.1.1 Point

Points are a single point in space (any dimensions from 2). After projection through the Eye, the first two dimensions are the coordinates in the Layer, the third dimension is the depth, and the following dimensions are parameters for the other entities. If a dimension is needed but not provided by the Point its value is considered to be 0.0.

#### 1.1.2 SCurve

SCurves are curves in space (any dimensions from 2). After projection through the Eye, the first two dimensions are the coordinates in the Layer, the third dimension is the depth, and the following dimensions are parameters for the other entities. If a dimension is needed but not provided by the Point its value is considered to be 0.0.

### 1.1.3 Shapoid

Shapoids are surfaces (if dimension equals 2) or volumes (if dimension is greater than 2) in space. After projection through the Eye, the first two dimensions are the coordinates in the Layer, the third dimension is the depth, and the following dimensions are parameters for the other entities. If a dimension is needed but not provided by the Point its value is considered to be 0.0.

## 1.2 Eye

The Eye create a projection of an Object from the original space coordinates system toward the Layer space coordinates system. The projected Object is always of the same type as the original Object, only its component are affected by the projection.

The Eye always sees the Object in 3 dimensions. If the Object has only two dimensions, the Eye considers it has a third one with values equal to 0.0. If the Object has more than 3 dimensions, the Eye applies the projection on the first 3 ones and leaves the other dimensions unchanged.

All the Eyes have a translation, a scale and rotation parameters. The first, second and third components of the projected Object are multiplied repectively by the first, second and third components of the scale vector. The rotation angle (in radians) is a 2D rotation applied on the two first components of the scaled projected Object. Finally the translation 2D vector is added to the rotated scaled projected Object. The translation acts as a translation of the viewed object in the plane of the Layer, the scale acts like a zoom on the viewed object, and the rotation like a tilt of the Eye. Given  $\vec{t}$ ,  $\vec{s}$  and  $\theta$  the translation, scale and rotation of the Eye the translated rotated scaled version  $O'$  of the projected version of Object  $O$  can be obtained as follow:

$$O' = \begin{bmatrix} s_x \cos \theta & -s_y \sin \theta & 0.0 \\ s_x \sin \theta & s_y \cos \theta & 0.0 \\ 0.0 & 0.0 & s_z \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (1)$$

### 1.2.1 Orthographic

The Orthographic Eye creates projection of Objects onto planes aligned with the original coordinates system. It has 6 views: front, rear, left, right, top, bottom. For each view the translated rotated scaled projected version  $O'$  of the Object  $O$  can be obtained as follow:

- front:

$$O' = \begin{bmatrix} s_x \cos \theta & -s_y \sin \theta & 0.0 \\ s_x \sin \theta & s_y \cos \theta & 0.0 \\ 0.0 & 0.0 & s_z \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (2)$$

- rear:

$$O' = \begin{bmatrix} -s_x \cos \theta & -s_y \sin \theta & 0.0 \\ -s_x \sin \theta & s_y \cos \theta & 0.0 \\ 0.0 & 0.0 & -s_z \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (3)$$

- top:

$$O' = \begin{bmatrix} s_x \cos \theta & 0.0 & -s_y \sin \theta \\ s_x \sin \theta & 0.0 & s_y \cos \theta \\ 0.0 & -s_z & 0.0 \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (4)$$

- bottom:

$$O' = \begin{bmatrix} s_x \cos \theta & 0.0 & s_y \sin \theta \\ s_x \sin \theta & 0.0 & -s_y \cos \theta \\ 0.0 & s_z & 0.0 \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (5)$$

- left:

$$O' = \begin{bmatrix} 0.0 & -s_y \sin \theta & -s_x \cos \theta \\ 0.0 & s_y \cos \theta & -s_x \sin \theta \\ s_z & 0.0 & 0.0 \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (6)$$

- right:

$$O' = \begin{bmatrix} 0.0 & -s_y \sin \theta & s_x \cos \theta \\ 0.0 & s_y \cos \theta & s_x \sin \theta \\ -s_z & 0.0 & 0.0 \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (7)$$

### 1.2.2 Isometric

The Isometric Eye creates 3D projection of Objects without simulation of the perspective. It adds two other rotations to the Eye: the rotation around the second dimension in the original coordinates system, and the rotation around the first dimension in the Layer coordinates system. Given  $\theta_y$  and  $\theta_r$  the angle in radians of these two rotations, the translated rotated scaled projected version  $O'$  of the Object  $O$  can be obtained as follow:

$$O' = \begin{bmatrix} M_{00} & M_{10} & M_{20} \\ M_{01} & M_{11} & M_{21} \\ M_{02} & M_{12} & M_{22} \end{bmatrix} O + \begin{pmatrix} t_x \\ t_y \\ 0.0 \end{pmatrix} \quad (8)$$

where

$$\begin{aligned} M_{00} &= s_x \cos \theta \cos \theta_y - s_y \sin \theta \sin \theta_y \sin \theta_r \\ M_{01} &= s_x \sin \theta \cos \theta_y + s_y \cos \theta \sin \theta_y \sin \theta_r \\ M_{02} &= s_z \sin \theta_y \cos \theta_r \\ M_{10} &= -s_y \sin \theta \cos \theta_r \\ M_{11} &= s_y \cos \theta \cos \theta_r \\ M_{12} &= -s_z \sin \theta_r \\ M_{20} &= -s_x \cos \theta \sin \theta_y - s_y \sin \theta \cos \theta_y \sin \theta_r \\ M_{21} &= -s_x \sin \theta \sin \theta_y + s_y \cos \theta \cos \theta_y \sin \theta_r \\ M_{22} &= s_z \cos \theta_y \cos \theta_r \end{aligned} \quad (9)$$

## 1.3 Hand

The Hand interprets each viewed Object and creates a new instance of one or several Objects (possibly of types different from the one of the original Object). This interpreted version of the Object is the one which will actually be traced by the Tool. For example a Hand may convert a volume object into its outline curve version.

The Hand may be parameterized by the components of dimensions from the 4th one of the Object.

A given Hand type may not be defined for all types of Object. If the user tries to apply a Hand on an unsupported Object, the Hand simply does nothing and the Object won't appear in the Surface.

### 1.3.1 Default

The default hand simply creates a copy of the Object created by the Eye.

## 1.4 Tool

The Tool translates each Object created by the Hand into pixels of Ink stacked into the Layers. It generally runs through the Object's internal coordinates, calculates the rounded coordinates of the Object (coordinates in the Layer coordinates system) and the coordinates of the original Object (coordinates in the global coordinates system), then get the Inks value at theses coordinates and add the corresponding pixels in the Layers.

The Tool may be parameterized by the components of dimensions from the 4th one of the Object(s).

A given Tool type may not be defined for all types of Object. If the user tries to apply a Tool on an unsupported Object, the Tool simply does nothing and the Object won't appear in the Surface.

### 1.4.1 Plotter

If the Plotter draws a Point, it adds one pixel at the rounded position in the Layer. The depth of the pixel is equals to the 3rd dimension of the Point if it has one, 0.0 else. The ink value is calculated by using a 3D vector null for the internal position as a Point doesn't have internal position.

If the Plotter draws a SCurve, it runs through the SCurve from beginning to end by small increment of its internal parameter equals to  $0.5/l$  where  $l$  is the length (or its approximation) of the SCurve. If the SCurve has only 2 dimensions, the Plotter considers the 3rd as being always equal to 0.0. At each step the Plotter checks if it has move to a different voxel, i.e. if at least one of the rounded value of the 3 first dimensions has changed. If so, the Plotter calculates the Ink value at this position and adds the equivalent pixel to the Layer.

If the Plotter draws a Shapoid, it checks for each voxel of the bounding box of the Shapoid if the center of the voxel is inside the Shapoid, and if so adds a pixel into the Layer at the position (2 first dimension) and depth



(3rd dimension) of this voxel. If the Shapoid has only 2 dimensions, a 3rd one always equals to 0.0 is considered. The internal coordinates for a given voxel can be calculated thanks to the Shapoid functions.

#### **1.4.2 Pen**

The Pen tool has a Shapoid which defines its shape and a softness coefficient which influences the Ink.

When used to draw a Point, SCurve or Shapoid, the Pen uses the same algorithm as the Plotter to find the positions of added pixels, and then draws its internal Shapoid at each of these positions as if it was a Plotter tool. However the alpha channel of the ink when drawing the internal Shapoid is multiplied by a value equals to  $(\text{Pen's Shapoid's depth at position in Pen's Shapoid})^{(\text{Pen's softness})}$ . According to the original alpha value of the ink, and the blending mode of the layer (Over is recommended), it allows to create a soft edge effect to the drawing.

### **1.5 Ink**

The Ink converts coordinates into RGBA values. It takes as input internal coordinates (in the Object internal coordinates system), external coordinates (in the global coordinates system) and layer coordinates. Layer coordinates have integer values while the others have floating values. An Ink may ignore some or all of the coordinates given as parameter, and to be able to process any kind of object should be resilient to lower than expected dimensions for these coordinates (typically by assuming the missing dimensions are equals to 0.0).

The Ink may be parameterized by the components of dimensions from the 4th one of the Object(s).

#### **1.5.1 Solid**

The Solid Ink returns a RGBA value set by the user, regardless of the coordinates given as parameters.

## 1.6 Surface

A Surface is a set of Layers plus an array of RGBA values (the final pixels). It is an abstraction level which allows to manipulate any kind of output for the rendering process: a file on the hard drive, a window on the screen, a widget in another application, ...

The result of the rendering of a scene is stored as individual pixels in the Layers of the Surface, and when the Surface is requested for update, these pixels are blended into the final pixels.

A Surface has a background color which is used as a fallback when blending pixels of Layers (see below for detail).

### 1.6.1 Image

An Image Surface is an image file saved on a physical media when the Surface is requested for update. Currently the Image Surface supports the following formats:

- TGA: supports only 16, 24 or 32 bits per pixel, uncompressed or RLE RGB (data types 2 and 10)

An Image Surface can also load an image from a physical media toward a new Layer. The new Layer is then created with the dimensions of the image, depth of pixels are set to 0.0, parameters of the new Layer to their default value.

### 1.6.2 GBWidget

A GBWidget Surface is a Surface compatible with the GTK library. It can return a GtkWidget drawing area to be used on the GTK side (added to a container, attached to an idle function, ...). The rendering of the Surface automatically update the GTK drawing area.

### 1.6.3 GBApp

A GBApp Surface is a full GtkApplication allowing the user to simply display graphics content on screen. The GTK windows created has a fixed size defined by the user. The rendering of the Surface refreshes the content of the window. An idle function can be set by the user to create animation. The

GBApp Surface can return a GtkWidget on which the user could attached more event handler to extend the behaviour of the window.

## 1.7 Layer

A Layer is a an array of stacked pixels (RGBA value, depth value and blend mode). A Layer has a position in its Surface and dimensions eventually larger or smaller than its Surface's dimensions. The Layer content is always clipped to its Surface when rendering.

The Layers are stacked in the Surface in three levels:

- Background: Pixels of Layers in Background level are rendered in the order defined by the stack, or in the order their original Object has been added to the Layer for the case of several Objects in the same Layer. For example, pixels of layerA will be hided by pixels of layerB if layerA is before layerB in the stack of Layers. Another example, pixels of objectA will be hided by pixels of objectB, both in the same Layer, if objectA has been added to the Layer before objectB.
- Inside: Pixels of Inside Layers always hide pixels of Background Layers. The order of addition into the scene of Inside Layers doesn't matter. Pixels are always reordered according to their depth accross all Inside Layers upon rendering. Pixels with lower depth hide pixels with higher depth.
- Foreground: Pixels of Foreground layers always hide pixels of Inside and Background Layers. Pixels of Layers in Background level are rendered in the order defined by the stack, or in the order their original Object has been added to the Layer for the case of several Objects in the same Layer. For example, pixels of layerA will be hided by pixels of layerB if layerA is before layerB in the stack of Layers. Another example, pixels of objectA will be hided by pixels of objectB, both in the same Layer, if objectA has been added to the Layer before objectB.

The position of a Layer in the stack, or its level, can be modified by the user after creation.

To create the final pixels, stacked pixels are blended according to their blending mode. The blending mode of a given stacked pixel is the one of

its Layer at the time of rendering. The blending occurs from top to bottom (from the end of the Foreground stack toward the beginning of the Background stack). The blending starts with the highest stacked pixel, and then blend it with its blending mode on the stacked pixel below, and so on downward. Blending stops as soon as the alpha value of the resulting final pixel reaches its maximal value (255) for optimization. If the blending operation reaches the bottom of the stack and the alpha value has still not reached its maximum, one last blend occurs with a pixel equals to the background color of the Surface.

The blending modes are detailed below (where  $rgba$  is the higher pixel,  $rgba'$  is the lower pixel.  $res$  is the result pixel and the blending mode is the blending mode of the higher pixel.

### 1.7.1 Default

The Default blending mode simply overwrites the lower pixel to the final pixel.

### 1.7.2 Normal

The Normal blending mode calculates the RGBA value as follow:

$$\begin{cases} res(red) = \lfloor (1.0 - u)rgba(red) + u * rgba'(red) + 0.5 \rfloor \\ res(green) = \lfloor (1.0 - u)rgba(green) + u * rgba'(green) + 0.5 \rfloor \\ res(blue) = \lfloor (1.0 - u)rgba(blue) + u * rgba'(blue) + 0.5 \rfloor \\ res(alpha) = \lfloor MIN(255.0, rgba(alpha) + rgba'(alpha)) + 0.5 \rfloor \end{cases} \quad (10)$$

where

$$u = 0.5 * (1.0 + (rgba(alpha) - rgba'(alpha))/255.0) \quad (11)$$

### 1.7.3 Over

The Over blending mode calculates the RGBA value as follow:

$$\begin{cases} res(red) = \lfloor (1.0 - u)rgba(red) + u * rgba'(red) + 0.5 \rfloor \\ res(green) = \lfloor (1.0 - u)rgba(green) + u * rgba'(green) + 0.5 \rfloor \\ res(blue) = \lfloor (1.0 - u)rgba(blue) + u * rgba'(blue) + 0.5 \rfloor \\ res(alpha) = \lfloor MIN(255.0, rgba(alpha) + rgba'(alpha)) + 0.5 \rfloor \end{cases} \quad (12)$$

where

$$u = rgba(alpha)/255.0 \quad (13)$$

## 2 Interface

### 2.1 genbrush.h

```
// ===== GENBRUSH.H =====

#ifndef GENBRUSH_H
#define GENBRUSH_H

// About the coordinates systems:
// In input, the coordinates system must be a left handed
// coordinates system, with x toward the right, y toward the top and
// z away from the viewer.
//   y
//   ^ z
//   |
//   -->x
// So the front view of a GBEyeOrtho has x to the right, y to the top
// and z as the depth component (positive is away from the viewer).
//   y
//   ^
//   |
//   z-->x
// For a GBEyeIsometric, x is toward the top-right, y is toward the top
// and z is toward the top-left.
//   y
//   z ^ x
//   \\/
// In output, the coordinates system of the surface is x toward the
// right and y toward the top, with the origin at the bottom-left of
// the surface.
//   y
//   ^
//   |
//   -->x
// In GBSurface, the final pixels are stored in rows from left to
// right, the first row is the top row in the surface.

// ===== Include =====

#include <stdlib.h>
#include <stdio.h>
#include <math.h>
#include <string.h>
#include <stdbool.h>
#include "pberr.h"
#include "pbmath.h"
#include "gset.h"
#include "shapoid.h"
#include "bcurve.h"

// ===== Define =====

// Color index in _rgba
// for CAIRO_FORMAT_ARGB32 :
#define GBPixelRed 2
#define GBPixelGreen 1
#define GBPixelBlue 0
#define GBPixelValue 2
#define GBPixelSaturation 1
#define GBPixelHue 0
```

```

#define GBPixelFormat 3

#define GBColorWhite (GBPixelFormat){ \
    ._rgba[GBPixelFormatAlpha]=255, ._rgba[GBPixelFormatRed]=255, \
    ._rgba[GBPixelFormatGreen]=255, ._rgba[GBPixelFormatBlue]=255}
#define GBColorBlack (GBPixelFormat){ \
    ._rgba[GBPixelFormatAlpha]=255, ._rgba[GBPixelFormatRed]=0, \
    ._rgba[GBPixelFormatGreen]=0, ._rgba[GBPixelFormatBlue]=0}
#define GBColorTransparent (GBPixelFormat){ \
    ._rgba[GBPixelFormatAlpha]=0, ._rgba[GBPixelFormatRed]=0, \
    ._rgba[GBPixelFormatGreen]=0, ._rgba[GBPixelFormatBlue]=0}
#define GBColorRed (GBPixelFormat){ \
    ._rgba[GBPixelFormatAlpha]=255, ._rgba[GBPixelFormatRed]=255, \
    ._rgba[GBPixelFormatGreen]=0, ._rgba[GBPixelFormatBlue]=0}
#define GBColorGreen (GBPixelFormat){ \
    ._rgba[GBPixelFormatAlpha]=255, ._rgba[GBPixelFormatRed]=0, \
    ._rgba[GBPixelFormatGreen]=255, ._rgba[GBPixelFormatBlue]=0}
#define GBColorBlue (GBPixelFormat){ \
    ._rgba[GBPixelFormatAlpha]=255, ._rgba[GBPixelFormatRed]=0, \
    ._rgba[GBPixelFormatGreen]=0, ._rgba[GBPixelFormatBlue]=255}

// ===== Data structure =====

typedef struct GBPixelFormat {
    // Pixel values
    union {
        unsigned char _rgba[4];
        unsigned char _hsva[4];
    };
} GBPixelFormat;

typedef enum GBLayerBlendMode {
    GBLayerBlendModeDefault, // Simple overwriting
    GBLayerBlendModeNormal, // Blending according to relative alpha
    GBLayerBlendModeOver // Blending according to alpha of top pix
} GBLayerBlendMode;

typedef enum GBLayerStackPosition {
    GBLayerStackPosBg, // Layers' pixels are stacked according to their
                       // index
    GBLayerStackPosInside, // Layers' pixels are stacked according to
                           // their depth
    GBLayerStackPosFg // Layers' pixels are stacked according to their
                      // index
} GBLayerStackPosition;

typedef struct GBStackedPixelFormat {
    // Pixel values
    GBPixelFormat _val;
    // Depth
    float _depth;
    // BlendMode
    GBLayerBlendMode _blendMode;
} GBStackedPixelFormat;

typedef struct GBLayer {
    // Position in the GBSurface of the bottom left corner of the GBLayer
    // (coordinates of the bottom left corner in the GBSurface are 0,0)
    // (x toward right, y toward top)
    VecShort2D _pos;
    // Previous position
    VecShort2D _prevPos;

```

```

    // Dimension
    VecShort2D _dim;
    // _dim[0] x _dim[1] GSet of StackedPixel (stored by rows)
    GSet* _pix;
    // Composition
    GBLayerBlendMode _blendMode;
    // Modified flag
    bool _modified;
    // Position in stack
    GBLayerStackPosition _stackPos;
    // Scale
    VecFloat2D _scale;
    // Previous scale
    VecFloat2D _prevScale;
    // Flag to memorize if the stacked pixels in the layer
    // are flushed after an update
    bool _isFlushed;
} GBLayer;

typedef enum GBPPTType {
    GBPPTTypeNormalizeHue,
    GBPPTTypeOrderedDithering,
    GBPPTTypeFloydSteinbergDithering
} GBPPTType;

typedef struct GBPostProcessing {
    enum GBPPTType _type;
} GBPostProcessing;

typedef enum GBSurfaceType {
    GBSurfaceTypeDefault,
    GBSurfaceTypeImage
#ifdef BUILDWITHGRAPHICLIB == 1
    , GBSurfaceTypeApp, GBSurfaceTypeWidget
#endif
} GBSurfaceType;

typedef struct GBSurface {
    // Type of the surface
    GBSurfaceType _type;
    // Dimension (x toward right, y toward top)
    VecShort2D _dim;
    // Background color
    GBPixel _bgColor;
    // Set of GBLayer
    GSet _layers;
    // Final pixels
    GBPixel* _finalPix;
} GBSurface;

typedef struct GBSurfaceImage {
    // Parent GBSurface
    GBSurface _surf;
    // File name
    char* _fileName;
} GBSurfaceImage;

typedef enum GBEyeType {
    GBEyeTypeOrtho,
    GBEyeTypeIsometric
} GBEyeType;

```

```

typedef struct GBEye {
    // Type
    GBEyeType _type;
    // Scale
    VecFloat3D _scale;
    // (0,0) in graphical element is translated at _orig in the surface
    VecFloat2D _orig;
    // Rotation of the eye (clockwise, radians)
    float _theta;
    // Projection matrix from real space to surface space
    // Transformation are applied in the following order in the
    // surface space:
    // scale, rotation, translation
    MatFloat* _proj;
} GBEye;

typedef enum GBEyeOrthoView {
    // View from ...
    GBEyeOrthoViewFront,
    GBEyeOrthoViewRear,
    GBEyeOrthoViewTop,
    GBEyeOrthoViewBottom,
    GBEyeOrthoViewLeft,
    GBEyeOrthoViewRight
} GBEyeOrthoView;

typedef struct GBEyeOrtho {
    // GBEye data
    GBEye _eye;
    // Orientation of the orthographic projection
    GBEyeOrthoView _view;
} GBEyeOrtho;

typedef struct GBEyeIsometric {
    // GBEye data
    GBEye _eye;
    // Rotation right handed around y (in radians, initially 0.0)
    float _thetaY;
    // Rotation right handed around the right direction in the surface
    // (in radians, in [-pi/2, pi/2], initially pi/4)
    float _thetaRight;
} GBEyeIsometric;

typedef enum GBHandType {
    GBHandTypeDefault
} GBHandType;

typedef struct GBHand {
    // Type
    GBHandType _type;
} GBHand;

typedef struct GBHandDefault {
    // Parent
    GBHand _hand;
} GBHandDefault;

typedef enum GBToolType {
    GBToolTypePlotter,
    GBToolTypePen
} GBToolType;

```



```

typedef struct GBTool {
    // Type
    GBToolType _type;
} GBTool;

typedef struct GBToolPlotter {
    // Parent
    GBTool _tool;
} GBToolPlotter;

typedef struct GBToolPen {
    // Parent
    GBTool _tool;
    // Shape of the pen
    Shapoid* _shape;
    // Softness of the pen
    // bigger than 0.0, the bigger the softener the pen is, used as
    // second argument of pow(...)
    float _softness;
} GBToolPen;

typedef enum GBInkType {
    GBInkTypeSolid
} GBInkType;

typedef struct GBInk {
    // Type
    GBInkType _type;
} GBInk;

typedef struct GBInkSolid {
    // Parent
    GBInk _ink;
    // Color
    GBPixel _color;
} GBInkSolid;

typedef enum GBObjType {
    GBObjTypePoint,
    GBObjTypeShapoid,
    GBObjTypeSCurve
} GBObjType;

typedef struct GBObjPod {
    // Type
    GBObjType _type;
    // Source object
    union {
        VecFloat* _srcPoint;
        Shapoid* _srcShapoid;
        SCurve* _srcSCurve;
    };
    // Object projected through eye
    union {
        VecFloat* _eyePoint;
        Shapoid* _eyeShapoid;
        SCurve* _eyeSCurve;
    };
    // GSet of projected Points (VecFloat) through eye + hand
    GSetVecFloat _handPoints;
    // GSet of projected Shapoids through eye + hand
    GSetShapoid _handShapoids;

```

```

// GSet of projected Shapoids through eye + hand
GSetSCurve _handSCurves;
// Eye
GBEye* _eye;
// Hand
GBHand* _hand;
// Tool
GBTool* _tool;
// Ink
GBInk* _ink;
// Layer
GBLayer* _layer;
} GBObjPod;

typedef enum GBScaleMethod {
    GBScaleMethod_AvgNeighbour
} GBScaleMethod;
#define GBScaleMethod_Default GBScaleMethod_AvgNeighbour

typedef struct GenBrush {
    // Surface of the GenBrush
    GBSurface* _surf;
    // Set of GBObjPod to be drawn
    GSet _pods;
    // Set of GBPostProcessing to be apply at the end of GBUdate
    GSet _postProcs;
} GenBrush;

// ===== Functions declaration =====

// ----- GBPixel -----

// Blend the pixel 'pix' into the pixel 'that'
// BlendNormal mixes colors according to their relative alpha value
void GBPixelBlendNormal(GBPixel* const that, const GBPixel* const pix);

// Blend the pixel 'pix' into the pixel 'that'
// BlendOver mixes colors according to the alpha value of 'pix'
// and add the alpha values
void GBPixelBlendOver(GBPixel* const that, const GBPixel* const pix);

// Return the blend result of the stack of Pixel 'stack'
// If there is transparency down to the bottom of the stack, use the
// background color 'bgColor'
// If the stack is empty, return a transparent pixel
GBPixel GBPixelStackBlend(const GSet* const stack,
    const GBPixel* const bgColor);

// Return true if the GBPixel 'that' and 'tho' are the same, else false.
#if BUILDMODE != 0
static inline
#endif
bool GBPixelIsSame(const GBPixel* const that, const GBPixel* const tho);

// Convert the GBPixel 'that' from RGB to HSV. Alpha channel is unchanged
GBPixel GBPixelRGB2HSV(const GBPixel* const that);

// Convert the GBPixel 'that' from HSV to RGB. Alpha channel is unchanged
GBPixel GBPixelHSV2RGB(const GBPixel* const that);

// ----- GBLayer -----

```

```

// Create a new GBLayer with dimensions 'dim'
// The layer is initialized with empty stacks of pixel
// _pos = (0,0)
// blendMode = GBLayerBlendModeDefault
// stackPos = GBLayerStackPosBg
GBLayer* GBLayerCreate(const VecShort2D* const dim);

// Free the GBLayer 'that'
void GBLayerFree(GBLayer** that);

// Get the area of the layer (width * height)
#if BUILDMODE != 0
static inline
#endif
int GBLayerArea(const GBLayer* const that);

// Get the position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D* GBLayerPos(const GBLayer* const that);

// Get a copy of the position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBLayerGetPos(const GBLayer* const that);

// Set the position of the GBLayer 'that' to 'pos'
// If the flag _modified==false _prevPos is first set to _pos
// and _modified is set to true
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetPos(GBLayer* const that, const VecShort2D* const pos);

// Get the previous position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D* GBLayerPrevPos(const GBLayer* const that);

// Get a copy of the previous position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBLayerGetPrevPos(const GBLayer* const that);

// Get the scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D* GBLayerScale(const GBLayer* const that);

// Get a copy of the scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D GBLayerGetScale(const GBLayer* const that);

// Set the scale of the GBLayer 'that' to 'scale'
// If the flag _modified==false _prevScale is first set to _scale

```

```

// and _modified is set to true
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetScale(GBLayer* const that, const VecFloat2D* const scale);

// Get the previous scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D* GBLayerPrevScale(const GBLayer* const that);

// Get a copy of the previous scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D GBLayerGetPrevScale(const GBLayer* const that);

// Get the dimensions of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D* GBLayerDim(const GBLayer* const that);

// Get a copy of the dimensions of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBLayerGetDim(const GBLayer* const that);

// Get a copy of the blend mode of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
GBLayerBlendMode GBLayerGetBlendMode(const GBLayer* const that);

// Set the blend mode of the GBLayer 'that' to 'blend'
// Set the flag _modified to true
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetBlendMode(GBLayer* const that,
    const GBLayerBlendMode blend);

// Get a copy of the modified flag of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
bool GBLayerIsModified(const GBLayer* const that);

// Set the modified flag of the GBLayer 'that' to 'flag'
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetModified(GBLayer* const that, const bool flag);

// Get a copy of the isFlushed flag of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
bool GBLayerIsFlushed(const GBLayer* const that);

```

```

// Set the isFlushed flag of the GBLayer 'that' to 'flag'
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetFlushed(GBLayer* const that, const bool flag);

// Get a copy of the stack position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
GBLayerStackPosition GBLayerGetStackPos(const GBLayer* const that);

// Set the stack position of the GBLayer 'that' to 'pos'
// Set the flag _modified to true
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetStackPos(GBLayer* const that,
    const GBLayerStackPosition pos);

// Get the stacked pixels of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBLayerPixels(const GBLayer* const that);

// Get the stacked pixels of the GBLayer 'that' at position 'pos'
// 'pos' must be inside the layer
#if BUILDMODE != 0
static inline
#endif
GSet* GBLayerPixel(const GBLayer* const that,
    const VecShort2D* const pos);

// Get the stacked pixels of the GBLayer 'that' at position 'pos'
// If 'pos' is out of the layer return NULL
#if BUILDMODE != 0
static inline
#endif
GSet* GBLayerPixelSafe(const GBLayer* const that,
    const VecShort2D* const pos);

// Add the pixel 'pix' with depth 'depth' on top of the stack at
// position 'pos' of GBLayer 'that'
// Set the flag _modified to true
// 'pos' must be inside the layer
// If the pixel is completely transparent (_rgba[GBPixelAlpha]==0)
// do nothing
#if BUILDMODE != 0
static inline
#endif
void GBLayerAddPixel(GBLayer* const that, const VecShort2D* const pos,
    const GBPixel* const pix, const float depth);

// Add the pixel 'pix' with depth 'depth' on top of the stack at
// position 'pos' of GBLayer 'that'
// Set the flag _modified to true
// If 'pos' is out of the layer do nothing
// If the pixel is completely transparent (_rgba[GBPixelAlpha]==0)
// do nothing
#if BUILDMODE != 0
static inline

```

```

#endif
void GBLayerAddPixelSafe(GBLayer* const that,
    const VecShort2D* const pos, const GBPixel* const pix,
    const float depth);

// Return true if the position 'pos' is inside the layer 'that'
// boundary, false else
#if BUILDMODE != 0
static inline
#endif
bool GBLayerIsPosInside(const GBLayer* const that,
    const VecShort2D* const pos);

// Delete all the stacked pixels in the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
void GBLayerFlush(GBLayer* const that);

// Create a new GBLayer with dimensions and content given by the
// image on disk at location 'fileName'
// Return NULL if we couldn't create the layer
GBLayer* GBLayerCreateFromFile(const char* const fileName);

// Get the boundary of the GBLayer 'that' inside the GBSurface 'surf'
// The boundaries are given as a Facoid
// If the flag 'prevStatus' is true, gives the bounday at the previous
// position
// Return NULL if the layer is completely out of the surface
Facoid* GBLayerGetBoundaryInSurface(const GBLayer* const that,
    const GBSurface* const surf, const bool prevStatus);

// ----- GBPostProcessing -----

// Create a static GBPostProcessing with type 'type'
GBPostProcessing* GBPostProcessingCreate(const GBPPType type);

// Create a new static GBPostProcessing with type 'type'
GBPostProcessing GBPostProcessingCreateStatic(const GBPPType type);

// Free the memory used by the GBPostProcessing 'that'
void GBPostProcessingFree(GBPostProcessing** that);

// Return the type of the GBPostProcessing 'that'
#if BUILDMODE != 0
static inline
#endif
GBPPType GBPostProcessingGetType(const GBPostProcessing* const that);

// ----- GBSurface -----

// Create a new static GBSurface with dimension 'dim' and type 'type'
// _finalPix is set to 0
// _bgColor is set to white
GBSurface GBSurfaceCreateStatic(const GBSurfaceType type,
    const VecShort2D* const dim);

// Create a static GBSurface with dimension 'dim' and type 'type'
// _finalPix is set to 0
// _bgColor is set to white
GBSurface* GBSurfaceCreate(const GBSurfaceType type,
    const VecShort2D* const dim);

```

```

// Free the memory used by the GBSurface 'that'
void GBSurfaceFree(GBSurface** that);

// Free the memory used by the properties of the GBSurface 'that'
void GBSurfaceFreeStatic(GBSurface* const that);

// Clone the GBSurface 'that'
GBSurface GBSurfaceClone(const GBSurface* const that);

// Return true if the GBSurface 'that' has same dimension and same
// values for _finalPix as GBSurface 'surf'
// Else, return false
#ifdef BUILDMODE != 0
static inline
#endif
bool GBSurfaceIsSameAs(const GBSurface* const that,
    const GBSurface* const surf);

// Get the type of the GBSurface 'that'
#ifdef BUILDMODE != 0
static inline
#endif
GBSurfaceType GBSurfaceGetType(const GBSurface* const that);

// Get a copy of the dimensions of the GBSurface 'that'
#ifdef BUILDMODE != 0
static inline
#endif
VecShort2D GBSurfaceGetDim(const GBSurface* const that);

// Get the dimensions of the GBSurface 'that'
#ifdef BUILDMODE != 0
static inline
#endif
VecShort2D* GBSurfaceDim(const GBSurface* const that);

// Get the final pixels of the GBSurface 'that'
#ifdef BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceFinalPixels(const GBSurface* const that);

// Get the final pixel at position 'pos' of the GBSurface 'that'
// 'pos' must be in the surface
#ifdef BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceFinalPixel(const GBSurface* const that,
    const VecShort2D* const pos);

// Get a copy of the final pixel at position 'pos' of the GBSurface
// 'that'
// 'pos' must be in the surface
#ifdef BUILDMODE != 0
static inline
#endif
GBPixel GBSurfaceGetFinalPixel(const GBSurface* const that,
    const VecShort2D* const pos);

// Set the final pixel at position 'pos' of the GBSurface 'that' to
// the pixel 'pix'

```

```

// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetFinalPixel(GBSurface* const that,
    const VecShort2D* const pos, const GBPixel* const pix);

// Get the final pixel at position 'pos' of the GBSurface 'that'
// If 'pos' is out of the surface return NULL
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceFinalPixelSafe(const GBSurface* const that,
    const VecShort2D* const pos);

// Get a copy of the final pixel at position 'pos' of the GBSurface
// 'that'
// If 'pos' is out of the surface return a transparent pixel
#if BUILDMODE != 0
static inline
#endif
GBPixel GBSurfaceGetFinalPixelSafe(const GBSurface* const that,
    const VecShort2D* const pos);

// Set the final pixel at position 'pos' of the GBSurface 'that' to
// the pixel 'pix'
// If 'pos' is out of the surface do nothing
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetFinalPixelSafe(GBSurface* const that,
    const VecShort2D* const pos, const GBPixel* const pix);

// Get the area of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
long GBSurfaceArea(const GBSurface* const that);

// Get the background color of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceBgColor(const GBSurface* const that);

// Get a copy of the background color of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel GBSurfaceGetBgColor(const GBSurface* const that);

// Set the background color of the GBSurface 'that' to 'col'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetBgColor(GBSurface* const that,
    const GBPixel* const col);

// Return true if the position 'pos' is inside the GBSurface 'that'
// boundary, false else
#if BUILDMODE != 0
static inline

```



```

#endif
bool GBSurfaceIsPosInside(const GBSurface* const that,
    const VecShort2D* const pos);

// Get the set of layers of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBSurfaceLayers(const GBSurface* const that);

// Add a new GBLayer with dimensions 'dim' to the top of the stack
// of layers of the GBSurface 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBSurfaceAddLayer(GBSurface* const that,
    const VecShort2D* const dim);

// Add a new GBLayer with the content of the image located at
// 'fileName' to the top of the stack of layers of the GBSurface 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBSurfaceAddLayerFromFile(GBSurface* const that,
    const char* const fileName);

// Get the 'iLayer'-th layer of the GBSurface 'that'
// 'iLayer' must be valid
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBSurfaceLayer(const GBSurface* const that, const int iLayer);

// Get the number of layer of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
int GBSurfaceNbLayer(const GBSurface* const that);

// Set the _modified flag of all layers of the GBSurface 'that'
// to 'flag'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetLayersModified(GBSurface* const that, const bool flag);

// Set the stack position of the GBLayer 'layer' into the set of
// layers of the GBSurface 'that' to 'pos'
// If 'layer' can't be found in the surface do nothing
// 'pos' must be valid (0<='pos'<nbLayers)
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetLayerStackPos(GBSurface* const that,
    GBLayer* const layer, const int pos);

// Remove the GBLayer 'layer' from the set of layers of the
// GBSurface 'that'
// The memory used by 'layer' is freed
#if BUILDMODE != 0

```

```

static inline
#endif
void GBSurfaceRemoveLayer(GBSurface* const that, GBLayer* layer);

// Get a GSet of Facoid representing the sub areas of the GBSurface
// 'that' affected by layers with _modified flag equal to true
// If there is no modified sub area return an empty GSet
GSetShapoid* GBSurfaceGetModifiedArea(const GBSurface* const that);

// Update the final pixels according to layers of the GBSurface 'that'
// Update only pixels affected by layers with the _modified flag
// equals to true
void GBSurfaceUpdate(GBSurface* const that);

// Reset all the final pix of the GBSurface 'that' to its
// background color, and reset all the modified flag of layers to true
void GBSurfaceFlush(GBSurface* const that);

// Apply the post processing 'post' to the final pixels in the
// GBSurface 'that'
void GBSurfacePostProcess(GBSurface* const that,
    const GBPostProcessing* const post);

// ----- GBSurfaceImage -----

// Create a new GBSurfaceImage with dimension 'dim'
GBSurfaceImage* GBSurfaceImageCreate(const VecShort2D* const dim);

// Free the memory used by the GBSurfaceImage 'that'
void GBSurfaceImageFree(GBSurfaceImage** that);

// Clone the GBSurfaceImage 'that'
GBSurfaceImage* GBSurfaceImageClone(const GBSurfaceImage* const that);

// Get the filename of the GBSurfaceImage 'that'
#if BUILDMODE != 0
static inline
#endif
char* GBSurfaceImageFileName(const GBSurfaceImage* const that);

// Set the filename of the GBSurfaceImage 'that' to 'fileName'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceImageSetFileName(GBSurfaceImage* const that,
    const char* const fileName);

// Save a GBSurfaceImage 'that'
// If the filename is not set do nothing and return false
// Return true if it could save the surface, false else
// For any other format than tga the surface is first saved in a temporary
// file /tmp/genbrush.tga and then converted using the 'convert' command
bool GBSurfaceImageSave(const GBSurfaceImage* const that);

// Create a new GBSurfaceImage with one layer containing the content
// of the image located at 'fileName' and dimensions equal to the
// dimensions of the image
// If the image couldn't be loaded return NULL
GBSurfaceImage* GBSurfaceImageCreateFromFile(const char* const fileName);

// ----- GBEye -----

```

```

// Create a new GBEye with type 'type'
GBEye GBEyeCreateStatic(const GBEyeType type);

// Free the memory used by the GBEye 'that'
void GBEyeFreeStatic(GBEye* const that);

// Return the type of the GBEye 'that'
#if BUILDMODE != 0
static inline
#endif
GBEyeType _GBEyeGetType(const GBEye* const that);

// Get the scale of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat3D* _GBEyeScale(const GBEye* const that);

// Get a copy of the scale of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat3D _GBEyeGetScale(const GBEye* const that);

// Get the translation of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat2D* _GBEyeOrig(const GBEye* const that);

// Get a copy of the translation of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat2D _GBEyeGetOrig(const GBEye* const that);

// Get the rotation of the GBEye (in radians)
#if BUILDMODE != 0
static inline
#endif
float _GBEyeGetRot(const GBEye* const that);

// Set the scale of the GBEye
#if BUILDMODE != 0
static inline
#endif
void GBEyeSetScaleVec(GBEye* const that, const VecFloat3D* const scale);
#if BUILDMODE != 0
static inline
#endif
void GBEyeSetScaleFloat(GBEye* const that, const float scale);

// Set the origin of the GBEye
#if BUILDMODE != 0
static inline
#endif
void _GBEyeSetOrig(GBEye* const that, const VecFloat2D* const orig);

// Set the rotation of the GBEye (in radians)
#if BUILDMODE != 0
static inline
#endif

```

```

void _GBEyeSetRot(GBEye* const that, const float theta);

// Update the projection matrix of the GBEye according to scale, rot
// and origin
void GBEyeUpdateProj(GBEye* const that);

// Get the matrix projection of the eye
#if BUILDMODE != 0
static inline
#endif
MatFloat* _GBEyeProj(const GBEye* const that);

// Call the appropriate GBEye<>Process according to the type of the
// GBEye 'that'
#if BUILDMODE != 0
static inline
#endif
void _GBEyeProcess(const GBEye* const that, GBObjPod* const pod);

// Return the projection through the GBEye 'that' of the Point 'point'
VecFloat* GBEyeGetProjectedPoint(const GBEye* const that,
    const VecFloat* const point);

// Return the projection through the GBEye 'that' of the SCurve 'curve'
SCurve* GBEyeGetProjectedCurve(const GBEye* const that,
    const SCurve* const curve);

// Return the projection through the GBEye 'that' of the Shapoid 'shap'
Shapoid* GBEyeGetProjectedShapoid(const GBEye* const that,
    const Shapoid* const shap);

// ----- GBEyeOrtho -----

// Return a new GBEyeOrtho with orientation 'view'
// scale is initialized to (1,1), trans to (0,0) and rot to 0
GBEyeOrtho* GBEyeOrthoCreate(const GBEyeOrthoView view);

// Free the memory used by the GBEyeOrtho 'that'
void GBEyeOrthoFree(GBEyeOrtho** that);

// Set the orientation the GBEyeOrtho 'that'
#if BUILDMODE != 0
static inline
#endif
void GBEyeOrthoSetView(GBEyeOrtho* const that,
    const GBEyeOrthoView view);

// Process the object of the GBObjPod 'pod' to update the viewed object
// through the GBEyeOrtho 'that'
void GBEyeOrthoProcess(const GBEyeOrtho* const that,
    GBObjPod* const pod);

// ----- GBEyeIsometric -----

// Return a new GBEyeIsometric with orientation 'view'
// scale is initialized to (1,1), trans to (0,0) and rot to 0
// thetaY is initialized to pi/4 and thetaRight to pi/4
GBEyeIsometric* GBEyeIsometricCreate();

// Free the memory used by the GBEyeIsometric 'that'
void GBEyeIsometricFree(GBEyeIsometric** that);

```

```

// Set the angle around Y of the GBEyeOrtho to 'theta' (in radians)
#if BUILDMODE != 0
static inline
#endif
void GBEyeIsometricSetRotY(GBEyeIsometric* const that,
    const float theta);

// Set the angle around Right of the GBEyeOrtho to 'theta'
// (in radians, in [-pi/2, pi/2])
// If 'theta' is out of range it is automatically bounded
// (ex: pi -> pi/2)
#if BUILDMODE != 0
static inline
#endif
void GBEyeIsometricSetRotRight(GBEyeIsometric* const that,
    const float theta);

// Get the angle around Y of the GBEyeOrtho 'that'
#if BUILDMODE != 0
static inline
#endif
float GBEyeIsometricGetRotY(const GBEyeIsometric* const that);

// Get the angle around Right of the GBEyeOrtho 'that'
#if BUILDMODE != 0
static inline
#endif
float GBEyeIsometricGetRotRight(const GBEyeIsometric* const that);

// Process the object of the GBObjPod 'pod' to update the viewed object
// through the GBEyeIsometric 'that'
void GBEyeIsometricProcess(const GBEyeIsometric* const that,
    GBObjPod* const pod);

// ----- GBHand -----

// Create a new GBHand with type 'type'
GBHand GBHandCreateStatic(const GBHandType type);

// Free the memory used by the GBHand 'that'
void GBHandFreeStatic(GBHand* const that);

// Return the type of the GBHand 'that'
#if BUILDMODE != 0
static inline
#endif
GBHandType _GBHandGetType(const GBHand* const that);

// Call the appropriate GBHand<>Process according to the type of the
// GBHand 'that'
#if BUILDMODE != 0
static inline
#endif
void _GBHandProcess(const GBHand* const that, GBObjPod* const pod);

// ----- GBHandDefault -----

// Create a new GBHandDefault
GBHandDefault* GBHandDefaultCreate();

// Free the memory used by the GBHandDefault 'that'
void GBHandDefaultFree(GBHandDefault** that);

```

```

// Process the viewed projection of the object in GBObjPod 'pod' into
// its handed projection through the GBHandDefault 'that'
void GBHandDefaultProcess(const GBHandDefault* const that,
    GBObjPod* const pod);

// ----- GBTool -----

// Create a static GBTool with GBToolType 'type'
GBTool GBToolCreateStatic(const GBToolType type);

// Free the memory used by the GBTool 'that'
void GBToolFreeStatic(GBTool* const that);

// Return a copy of the type of the GBTool 'that'
#if BUILDMODE != 0
static inline
#endif
GBToolType GBToolGetType(const GBTool* const that);

// Function to call the appropriate GBTool<>Draw function according to
// type of GBTool 'that'
#if BUILDMODE != 0
static inline
#endif
void _GBToolDraw(const GBTool* const that, GBObjPod* const pod);

// ----- GBToolPlotter -----

// Create a new GBToolPlotter
GBToolPlotter* GBToolPlotterCreate();

// Free the memory used by the GBToolPlotter 'that'
void GBToolPlotterFree(GBToolPlotter** that);

// Draw the object in the GBObjPod 'pod' with the GBToolPlotter 'that'
void GBToolPlotterDraw(const GBToolPlotter* const that,
    const GBObjPod* const pod);

// ----- GBToolPen -----

// Create a new GBToolPen with the given 'shape' and default
// 'softness' value of 1.0
GBToolPen* GBToolPenCreate(const Shapoid* shape);

// Free the memory used by the GBToolPen 'that'
void GBToolPenFree(GBToolPen** that);

// Draw the object in the GBObjPod 'pod' with the GBToolPen 'that'
void GBToolPenDraw(const GBToolPen* const that,
    const GBObjPod* const pod);

// Function to get the shape of GBToolPen 'that'
#if BUILDMODE != 0
static inline
#endif
Shapoid* GBToolPenShape(const GBToolPen* that);

// Function to set the shape of GBToolPen 'that' to a clone of 'shape'
#if BUILDMODE != 0
static inline
#endif

```

```

void GBToolPenSetShape(GBToolPen* that, const Shapoid* shape);

// Function to get the softness of GBToolPen 'that'
#if BUILDMODE != 0
static inline
#endif
float GBToolPenGetSoftness(const GBToolPen* that);

// Function to set the softness of GBToolPen 'that' to 'softness'
// 'softness' > 0.0, the bigger the softener the pen is
#if BUILDMODE != 0
static inline
#endif
void GBToolPenSetSoftness(GBToolPen* that, float softness);

// ----- GBInk -----

// Return the type of the GBInk 'that'
#if BUILDMODE != 0
static inline
#endif
GBInkType _GBInkGetType(const GBInk* const that);

// Free the memory used by the GBInk 'that'
void GBInkFree(GBInk* const that);

// Entry point for the GBTool<>Draw function to get the color of the
// appropriate GBInk according to the type of 'that'
// posInternal represents the position in the object internal space
// posExternal represents the position in the global coordinates system
// posLayer represents the position in the destination layer
GBPixel _GBInkGet(const GBInk* const that, const GBTool* const tool,
    const GBObjPod* const pod, const VecFloat* const posInternal,
    const VecFloat* const posExternal, const VecShort* const posLayer);

// ----- GBInkSolid -----

// Create a new GBInkSolid with color 'col'
GBInkSolid* GBInkSolidCreate(const GBPixel* const col);

// Free the memory used by the GBInkSolid 'that'
void GBInkSolidFree(GBInkSolid** that);

// Get the color of the GBInkSolid 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel GBInkSolidGet(const GBInkSolid* const that);

// Set the color of the GBInkSolid 'that' to 'col'
#if BUILDMODE != 0
static inline
#endif
void GBInkSolidSet(GBInkSolid* const that, const GBPixel* const col);

// ----- GBObjPod -----

// Create a new GBObjPod for a Point at position 'pos'
// drawn with 'eye', 'hand', 'tool' and 'ink' in layer 'layer'
// 'pos' must be a vector of 2 or more dimensions
// If 'eye', 'hand', 'tool', 'ink' or 'layer' is null return null
GBObjPod* _GBObjPodCreatePoint(VecFloat* const pos, GBEye* const eye,

```

```

    GBHand* const hand, GBTool* const tool, GBInk* const ink,
    GBLayer* const layer);

// Create a new GBObjPod for the Shapoid 'shap'
// drawn with 'eye', 'hand', 'tool' and 'ink' in layer 'layer'
// 'shap' 's dimension must be 2 or more
// If 'eye', 'hand', 'tool', 'ink' or 'layer' is null return null
GBObjPod* _GBObjPodCreateShapoid(Shapoid* const shap, GBEye* const eye,
    GBHand* const hand, GBTool* const tool, GBInk* const ink,
    GBLayer* const layer);

// Create a new GBObjPod for the SCurve 'curve'
// drawn with 'eye', 'hand', 'tool' and 'ink' in layer 'layer'
// 'curve' 's dimension must be 2 or more
// If 'eye', 'hand', 'tool', 'ink' or 'layer' is null return null
GBObjPod* _GBObjPodCreateSCurve(SCurve* const curve, GBEye* const eye,
    GBHand* const hand, GBTool* const tool, GBInk* const ink,
    GBLayer* const layer);

// Free the memory used by the GBObjPod 'that'
void GBObjPodFree(GBObjPod** that);

// Process the object in the GBObjPod 'that' to update the resulting
// object when some components of the pod have changed
#if BUILDMODE != 0
static inline
#endif
void GBObjPodProcess(GBObjPod* const that);

// Return the type of the object in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBObjType GBObjPodGetType(const GBObjPod* const that);

// Return the object in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
void* GBObjPodObj(const GBObjPod* const that);

// Return the object viewed by its attached eye in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
void* GBObjPodEyeObj(const GBObjPod* const that);

// Return the object processed as Points by its attached hand in the
// GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GSetVecFloat* GBObjPodGetHandObjAsPoints(const GBObjPod* const that);

// Return the object processed as Shapoids by its attached hand in the
// GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GSetShapoid* GBObjPodGetHandObjAsShapoids(const GBObjPod* const that);

// Return the object processed as SCurves by its attached hand in the

```



```

// GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GSetSCurve* GBObjPodGetHandObjAsSCurves(const GBObjPod* const that);

// Return the eye in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GEye* GBObjPodEye(const GBObjPod* const that);

// Return the hand in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBHand* GBObjPodHand(const GBObjPod* const that);

// Return the tool in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBTool* GBObjPodTool(const GBObjPod* const that);

// Return the ink in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBInk* GBObjPodInk(const GBObjPod* const that);

// Return the layer in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBObjPodLayer(const GBObjPod* const that);

// Set the Point viewed by its attached eye in the GBObjPod 'that'
// to 'point'
// If 'point' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEyePoint(GBObjPod* const that, VecFloat* const point);

// Set the Shapoid viewed by its attached eye in the GBObjPod 'that'
// to 'shap'
// If 'shap' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEyeShapoid(GBObjPod* const that, Shapoid* const shap);

// Set the SCurve viewed by its attached eye in the GBObjPod 'that'
// to 'curve'
// If 'curve' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEyeSCurve(GBObjPod* const that, SCurve* const curve);

// Set the eye in the GBObjPod 'that' to 'eye'
// If 'eye' is null do nothing

```

```

#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEye(GBObjPod* const that, GBEye* const eye);

// Set the hand in the GBObjPod 'that' to 'hand'
// If 'hand' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetHand(GBObjPod* const that, GBHand* const hand);

// Set the tool in the GBObjPod 'that' to 'tool'
// If 'tool' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetTool(GBObjPod* const that, GBTool* const tool);

// Set the ink in the GBObjPod 'that' to 'ink'
// If 'ink' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetInk(GBObjPod* const that, GBInk* const ink);

// Set the layer in the GBObjPod 'that' to 'layer'
// If 'layer' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void GBObjPodSetLayer(GBObjPod* const that, GBLayer* const layer);

// ----- GenBrush -----

// Create a new GenBrush with a GBSurface of type GBSurfaceTypeImage
// and dimensions 'dim'
GenBrush* GBCreateImage(const VecShort2D* const dim);

// Free memory used by the GenBrush 'that'
void GBFree(GenBrush** that);

// Create a new GenBrush with one layer containing the content
// of the image located at 'fileName' and dimensions equal to the
// dimensions of the image
// If the image couldn't be loaded return NULL
GenBrush* GBCreateFromFile(const char* const fileName);

// Get the GBSurface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBSurface* GBSurf(const GenBrush* const that);

// Get the set of pods of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBPods(const GenBrush* const that);

// Get the dimensions of the GenBrush 'that'
VecShort2D* GBDim(const GenBrush* const that);

```

```

// Get a copy of the dimensions of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBGetDim(const GenBrush* const that);

// Get the final pixels of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBFinalPixels(const GenBrush* const that);

// Get the final pixel at position 'pos' of the GBSurface of the GB
// 'that'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBFinalPixel(const GenBrush* const that,
    const VecShort2D* const pos);

// Get a copy of the final pixel at position 'pos' of the GBSurface
// of the GB 'that'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
GBPixel GBGetFinalPixel(const GenBrush* const that,
    const VecShort2D* const pos);

// Set the final pixel at position 'pos' of the GBSurface of the GB
// 'that' to the pixel 'pix'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
void GBSetFinalPixel(GenBrush* const that, const VecShort2D* const pos,
    const GBPixel* const pix);

// Get the final pixel at position 'pos' of the GBSurface of the GB
// 'that'
// If 'pos' is out of the surface return NULL
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBFinalPixelSafe(const GenBrush* const that,
    const VecShort2D* const pos);

// Get a copy of the final pixel at position 'pos' of the GBSurface
// of the GB 'that'
// If 'pos' is out of the surface return a transparent pixel
#if BUILDMODE != 0
static inline
#endif
GBPixel GBGetFinalPixelSafe(const GenBrush* const that,
    const VecShort2D* const pos);

// Set the final pixel at position 'pos' of the GBSurface of the GB
// 'that' to the pixel 'pix'
// If 'pos' is out of the surface do nothing
#if BUILDMODE != 0

```

```

static inline
#endif
void GBSetFinalPixelSafe(GenBrush* const that,
    const VecShort2D* const pos, const GBPixel* const pix);

// Get the type of the GBSurface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBSurfaceType GBGetType(const GenBrush* const that);

// Get the background color of the GBSurface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBBgColor(const GenBrush* const that);

// Get a copy of the background color of the GBSurface of the
// GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel GBGetBgColor(const GenBrush* const that);

// Set the background color of the GBSurface of the GenBrush
// 'that' to 'col'
#if BUILDMODE != 0
static inline
#endif
void GBSetBgColor(GenBrush* const that, const GBPixel* const col);

// Get the filename of the GBSurfaceImage of the GenBrush 'that'
// Return NULL if the surface is not a GBSurfaceImage
#if BUILDMODE != 0
static inline
#endif
char* GBFileName(const GenBrush* const that);

// Set the filename of the GBSurfaceImage of the GenBrush 'that'
// to 'fileName'
// Do nothing if the surface is not a GBSurfaceImage
#if BUILDMODE != 0
static inline
#endif
void GBSetFileName(GenBrush* const that, const char* const fileName);

// Update the GBSurface of the GenBrush 'that'
void GBUpdate(GenBrush* const that);

// Render the GBSurface (save on disk, display on screen, ...) of
// the GenBrush 'that'
bool GBRender(GenBrush* const that);

// Get the area of the GBSurface of the Genbrush 'that'
#if BUILDMODE != 0
static inline
#endif
long GBArea(const GenBrush* const that);

// Return true if the position 'pos' is inside the GBSurface of the
// GenBrush 'that'
// boundary, false else

```

```

#if BUILDMODE != 0
static inline
#endif
bool GBIsPosInside(const GenBrush* const that,
    const VecShort2D* const pos);

// Return the layers of the surface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBLayers(const GenBrush* const that);

// Add a new GBLayer with dimensions 'dim' to the top of the stack
// of layers of the GBSurface of the GenBrush 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBAddLayer(GenBrush* const that, const VecShort2D* const dim);

// Add a new GBLayer with content equals to the image located at
// 'fileName' to the top of the stack
// of layers of the GBSurface of the GenBrush 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBAddLayerFromFile(GenBrush* const that,
    const char* const fileName);

// Get the 'iLayer'-th layer of the GBSurface of the GenBrush 'that'
// 'iLayer' must be valid
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBLay(const GenBrush* const that, const int iLayer);

// Get the number of layer of the GBSurface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
int GBGetNbLayer(const GenBrush* const that);

// Set the stack position of the GBLayer 'layer' into the set of
// layers of the GBSurface of the GenBrush 'that' to 'pos'
// If 'layer' can't be found in the surface do nothing
// 'pos' must be valid (0<='pos'<nbLayers)
#if BUILDMODE != 0
static inline
#endif
void GBSetLayerStackPos(GenBrush* const that,
    GBLayer* const layer, const int pos);

// Remove the GBLayer 'layer' from the set of layers of the
// GBSurface of the GenBrush 'that'
// The memory used by 'layer' is freed
#if BUILDMODE != 0
static inline
#endif
void GBRemoveLayer(GenBrush* const that, GBLayer* layer);

// Get the number of objects in the GenBrush 'that'

```

```

#if BUILDMODE != 0
static inline
#endif
int GBGetNbPod(const GenBrush* const that);

// Add a GBObjPod for the Point at position 'pos' to the GenBrush 'that'
// drawn with 'eye', 'hand' and 'tool' in layer 'layer'
// 'pos' must be a vector of 2 or more dimensions
// Return the GBObjPod
#if BUILDMODE != 0
static inline
#endif
GBObjPod* _GBAddPoint(GenBrush* const that, VecFloat* const pos,
    GBEye* const eye, GBHand* const hand, GBTool* const tool,
    GBInk* const ink, GBLayer* const layer);

// Add a GBObjPod for the Shapoid 'shap' to the GenBrush 'that'
// drawn with 'eye', 'hand' and 'tool' in layer 'layer'
// 'shap' 's dimension must be 2 or more
// Return the GBObjPod
#if BUILDMODE != 0
static inline
#endif
GBObjPod* _GBAddShapoid(GenBrush* const that, Shapoid* const shap,
    GBEye* const eye, GBHand* const hand, GBTool* const tool,
    GBInk* const ink, GBLayer* const layer);

// Add a GBObjPod for the SCurve 'curve' to the GenBrush 'that'
// drawn with 'eye', 'hand' and 'tool' in layer 'layer'
// 'curve' 's dimension must be 2 or more
// Return the GBObjPod
#if BUILDMODE != 0
static inline
#endif
GBObjPod* _GBAddSCurve(GenBrush* const that, SCurve* const curve,
    GBEye* const eye, GBHand* const hand, GBTool* const tool,
    GBInk* const ink, GBLayer* const layer);

// Remove from the list of pods of the GenBrush 'that' those who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBRemovePod(that, elemA, NULL, NULL, NULL, NULL, NULL) removes all
// the pods related to the object 'elemA'
// GBRemovePod(that, elemA, NULL, handA, NULL, NULL, NULL) removes
// all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it removes all the pods
void _GBRemovePod(GenBrush* const that, const void* const obj,
    const GBEye* const eye, const GBHand* const hand,
    const GBTool* const tool, const GBInk* const ink,
    const GBLayer* const layer);
// TODO: the filtering arguments should be in a struct

// Set the eye to 'toEye' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodEye(that, toEye, elemA, NULL, NULL, NULL, NULL)
// affects all the pods related to the object 'elemA'
// GBSetPodEye(that, toEye, elemA, NULL, handA, NULL, NULL)
// affects all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toEye' is null, do nothing
void _GBSetPodEye(GenBrush* const that, GBEye* const toEye,

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    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer);
// TODO: the filtering arguments should be in a struct

// Set the hand to 'toHand' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodEye(that, toHand, elemA, NULL, NULL, NULL, NULL, NULL)
// affects all the pods related to the object 'elemA'
// GBSetPodEye(that, toHand, elemA, NULL, handA, NULL, NULL, NULL)
// affects all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toHand' is null, do nothing
void _GBSetPodHand(GenBrush* const that, GBHand* const toHand,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer);
// TODO: the filtering arguments should be in a struct

// Set the tool to 'toTool' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodTool(that, toTool, elemA, NULL, NULL, NULL, NULL, NULL) affects
// all the pods related to the object 'elemA'
// GBSetPodTool(that, toTool, elemA, NULL, handA, NULL, NULL, NULL) affects
// all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toTool' is null, do nothing
void _GBSetPodTool(GenBrush* const that, GBTool* const toTool,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer);
// TODO: the filtering arguments should be in a struct

// Set the ink to 'toInk' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodTool(that, toTool, elemA, NULL, NULL, NULL, NULL, NULL) affects
// all the pods related to the object 'elemA'
// GBSetPodTool(that, toTool, elemA, NULL, handA, NULL, NULL, NULL) affects
// all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toInk' is null, do nothing
void _GBSetPodInk(GenBrush* const that, GBInk* const toInk,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer);
// TODO: the filtering arguments should be in a struct

// Set the layer to 'toLayer' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodLayer(that, toLayer, elemA, NULL, NULL, NULL, NULL, NULL)
// affects all the pods related to the object 'elemA'
// GBSetPodLayer(that, toLayer, elemA, NULL, handA, NULL, NULL, NULL)
// affects all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toLayer' is null, do nothing
void _GBSetPodLayer(GenBrush* const that, GBLayer* const toLayer,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,

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```

    const GBInk* const ink, const GBLayer* const layer);
// TODO: the filtering arguments should be in a struct

// Reset all the final pix of the surface of the GenBrush 'that' to its
// background color, and reset all the modified flag of layers to true
#if BUILDMODE != 0
static inline
#endif
void GBFlush(GenBrush* const that);

// Set to true the modified flag of the layers of pods attached to the
// object 'obj' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromObj(GenBrush* const that, const void* const obj);

// Set to true the modified flag of the layers of pods attached to the
// GBEye 'eye' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromEye(GenBrush* const that,
    const GBEye* const eye);

// Set to true the modified flag of the layers of pods attached to the
// GBInk 'ink' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromInk(GenBrush* const that,
    const GBInk* const ink);

// Set to true the modified flag of the layers of pods attached to the
// GBHand 'hand' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromHand(GenBrush* const that,
    const GBHand* const hand);

// Set to true the modified flag of the layers of pods attached to the
// GBTool 'tool' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromTool(GenBrush* const that,
    const GBTool* const tool);

// Return true if the surface of the GenBrush 'that' is same as the
// surface of the GenBrush 'gb'
// Else, return false
#if BUILDMODE != 0
static inline
#endif
bool GBIsSameAs(const GenBrush* const that, const GenBrush* const gb);

// Add a GBPostProcessing of type 'type' to the GenBrush 'that'
// Return the GBPostProcessing
#if BUILDMODE != 0
static inline
#endif
GBPostProcessing* GBAddPostProcess(GenBrush* const that,
    const GBPPType type);

// Remove the GBPostProcessing 'post' from the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
void GBRemovePostProcess(GenBrush* const that,
    const GBPostProcessing* const post);

// Remove all the GBPostProcessing from the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
void GBRemoveAllPostProcess(GenBrush* const that);

```



```

// Get the 'iPost'-th post process of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBPostProcessing* GBPostProcess(const GenBrush* const that,
    const int iPost);

// Get the GSet of GBPostProcessing of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBPostProcs(const GenBrush* const that);

// Get the number of GBPostProcessing of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
int GBGetNbPostProcs(const GenBrush* const that);

// Remove all the GBObjPods from the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
void GBRemoveAllPod(GenBrush* const that);

// Return a clone of the GenBrush 'that' with its final surface scaled
// to the dimensions 'dim' according to the scaling method 'scaleMethod'
GenBrush* GBScale(const GenBrush* const that,
    const VecShort2D* const dim, const GBScaleMethod scaleMethod);

// Return a clone of the GenBrush 'that' with its final surface flipped
// relatively to the 'iAxis'-th axis
GenBrush* GBFlip(const GenBrush* const that,
    const long dim);

// Return a clone of the GenBrush 'that' with its final surface cropped
// to the dimensions 'dim' from the lower right position 'posLR'
// If the cropping area is partially or totally outside of the
// original image, pixels outside of the image are filled with
// 'fillPix' or left to their default value (cf GBSurfaceCreate) if
// 'fillPix' is NULL
GenBrush* GBCrop(const GenBrush* const that,
    const VecShort2D* const posLR, const VecShort2D* const dim,
    const GBPixel* const fillPix);

// Duplicate the final pixels of the GenBrush 'src' to the
// GenBrush 'dest' for the area starting at 'posSrc' in 'src' and
// 'posDest' in 'dest' and having dimension 'dim'
// The fragment must be fully included in both 'src' and 'dest'
void GBCopyFragment(const GenBrush* const src, GenBrush* const dest,
    const VecShort2D* const posSrc, const VecShort2D* const posDest,
    const VecShort2D* const dim);

// Return a value between 0.0 and 1.0, such as 1.0 means 'gba' and 'gbB'
// are identical, 0.0 means they are completely different
// The value is calculated as the average of the difference between
// rgba of final pixels of 'gba' and final pixels of 'gbB'
// 'gba' and 'gbB' must be of same dimensions
float GBGetSimilarity(const GenBrush* const gba, GenBrush* const gbB);

#if BUILDWITHGRAPHICLIB == 1

```

```

#include "genbrush-GTK.h"
#endif

// ===== Polymorphism =====

#define GBPosIndex(Pos, Dim) \
    (VecGet(Dim, 0) * VecGet(Pos, 1) + VecGet(Pos, 0))

#define GBInkGetType(Ink) _Generic(Ink, \
    GBInk*: _GBInkGetType, \
    GBInkSolid*: _GBInkGetType, \
    const GBInk*: _GBInkGetType, \
    const GBInkSolid*: _GBInkGetType, \
    default: PBErrInvalidPolymorphism)((GBInk*)(Ink))

#define GBInkGet(Ink, Tool, Pod, PosInternal, PosExternal, PosLayer) \
    _GBInkGet((GBInk*)(Ink), (GBTool*)(Tool), Pod, \
    (VecFloat*)(PosInternal), (VecFloat*)(PosExternal), \
    (VecShort*)(PosLayer))

#define GBObjPodCreatePoint(Pos, Eye, Hand, Tool, Ink, Layer) \
    _Generic(Pos, \
    VecFloat*: _GBObjPodCreatePoint, \
    VecFloat2D*: _GBObjPodCreatePoint, \
    VecFloat3D*: _GBObjPodCreatePoint, \
    const VecFloat*: _GBObjPodCreatePoint, \
    const VecFloat2D*: _GBObjPodCreatePoint, \
    const VecFloat3D*: _GBObjPodCreatePoint, \
    default: PBErrInvalidPolymorphism)((VecFloat*)(Pos), \
    (GBEye*)(Eye), (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBObjPodCreateShapoid(Shap, Eye, Hand, Tool, Ink, Layer) \
    _Generic(Shap, \
    Shapoid*: _GBObjPodCreateShapoid, \
    Facoid*: _GBObjPodCreateShapoid, \
    Spheroid*: _GBObjPodCreateShapoid, \
    Pyramidoid*: _GBObjPodCreateShapoid, \
    const Shapoid*: _GBObjPodCreateShapoid, \
    const Facoid*: _GBObjPodCreateShapoid, \
    const Spheroid*: _GBObjPodCreateShapoid, \
    const Pyramidoid*: _GBObjPodCreateShapoid, \
    default: PBErrInvalidPolymorphism)((Shapoid*)(Shap), \
    (GBEye*)(Eye), (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBObjPodCreateSCurve(Curve, Eye, Hand, Tool, Ink, Layer) \
    _GBObjPodCreateSCurve(Curve, \
    (GBEye*)(Eye), (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBAddPoint(GB, Pos, Eye, Hand, Tool, Ink, Layer) \
    _Generic(Pos, \
    VecFloat*: _GBAddPoint, \
    VecFloat2D*: _GBAddPoint, \
    VecFloat3D*: _GBAddPoint, \
    const VecFloat*: _GBAddPoint, \
    const VecFloat2D*: _GBAddPoint, \
    const VecFloat3D*: _GBAddPoint, \
    default: PBErrInvalidPolymorphism)(GB, (VecFloat*)(Pos), \
    (GBEye*)(Eye), (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBAddShapoid(GB, Shap, Eye, Hand, Tool, Ink, Layer) \
    _Generic(Shap, \
    Shapoid*: _GBAddShapoid, \

```

```

    Facoid*: _GBAddShapoid, \
    Spheroid*: _GBAddShapoid, \
    Pyramidoid*: _GBAddShapoid, \
    const Shapoid*: _GBAddShapoid, \
    const Facoid*: _GBAddShapoid, \
    const Spheroid*: _GBAddShapoid, \
    const Pyramidoid*: _GBAddShapoid, \
    default: PBErrInvalidPolymorphism) (GB, (Shapoid*)(Shap), \
    (GBEye*)(Eye), (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBAddSCurve(GB, Curve, Eye, Hand, Tool, Ink, Layer) \
    _GBAddSCurve(GB, Curve, \
    (GBEye*)(Eye), (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBRemovePod(GB, Obj, Eye, Hand, Tool, Ink, Layer) \
    _GBRemovePod(GB, (void*)(Obj), (GBEye*)(Eye), (GBHand*)(Hand), \
    (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBObjPodGetObjAsPoint(Pod) (VecFloat*)GBObjPodObj(Pod)
#define GBObjPodGetObjAsShapoid(Pod) (Shapoid*)GBObjPodObj(Pod)
#define GBObjPodGetObjAsSCurve(Pod) (SCurve*)GBObjPodObj(Pod)

#define GBObjPodGetEyeObjAsPoint(Pod) (VecFloat*)GBObjPodEyeObj(Pod)
#define GBObjPodGetEyeObjAsShapoid(Pod) (Shapoid*)GBObjPodEyeObj(Pod)
#define GBObjPodGetEyeObjAsSCurve(Pod) (SCurve*)GBObjPodEyeObj(Pod)

#define GBObjPodSetEyePoint(Pod, Point) \
    _GBObjPodSetEyePoint(Pod, (VecFloat*)Point)
#define GBObjPodSetEyeShapoid(Pod, Shap) \
    _GBObjPodSetEyeShapoid(Pod, (Shapoid*)Shap)
#define GBObjPodSetEyeSCurve(Pod, Curve) \
    _GBObjPodSetEyeSCurve(Pod, (SCurve*)Curve)

#define GBSetPodEye(GB, ToEye, Obj, Eye, Hand, Tool, Ink, Layer) \
    _GBSetPodEye(GB, (GBEye*)(ToEye), (void*)(Obj), (GBEye*)(Eye), \
    (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBSetPodHand(GB, ToHand, Obj, Eye, Hand, Tool, Ink, Layer) \
    _GBSetPodHand(GB, (GBHand*)(ToHand), (void*)(Obj), (GBEye*)(Eye), \
    (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBSetPodTool(GB, ToTool, Obj, Eye, Hand, Tool, Ink, Layer) \
    _GBSetPodTool(GB, (GBTool*)(ToTool), (void*)(Obj), (GBEye*)(Eye), \
    (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBSetPodInk(GB, ToInk, Obj, Eye, Hand, Tool, Ink, Layer) \
    _GBSetPodInk(GB, (GBInk*)(ToInk), (void*)(Obj), (GBEye*)(Eye), \
    (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBSetPodLayer(GB, ToLayer, Obj, Eye, Hand, Tool, Ink, Layer) \
    _GBSetPodLayer(GB, ToLayer, (void*)(Obj), (GBEye*)(Eye), \
    (GBHand*)(Hand), (GBTool*)(Tool), (GBInk*)(Ink), Layer)

#define GBNotifyChangeFromObj(GB, Obj) \
    _GBNotifyChangeFromObj(GB, (void*)(Obj))

#define GBNotifyChangeFromEye(GB, Eye) \
    _GBNotifyChangeFromEye(GB, (GBEye*)(Eye))

#define GBNotifyChangeFromHand(GB, Hand) \
    _GBNotifyChangeFromHand(GB, (GBHand*)(Hand))

```

```

#define GBNotifyChangeFromTool(GB, Tool) \
    _GBNotifyChangeFromTool(GB, (GBTool*)(Tool))

#define GBNotifyChangeFromInk(GB, Ink) \
    _GBNotifyChangeFromInk(GB, (GBInk*)(Ink))

#define GBHandGetType(Hand) _Generic(Hand, \
    GBHand*: _GBHandGetType, \
    GBHandDefault*: _GBHandGetType, \
    const GBHand*: _GBHandGetType, \
    const GBHandDefault*: _GBHandGetType, \
    default: PBErrInvalidPolymorphism)((GBHand*)(Hand))

#define GBHandProcess(Hand, Pod) _Generic(Hand, \
    GBHand*: _GBHandProcess, \
    GBHandDefault*: GBHandDefaultProcess, \
    const GBHand*: _GBHandProcess, \
    const GBHandDefault*: GBHandDefaultProcess, \
    default: PBErrInvalidPolymorphism)(Hand, Pod)

#define GBObjPodSetHand(Pod, Hand) \
    _GBObjPodSetHand(Pod, (GBHand*)(Hand))

#define GBObjPodSetEye(Pod, Eye) \
    _GBObjPodSetEye(Pod, (GBEye*)(Eye))

#define GBObjPodSetTool(Pod, Tool) \
    _GBObjPodSetTool(Pod, (GBTool*)(Tool))

#define GBObjPodSetInk(Pod, Ink) \
    _GBObjPodSetInk(Pod, (GBInk*)(Ink))

#define GBEyeGetType(Eye) _Generic(Eye, \
    GBEye*: _GBEyeGetType, \
    GBEyeOrtho*: _GBEyeGetType, \
    GBEyeIsometric*: _GBEyeGetType, \
    const GBEye*: _GBEyeGetType, \
    const GBEyeOrtho*: _GBEyeGetType, \
    const GBEyeIsometric*: _GBEyeGetType, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye))

#define GBEyeScale(Eye) _Generic(Eye, \
    GBEye*: _GBEyeScale, \
    GBEyeOrtho*: _GBEyeScale, \
    GBEyeIsometric*: _GBEyeScale, \
    const GBEye*: _GBEyeScale, \
    const GBEyeOrtho*: _GBEyeScale, \
    const GBEyeIsometric*: _GBEyeScale, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye))

#define GBEyeGetScale(Eye) _Generic(Eye, \
    GBEye*: _GBEyeGetScale, \
    GBEyeOrtho*: _GBEyeGetScale, \
    GBEyeIsometric*: _GBEyeGetScale, \
    const GBEye*: _GBEyeGetScale, \
    const GBEyeOrtho*: _GBEyeGetScale, \
    const GBEyeIsometric*: _GBEyeGetScale, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye))

#define GBEyeSetScale(Eye, Scale) _Generic(Scale, \
    float: GBEyeSetScaleFloat, \
    VecFloat3D*: GBEyeSetScaleVec, \

```

```

const float: GBEyeSetScaleFloat, \
const VecFloat3D*: GBEyeSetScaleVec, \
default: PBErrInvalidPolymorphism)( \
    _Generic(Eye, \
        GBEye*: Eye, \
        GBEyeOrtho*: (GBEye*)Eye, \
        GBEyeIsometric*: (GBEye*)Eye, \
        const GBEye*: Eye, \
        const GBEyeOrtho*: (GBEye*)Eye, \
        const GBEyeIsometric*: (GBEye*)Eye, \
        default: Eye), \
    _Generic(Scale, \
        float: Scale, \
        VecFloat3D*: Scale, \
        const float: Scale, \
        const VecFloat3D*: Scale, \
        default: Scale))

#define GBEyeOrig(Eye) _Generic(Eye, \
    GBEye*: _GBEyeOrig, \
    GBEyeOrtho*: _GBEyeOrig, \
    GBEyeIsometric*: _GBEyeOrig, \
    const GBEye*: _GBEyeOrig, \
    const GBEyeOrtho*: _GBEyeOrig, \
    const GBEyeIsometric*: _GBEyeOrig, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye))

#define GBEyeGetOrig(Eye) _Generic(Eye, \
    GBEye*: _GBEyeGetOrig, \
    GBEyeOrtho*: _GBEyeGetOrig, \
    GBEyeIsometric*: _GBEyeGetOrig, \
    const GBEye*: _GBEyeGetOrig, \
    const GBEyeOrtho*: _GBEyeGetOrig, \
    const GBEyeIsometric*: _GBEyeGetOrig, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye))

#define GBEyeSetOrig(Eye, Orig) _Generic(Eye, \
    GBEye*: _GBEyeSetOrig, \
    GBEyeOrtho*: _GBEyeSetOrig, \
    GBEyeIsometric*: _GBEyeSetOrig, \
    const GBEye*: _GBEyeSetOrig, \
    const GBEyeOrtho*: _GBEyeSetOrig, \
    const GBEyeIsometric*: _GBEyeSetOrig, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye), Orig)

#define GBEyeGetRot(Eye) _Generic(Eye, \
    GBEye*: _GBEyeGetRot, \
    GBEyeOrtho*: _GBEyeGetRot, \
    GBEyeIsometric*: _GBEyeGetRot, \
    const GBEye*: _GBEyeGetRot, \
    const GBEyeOrtho*: _GBEyeGetRot, \
    const GBEyeIsometric*: _GBEyeGetRot, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye))

#define GBEyeSetRot(Eye, Theta) _Generic(Eye, \
    GBEye*: _GBEyeSetRot, \
    GBEyeOrtho*: _GBEyeSetRot, \
    GBEyeIsometric*: _GBEyeSetRot, \
    const GBEye*: _GBEyeSetRot, \
    const GBEyeOrtho*: _GBEyeSetRot, \
    const GBEyeIsometric*: _GBEyeSetRot, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye), Theta)

```

```

#define GBEyeProj(Eye) _Generic(Eye, \
    GBEye*: _GBEyeProj, \
    GBEyeOrtho*: _GBEyeProj, \
    GBEyeIsometric*: _GBEyeProj, \
    const GBEye*: _GBEyeProj, \
    const GBEyeOrtho*: _GBEyeProj, \
    const GBEyeIsometric*: _GBEyeProj, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye))

#define GBEyeProcess(Eye, Pod) _Generic(Eye, \
    GBEye*: _GBEyeProcess, \
    GBEyeOrtho*: _GBEyeProcess, \
    GBEyeIsometric*: _GBEyeProcess, \
    const GBEye*: _GBEyeProcess, \
    const GBEyeOrtho*: _GBEyeProcess, \
    const GBEyeIsometric*: _GBEyeProcess, \
    default: PBErrInvalidPolymorphism)((GBEye*)(Eye), Pod)

#define GBEyeFree(EyeRef) _Generic(EyeRef, \
    GBEyeOrtho*: GBEyeOrthoFree, \
    GBEyeIsometric*: GBEyeIsometricFree, \
    default: PBErrInvalidPolymorphism)(EyeRef)

#define GBToolDraw(Tool, Pod) _Generic(Tool, \
    GBTool*: _GBToolDraw, \
    GBToolPlotter*: GBToolPlotterDraw, \
    GBToolPen*: GBToolPenDraw, \
    const GBTool*: _GBToolDraw, \
    const GBToolPlotter*: GBToolPlotterDraw, \
    const GBToolPen*: GBToolPenDraw, \
    default: PBErrInvalidPolymorphism)(Tool, Pod)

#if BUILDWITHGRAPHICLIB == 0

#elif BUILDWITHGRAPHICLIB == 1

#define GBScreenshot(GB, FileName) _Generic(GB, \
    GenBrush*: _GBScreenshot, \
    const GenBrush*: _GBScreenshot, \
    GBSurfaceApp*: GBSurfaceAppScreenshot, \
    const GBSurfaceApp*: GBSurfaceAppScreenshot, \
    GBSurfaceWidget*: GBSurfaceWidgetScreenshot, \
    const GBSurfaceWidget*: GBSurfaceWidgetScreenshot, \
    default: PBErrInvalidPolymorphism)(GB, FileName)

#endif

// ===== static inliner =====

#if BUILDMODE != 0
#include "genbrush-inline.c"
#endif

#endif

```

## 2.2 genbrush-GTK.h

```
// ===== GENBRUSH-GTK.H =====

#include <gtk/gtk.h>
#include <cairo.h>

// ===== Define =====

// ===== Data structure =====

typedef struct GBSurfaceApp {
    GBSurface _surf;
    // Title of the window
    char* _title;
    // Application
    GtkApplication* _app;
    // Window
    GtkWidget* _window;
    // Widget
    GtkWidget* _drawingArea;
    // cairo surface
    cairo_surface_t* _cairoSurf;
    // Idle function
    gint (*_idleFun)(gpointer);
    // Idle function time out
    int _idleMs;
    // Returned status when the application is killed
    int _returnStatus;

    // cf GBSurfaceAppCallbackDraw
    // Flipped data
    unsigned char* _flippedData;
} GBSurfaceApp;

typedef struct GBSurfaceWidget {
    GBSurface _surf;
    // Widget
    GtkWidget* _drawingArea;
    // cairo surface
    cairo_surface_t* _cairoSurf;

    // cf GBSurfaceWidgetCallbackDraw
    // Flipped data
    unsigned char* _flippedData;
} GBSurfaceWidget;

// ===== Functions declaration =====

// Create a new GBSurfaceApp with title 'title' and
// dimensions 'dim'
GBSurfaceApp* GBSurfaceAppCreate(const VecShort2D* const dim,
    const char* const title);

// Free the GBSurfaceApp 'that'
void GBSurfaceAppFree(GBSurfaceApp** that);

// Render the GBSurfaceApp 'that'
// This function block the execution until the app is killed
```

```

// Return true if the status of the app when closed was 0, false else
bool GBSurfaceAppRender(GBSurfaceApp* const that);

// Close the GBSurfaceApp 'that'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceAppClose(const GBSurfaceApp* const that);

// Refresh the content of the GBSurfaceApp 'that'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceAppRefresh(const GBSurfaceApp* const that);

// Set the idle function of the GBSurfaceApp 'that' to 'idleFun'
// with a timeout of 'idleMs'
// The interface of the 'idleFun' is
// gint tick(gpointer data)
// the argument of 'idleFun' is a pointer to GBSurfaceApp
void GBSurfaceSetIdle(GBSurfaceApp* const that,
    gint (*idleFun)(gpointer), int idleMs);

// Create a new GBSurfaceWidget with dimensions 'dim'
GBSurfaceWidget* GBSurfaceWidgetCreate(const VecShort2D* const dim);

// Free the GBSurfaceWidget 'that'
void GBSurfaceWidgetFree(GBSurfaceWidget** that);

// Return the GtkWidget of the GBSurfaceWidget 'that'
#if BUILDMODE != 0
static inline
#endif
GtkWidget* GBSurfaceWidgetGtkWidget(const GBSurfaceWidget* const that);

// Return the GtkWidget of the GBSurfaceApp 'that'
#if BUILDMODE != 0
static inline
#endif
GtkWidget* GBSurfaceAppGtkWidget(const GBSurfaceApp* const that);

// Render the GBSurfaceWidget 'that'
void GBSurfaceWidgetRender(const GBSurfaceWidget* const that);

// Create a GenBrush with a blank GBSurfaceApp
GenBrush* GBCreateApp(const VecShort2D* const dim,
    const char* const title);

// Set the idle function of the GBSurfaceApp of the GenBrush 'that'
// to 'idleFun' with a timeout of 'idleMs'
// The interface of the 'idleFun' is
// gint tick(gpointer data)
// the argument of 'idleFun' is a pointer to GBSurfaceApp
// If the surface of the app is not a GBSurfaceTypeApp, do nothing
void GBSurfaceSetIdle(GenBrush* that, gint (*idleFun)(gpointer),
    const int idleMs);

// Create a GenBrush with a blank GBSurfaceWidget
GenBrush* GBCreateWidget(const VecShort2D* const dim);

// Return the GtkWidget of the GenBrush 'that', or NULL if the surface
// of the GenBrush is not a GBSurfaceWidget

```



```

#if BUILDMODE != 0
static inline
#endif
GtkWidget* GBGetGtkWidget(const GenBrush* const that);

// Take a snapshot of the GenBrush 'that' and save it to 'fileName'
// Return true if successful, false else
bool _GBScreenshot(
    const GenBrush* const that,
    const char* const fileName);

// Take a snapshot of the GBSurfaceApp 'that' and save it to 'filename'
// Return true if successful, false else
bool GBSurfaceAppScreenshot(
    const GBSurfaceApp* const that,
    const char* const filename);

// Take a snapshot of the GBSurfaceWidget 'that' and save it to 'filename'
// Return true if successful, false else
bool GBSurfaceWidgetScreenshot(
    const GBSurfaceWidget* const that,
    const char* const filename);

```

## 3 Code

### 3.1 genbrush.c

```

// ===== GENBRUSH.C =====

// ===== Include =====

#include "genbrush.h"
#if BUILDMODE == 0
#include "genbrush-inline.c"
#endif

// ===== Structure declaration =====

// Header of a TGA file
typedef struct GBTGAHeader {
    // Origin of the color map
    short int _colorMapOrigin;
    // Length of the color map
    short int _colorMapLength;
    // X coordinate of the origin
    short int _xOrigin;
    // Y coordinate of the origin
    short int _yOrigin;
    // Width of the TGA
    short _width;
    // Height of the TGA
    short _height;
    // Length of a string located after the header
    char _idLength;
    // Type of the color map
    char _colorMapType;
    // Type of the image
    char _dataTypeCode;
}

```

```

    // Depth of the color map
    char _colorMapDepth;
    // Number of bit per pixel
    char _bitsPerPixel;
    // Image descriptor
    char _imageDescriptor;
} GBTGAHeader;

// ===== Functions declaration =====

// Function to decode rgba values when loading a TGA file
// Do nothing if arguments are invalid
void GBTGAMergeBytes(GBPixel* pixel, unsigned char* p, int bytes);

// Convert the indice of the TGA file data to the indice in layer's
// pixel according to origin position
int GBConvertToIndexLayerForTGA(int n, GBTGAHeader* header);

// Read the header of a TGA file from the stream 'stream' and store
// it into 'header'
// Return true if it could read the header, else false
bool GBReadTGAHeader(FILE* stream, GBTGAHeader* header);

// Read the body of a TGA file from the stream 'stream' and store
// it into 'pix', given the header 'header' of the file and the
// blend mode 'blendMode'
// Return true if it could read the body, else false
bool GBReadTGAbody(FILE *stream, GSet* pix, GBTGAHeader* header,
    GBLayerBlendMode blendMode);

// Create a new GBLayer with dimensions and content given by the
// TGA image on disk at location 'fileName'
// Return NULL if we couldn't create the layer
GBLayer* GBLayerCreateFromFileTGA(const char* const fileName);

// Save the GBSurfaceImage 'that' as a TGA file
// Return false if the image couldn't be saved, true else
bool GBSurfaceImageSaveAsTGA(const GBSurfaceImage* const that);

// Create a new GBSurfaceImage with one layer containing the content
// of the TGA image located at 'fileName' and dimensions equal to the
// dimensions of the image
// If the image couldn't be loaded return NULL
GBSurfaceImage* GBSurfaceImageCreateFromTGA(const char* const fileName);

// Draw the Point 'point' in the GBObjPod 'pod' with the
// GBToolPlotter 'that'
void GBToolPlotterDrawPoint(const GBToolPlotter* const that,
    const VecFloat* const point, const GBObjPod* const pod);

// Draw the Shapoid 'shap' in the GBObjPod 'pod' with the
// GBToolPlotter 'that'
void GBToolPlotterDrawShapoid(const GBToolPlotter* const that,
    const Shapoid* const shap, const GBObjPod* const pod);

// Draw the SCurve 'curve' in the GBObjPod 'pod' with the
// GBToolPlotter 'that'
void GBToolPlotterDrawSCurve(const GBToolPlotter* const that,
    const SCurve* const curve, const GBObjPod* const pod);

// Draw the Point 'point' in the GBObjPod 'pod' with the
// GBToolPen 'that'

```

```

void GBToolPenDrawPoint(const GBToolPen* const that,
    const VecFloat* const point, const GBObjPod* const pod);

// Draw the Shapoid 'shap' in the GBObjPod 'pod' with the
// GBToolPen 'that'
void GBToolPenDrawShapoid(const GBToolPen* const that,
    const Shapoid* const shap, const GBObjPod* const pod);

// Draw the SCurve 'curve' in the GBObjPod 'pod' with the
// GBToolPen 'that'
void GBToolPenDrawSCurve(const GBToolPen* const that,
    const SCurve* const curve, const GBObjPod* const pod);

// Update the content of the layer 'layer' of the GenBrush 'that'
// Flush the content of the layer and redraw all the pod attached to it
void GBUpdateLayer(GenBrush* const that, GBLayer* const layer);

// Get the value for the projection matrix of a GBEyeOrtho
void GBEyeOrthoGetProjVal(const GBEyeOrtho* const that,
    float* const val);

// Get the value for the projection matrix of a GBEyeIsometric
void GBEyeIsometricGetProjVal(const GBEyeIsometric* const that,
    float* const val);

// Normalize in hue the final pixels of the GBSurface 'that'
void GBSurfaceNormalizeHue(GBSurface* const that);

// Apply ordered dithering to the final pixels of the GBSurface 'that'
void GBSurfaceOrderedDithering(GBSurface* const that);

// Apply Floyd-Steinberg dithering to the final pixels of the GBSurface 'that'
void GBSurfaceFloydSteinbergDithering(GBSurface* const that);

// Return a clone of the GenBrush 'that' with its final surface scaled
// to the dimensions 'dim' according to the scaling method AvgNeighbour
GenBrush* GBScaleAvgNeighbour(const GenBrush* const that,
    const VecShort2D* const dim);

// ===== Functions implementation =====

// Function to decode rgba values when loading a TGA file
// Do nothing if arguments are invalid
void GBTGAMergeBytes(GBPixel* pixel, unsigned char* p, int bytes) {
    // Check arguments
    if (pixel == NULL || p == NULL)
        return;
    // Merge bytes
    if (bytes == 4) {
        pixel->_rgba[GBPixelRed] = p[2];
        pixel->_rgba[GBPixelGreen] = p[1];
        pixel->_rgba[GBPixelBlue] = p[0];
        pixel->_rgba[GBPixelAlpha] = p[3];
    } else if (bytes == 3) {
        pixel->_rgba[GBPixelRed] = p[2];
        pixel->_rgba[GBPixelGreen] = p[1];
        pixel->_rgba[GBPixelBlue] = p[0];
        pixel->_rgba[GBPixelAlpha] = 255;
    } else if (bytes == 2) {
        pixel->_rgba[GBPixelRed] = (p[1] & 0x7c) << 1;
        pixel->_rgba[GBPixelGreen] =
            ((p[1] & 0x03) << 6) | ((p[0] & 0xe0) >> 2);
    }
}

```

```

        pixel->_rgba[GBPixelBlue] = (p[0] & 0x1f) << 3;
        pixel->_rgba[GBPixelAlpha] = (p[1] & 0x80);
    }
}

// Convert the indice of the TGA file data to the indice in layer's
// pixel according to origin position
int GBConvertToIndexLayerForTGA(int n, GBTGAHeader* header) {
    if ((header->_imageDescriptor & 32) == 0)
        // lower left hand corner
        return n;
    else
        // upper left hand corner
        return (header->_height - 1 -
            ((int)floor((float)n / (float)(header->_width)))) *
            header->_width + n % header->_width;
}

// Read the header of a TGA file from the stream 'stream' and store
// it into 'header'
// Return true if it could read the header, else false
bool GBReadTGAHeader(FILE* stream, GBTGAHeader* header) {
    // Declare a variable to memorize the return value of fread
    size_t ret = 0;
    // Read the header's values
    header->_idLength = fgetc(stream);
    header->_colorMapType = fgetc(stream);
    // If the color map type is not supported
    if (header->_colorMapType != 0 &&
        header->_colorMapType != 1) {
        // Stop here
        return false;
    }
    header->_dataTypeCode = fgetc(stream);
    // If the data type is not supported
    if (header->_dataTypeCode != 2 && header->_dataTypeCode != 10) {
        // Stop here
        return false;
    }
    ret = fread(&(header->_colorMapOrigin), 2, 1, stream);
    if (ret == 0) {
        // Stop here
        return false;
    }
    ret = fread(&(header->_colorMapLength), 2, 1, stream);
    if (ret == 0) {
        // Stop here
        return false;
    }
    header->_colorMapDepth = fgetc(stream);
    ret = fread(&(header->_xOrigin), 2, 1, stream);
    if (ret == 0) {
        // Stop here
        return false;
    }
    ret = fread(&(header->_yOrigin), 2, 1, stream);
    if (ret == 0) {
        // Stop here
        return false;
    }
    ret = fread(&(header->_width), 2, 1, stream);
    if (ret == 0 || header->_width <= 0) {

```

```

        // Stop here
        return false;
    }
    ret = fread(&(header->_height), 2, 1, stream);
    if (ret == 0 || header->_height <= 0) {
        // Stop here
        return false;
    }
    header->_bitsPerPixel = fgetc(stream);
    header->_imageDescriptor = fgetc(stream);
    // Origin of the screen
    // TODO0: Override the initial _yOrigin
    /*if ((header->_imageDescriptor & 32) == 0)
        // lower left hand corner
        header->_yOrigin = header->_height;
    else
        // upper left hand corner
        header->_yOrigin = 0;*/
    // Return the success code
    return true;
}

// Read the body of a TGA file from the stream 'stream' and store
// it into 'pix', given the header 'header' of the file and the
// blend mode 'blendMode'
// Return true if it could read the body, else false
bool GBReadTGABody(FILE *stream, GSet* pix, GBTGAHeader* header,
    GBLayerBlendMode blendMode) {
    // Declare variables used during decoding
    int i = 0, j = 0;
    unsigned int bytes2read = 0, skipover = 0;
    unsigned char p[5] = {0};
    // If the number of byte per pixel is not supported
    if (header->_bitsPerPixel != 16 &&
        header->_bitsPerPixel != 24 &&
        header->_bitsPerPixel != 32) {
        sprintf(GenBrushErr->_msg, "Invalid bitesPerPixel (%d)",
            header->_bitsPerPixel);
        return false;
    }
    // Skip the unused information
    skipover += header->_idLength;
    skipover += header->_colorMapType * header->_colorMapLength;
    fseek(stream, skipover, SEEK_CUR);
    // Calculate the number of byte per pixel
    bytes2read = header->_bitsPerPixel / 8;
    // Flag to manage premature end of file
    bool flagPrematureEnd = false;
    // For each pixel
    int n = 0;
    while (n < header->_height * header->_width && !flagPrematureEnd) {
        int nLayer = GBConvertToIndexLayerForTGA(n, header);
        // Read the pixel according to the data type, merge and
        // move to the next pixel
        if (header->_dataTypeCode == 2) {
            if (fread(p, 1, bytes2read, stream) != bytes2read) {
                flagPrematureEnd = true;
            } else {
                GBPixel mergedPix;
                GBTGAMergeBytes(&mergedPix, p, bytes2read);
                // Create a stacked pixel
                GBStackedPixel* stacked = PBErrMalloc(GenBrushErr,

```

```

        sizeof(GBStackedPixel));
memcpy(&(stacked->_val), &mergedPix, sizeof(GBPixel));
stacked->_depth = 0.0;
stacked->_blendMode = blendMode;
// Add the stacked pixel to the stack
GSetAddSort(pix + nLayer, stacked, stacked->_depth);
// Increment the index
++n;
nLayer = GBConvertToIndexLayerForTGA(n, header);
}
} else if (header->_dataTypeCode == 10) {
if (fread(p, 1, bytes2read + 1, stream) != bytes2read + 1) {
flagPrematureEnd = true;
} else {
j = p[0] & 0x7f;
GBPixel mergedPix;
GBTGAMergeBytes(&mergedPix, &(p[1]), bytes2read);
// Create a stacked pixel
GBStackedPixel* stacked = PBErrMalloc(GenBrushErr,
sizeof(GBStackedPixel));
memcpy(&(stacked->_val), &mergedPix, sizeof(GBPixel));
stacked->_depth = 0.0;
stacked->_blendMode = blendMode;
// Add the stacked pixel to the stack
GSetAddSort(pix + nLayer, stacked, stacked->_depth);
// Increment the index
++n;
nLayer = GBConvertToIndexLayerForTGA(n, header);
if (p[0] & 0x80) {
for (i = 0; i < j; ++i) {
GBPixel mergedPix;
GBTGAMergeBytes(&mergedPix, &(p[1]), bytes2read);
// Create a stacked pixel
GBStackedPixel* stacked = PBErrMalloc(GenBrushErr,
sizeof(GBStackedPixel));
memcpy(&(stacked->_val), &mergedPix, sizeof(GBPixel));
stacked->_depth = 0.0;
stacked->_blendMode = blendMode;
// Add the stacked pixel to the stack
GSetAddSort(pix + nLayer, stacked, stacked->_depth);
// Increment the index
++n;
nLayer = GBConvertToIndexLayerForTGA(n, header);
}
} else {
for (i = 0; i < j; ++i) {
if (fread(p, 1, bytes2read, stream) != bytes2read) {
sprintf(GenBrushErr->_msg, "fread failed (%s)",
strerror(errno));
return false;
}
GBPixel mergedPix;
GBTGAMergeBytes(&mergedPix, p, bytes2read);
// Create a stacked pixel
GBStackedPixel* stacked = PBErrMalloc(GenBrushErr,
sizeof(GBStackedPixel));
memcpy(&(stacked->_val), &mergedPix, sizeof(GBPixel));
stacked->_depth = 0.0;
stacked->_blendMode = blendMode;
// Add the stacked pixel to the stack
GSetAddSort(pix + nLayer, stacked, stacked->_depth);
// Increment the index
}
}
}
}

```

```

        ++n;
        nLayer = GBConvertToIndexLayerForTGA(n, header);
    }
}
}
}
// Return the success code
return true;
}

// ----- GbPixel -----

// Blend the pixel 'pix' into the pixel 'that'
// BlendNormal mixes colors according to their relative alpha value
void GbPixelBlendNormal(GbPixel* const that, const GbPixel* const pix) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pix == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pix' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Declare a variable for computation
    float u = 0.5;
    for (int iRgb = 4; iRgb--;)
        // Add 0.5 to the conversion to float ot avoid numeric instability
        that->_rgba[iRgb] = (unsigned char)floor(
            (1.0 - u) * (float)(that->_rgba[iRgb]) +
            u * (float)(pix->_rgba[iRgb]) + 0.5);
}

// Blend the pixel 'pix' into the pixel 'that'
// BlendOver mixes colors according to the alpha value of 'pix'
// and add the alpha values
void GbPixelBlendOver(GbPixel* const that, const GbPixel* const pix) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pix == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pix' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Declare a variable for computation
    float u = (float)(pix->_rgba[GbPixelAlpha]) / 255.0;
    for (int iRgb = 4; iRgb--;)
        // Add 0.5 to the conversion to float ot avoid numeric instability
        if (iRgb == GbPixelAlpha)
            that->_rgba[iRgb] = (unsigned char)floor(
                MIN(255.0, (float)(that->_rgba[iRgb]) +
                (float)(pix->_rgba[iRgb])) + 0.5);
        else

```

```

        that->_rgba[iRgb] = (unsigned char)floor(
            (1.0 - u) * (float)(that->_rgba[iRgb]) +
            u * (float)(pix->_rgba[iRgb]) + 0.5);
    }

    // Return the blend result of the stack of Pixel 'stack'
    // If there is transparency down to the bottom of the stack, use the
    // background color 'bgColor'
    // If the stack is empty, return a transparent pixel
    GBPixel GBPixelStackBlend(const GSet* const stack,
        const GBPixel* const bgColor) {
    #if BUILDMODE == 0
        if (stack == NULL) {
            GenBrushErr->_type = PErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'stack' is null");
            PErrCatch(GenBrushErr);
        }
        if (bgColor == NULL) {
            GenBrushErr->_type = PErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'bgColor' is null");
            PErrCatch(GenBrushErr);
        }
    #endif
        // Declare the result pixel
        GBPixel res = GBColorTransparent;
        // Declare a variable to memorize the blend mode
        GBLayerBlendMode blendMode = GBLayerBlendModeNormal;
        // If the stack is not empty
        if (GSetNbElem(stack) > 0) {
            // Initialise the result pixel with the last pixel
            GSetIterBackward iter = GSetIterBackwardCreateStatic(stack);
            GBStackedPixel* pix = GSetIterGet(&iter);
            res = pix->_val;
            blendMode = pix->_blendMode;
            // For each following pixel until we reach the bottom of the stack
            // or the opacity reaches 255
            while (res._rgba[GBPixelAlpha] < 255 && GSetIterStep(&iter)) {
                pix = GSetIterGet(&iter);
                // Blend according to the blending mode of the previous pixel
                switch (blendMode) {
                    case GBLayerBlendModeDefault:
                        blendMode = pix->_blendMode;
                        break;
                    case GBLayerBlendModeNormal:
                        GBPixelBlendNormal(&res, &(pix->_val));
                        blendMode = pix->_blendMode;
                        break;
                    case GBLayerBlendModeOver:
                        GBPixelBlendOver(&res, &(pix->_val));
                        blendMode = pix->_blendMode;
                        break;
                    default:
                        blendMode = pix->_blendMode;
                        break;
                }
            }
        }
        // If we've reached the bottom of the stack and there is still
        // transparency
        if (res._rgba[GBPixelAlpha] < 255) {
            if (blendMode != GBLayerBlendModeDefault) {
                // Add the background color
                GBPixel tmp = *bgColor;

```



```

        GbPixelBlendOver(&tmp, &res);
        res = tmp;
    }
}
// Else, the stack is empty
} else {
    // Simply copy the background pixel;
    res = *bgColor;
}
// Return the result pixel
return res;
}

// Convert the GbPixel 'that' from RGB to HSV. Alpha channel is unchanged
GbPixel GbPixelRGB2HSV(const GbPixel* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the result pixel
    GbPixel res = *that;
    // Calculate the hsv values
    float rgb[3] = {0.0, 0.0, 0.0};
    rgb[GbPixelRed] = (float)(that->_rgba[GbPixelRed]) / 255.0;
    rgb[GbPixelGreen] = (float)(that->_rgba[GbPixelGreen]) / 255.0;
    rgb[GbPixelBlue] = (float)(that->_rgba[GbPixelBlue]) / 255.0;
    float max = MAX(rgb[0], MAX(rgb[1], rgb[2]));
    float min = MIN(rgb[0], MIN(rgb[1], rgb[2]));
    float delta = max - min;
    float hsv[3] = {0.0, 0.0, 0.0};
    if (ISEQUALF(delta, 0.0))
        hsv[GbPixelHue] = 0.0;
    else if (ISEQUALF(max, rgb[GbPixelRed]))
        hsv[GbPixelHue] = 60.0 * (float)((int)round(
            (rgb[GbPixelGreen] - rgb[GbPixelBlue]) / delta)) % 6;
    else if (ISEQUALF(max, rgb[GbPixelGreen]))
        hsv[GbPixelHue] =
            60.0 * ((rgb[GbPixelBlue] - rgb[GbPixelRed]) / delta + 2.0);
    else if (ISEQUALF(max, rgb[GbPixelBlue]))
        hsv[GbPixelHue] =
            60.0 * ((rgb[GbPixelRed] - rgb[GbPixelGreen]) / delta + 4.0);
    res._hsva[GbPixelHue] =
        (unsigned char)round(hsv[GbPixelHue] / 360.0 * 255.0);
    if (ISEQUALF(max, 0.0))
        hsv[GbPixelSaturation] = 0.0;
    else
        hsv[GbPixelSaturation] = delta / max;
    res._hsva[GbPixelSaturation] =
        (unsigned char)round(hsv[GbPixelSaturation] * 255.0);
    hsv[GbPixelValue] = max;
    res._hsva[GbPixelValue] =
        (unsigned char)round(hsv[GbPixelValue] * 255.0);
    // Return the result
    return res;
}

// Convert the GbPixel 'that' from HSV to RGB. Alpha channel is unchanged
GbPixel GbPixelHSV2RGB(const GbPixel* const that) {
#ifdef BUILDMODE == 0

```

```

    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the result pixel
    GBPixel res = *that;
    // Calculate the rgb values
    float hsv[3] = {0.0, 0.0, 0.0};
    hsv[GBPixelHue] = (float)(that->_hsva[GBPixelHue]) / 255.0 * 360.0;
    hsv[GBPixelSaturation] =
        (float)(that->_hsva[GBPixelSaturation]) / 255.0;
    hsv[GBPixelValue] = (float)(that->_hsva[GBPixelValue]) / 255.0;
    float c = hsv[GBPixelValue] * hsv[GBPixelSaturation];
    float x = c * (1.0 - fabs((int)round(hsv[GBPixelHue] / 60.0) % 2 - 1));
    float m = hsv[GBPixelValue] - c;
    float rgb[3] = {0.0, 0.0, 0.0};
    if (hsv[GBPixelHue] < 60.0) {
        rgb[GBPixelRed] = c;
        rgb[GBPixelGreen] = x;
        rgb[GBPixelBlue] = 0.0;
    } else if (hsv[GBPixelHue] < 120.0) {
        rgb[GBPixelRed] = x;
        rgb[GBPixelGreen] = c;
        rgb[GBPixelBlue] = 0.0;
    } else if (hsv[GBPixelHue] < 180.0) {
        rgb[GBPixelRed] = 0.0;
        rgb[GBPixelGreen] = c;
        rgb[GBPixelBlue] = x;
    } else if (hsv[GBPixelHue] < 240.0) {
        rgb[GBPixelRed] = 0.0;
        rgb[GBPixelGreen] = x;
        rgb[GBPixelBlue] = c;
    } else if (hsv[GBPixelHue] < 300.0) {
        rgb[GBPixelRed] = x;
        rgb[GBPixelGreen] = 0.0;
        rgb[GBPixelBlue] = c;
    } else {
        rgb[GBPixelRed] = c;
        rgb[GBPixelGreen] = 0.0;
        rgb[GBPixelBlue] = x;
    }
    res._rgba[GBPixelRed] =
        (unsigned char)round(255.0 * (rgb[GBPixelRed] + m));
    res._rgba[GBPixelGreen] =
        (unsigned char)round(255.0 * (rgb[GBPixelGreen] + m));
    res._rgba[GBPixelBlue] =
        (unsigned char)round(255.0 * (rgb[GBPixelBlue] + m));
    // Return the result
    return res;
}

// ----- GBLayer -----

// Create a new GBLayer with dimensions 'dim'
// The layer is initialized with empty stacks of pixel
// _pos = (0,0)
// blendMode = GBLayerBlendModeDefault
// stackPos = GBLayerStackPosBg
GBLayer* GBLayerCreate(const VecShort2D* const dim) {
#if BUILDMODE == 0

```

```

    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare a variable to memorize the new layer
    GBLayer* that = PBErrMalloc(GenBrushErr, sizeof(GBLayer));
    // Set properties
    that->_dim = *dim;
    that->_pos = VecShortCreateStatic2D();
    that->_prevPos = VecShortCreateStatic2D();
    that->_scale = VecFloatCreateStatic2D();
    that->_prevScale = VecFloatCreateStatic2D();
    VecSet(&(that->_scale), 0, 1.0);
    VecSet(&(that->_scale), 1, 1.0);
    that->_prevScale = that->_scale;
    that->_pix = PBErrMalloc(GenBrushErr,
        sizeof(GSet) * GBLayerArea(that));
    for (int iPix = GBLayerArea(that); iPix--;)
        that->_pix[iPix] = GSetCreateStatic();
    that->_blendMode = GBLayerBlendModeDefault;
    that->_modified = true;
    that->_stackPos = GBLayerStackPosBg;
    that->_isFlushed = true;
    // Return the new layer
    return that;
}

// Free the GBLayer 'that'
void GBLayerFree(GBLayer** that) {
    if (that == NULL || *that == NULL) {
        return;
    }
    // Free the memory
    if ((*that)->_pix != NULL) {
        GBLayerFlush(*that);
        free((*that)->_pix);
    }
    free(*that);
    *that = NULL;
}

// Create a new GBLayer with dimensions and content given by the
// image on disk at location 'fileName'
// By default layers created from images are not flushed
// Return NULL if we couldn't create the layer
GBLayer* GBLayerCreateFromFile(const char* const fileName) {
    // If the fileName is NULL
    if (fileName == NULL)
        // Nothing to do
        return NULL;
    // Declare the result layer
    GBLayer* layer = NULL;
    // Call the appropriate function depending on file extension
    if (strcmp(fileName + strlen(fileName) - 4, ".tga") == 0 ||

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        strcmp(fileName + strlen(fileName) - 4, ".TGA") == 0)
        layer = GBLayerCreateFromFileTGA(fileName);
// Set the flag isFlushed to false to avoid stacked pixels
// to be flushed away between rendering
GBLayerSetFlushed(layer, false);
// Return the result layer
return layer;
}

// Create a new GBLayer with dimensions and content given by the
// TGA image on disk at location 'fileName'
// Return NULL if we couldn't create the layer
GBLayer* GBLayerCreateFromFileTGA(const char* const fileName) {
    // Open the file
    FILE* fptr = fopen(fileName, "r");
    // If we couldn't open the file
    if (fptr == NULL)
        // Stop here
        return NULL;
    // Declare a variable to memorize the header
    GBTGAHeader h;
    // Read the header
    if (GBReadTGAHeader(fptr, &h) == false) {
        // Stop here
        fclose(fptr);
        return NULL;
    }
    // Create the layer
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, h._width);
    VecSet(&dim, 1, h._height);
    GBLayer* layer = GBLayerCreate(&dim);
    // Set a pointer to the pixels of the new layer
    GSet* pix = GBLayerPixels(layer);
    // Read the body of the TGA file
    if (GBReadTGABody(fptr, pix, &h, layer->_blendMode) == false) {
        // Stop here
        GBLayerFree(&layer);
        fclose(fptr);
        return NULL;
    }
    // Close the file
    fclose(fptr);
    // Return the new layer
    return layer;
}

// Get the boundary of the GBLayer 'that' inside the GBSurface 'surf'
// The boundaries are given as a Facoid
// If the flag 'prevStatus' is true, gives the boundary at the previous
// position
// Return NULL if the layer is completely out of the surface
Facoid* GBLayerGetBoundaryInSurface(const GBLayer* const that,
    const GBSurface* const surf, const bool prevStatus) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (surf == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;

```

```

        sprintf(GenBrushErr->_msg, "'surf' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare a pointer toward the relevant position according to
    // 'prevPos'
    VecShort2D* pos =
        (prevStatus == false ? GBLayerPos(that) : GBLayerPrevPos(that));
    VecFloat2D* scale =
        (prevStatus == false ? GBLayerScale(that) : GBLayerPrevScale(that));
    // Get the values of the clip area made by the intersection of the
    // layer and the surface
    VecFloat2D min = VecFloatCreateStatic2D();
    VecFloat2D max = VecFloatCreateStatic2D();
    for (int i = 2; i--;) {
        VecSet(&min, i, MAX(0, floor(((float)VecGet(pos, i)) * VecGet(scale, i))));
        VecSet(&max, i, MIN(VecGet(GBSurfaceDim(surf), i),
            floor((float)(VecGet(GBLayerDim(that), i) + VecGet(pos, i)) * VecGet(scale, i)) + 1.0));
    }
    // Declare a Facoid to memorize the result
    Facoid* bound = NULL;
    // If the layer is in intersection with the surface
    VecOp(&max, 1, &min, -1);
    if (VecGet(&max, 0) > 0.0 &&
        VecGet(&max, 1) > 0.0) {
        // Set the values of the Facoid
        bound = FacoidCreate(2);
        ShapoidSetPos(bound, (VecFloat*)&min);
        ShapoidScale(bound, (VecFloat*)&max);
    }
    // Return the result
    return bound;
}

// ----- GBPostProcessing -----

// Create a static GBPostProcessing with type 'type'
GBPostProcessing* GBPostProcessingCreate(const GBPPType type) {
    // Declare the new GBPostProcessing
    GBPostProcessing* ret = PBErrMalloc(GenBrushErr,
        sizeof(GBPostProcessing));
    // Set the properties
    ret->_type = type;
    // Return the new post processing
    return ret;
}

// Create a new static GBPostProcessing with type 'type'
GBPostProcessing GBPostProcessingCreateStatic(const GBPPType type) {
    // Declare the new GBPostProcessing
    GBPostProcessing ret;
    // Set the properties
    ret._type = type;
    // Return the new post processing
    return ret;
}

// Free the memory used by the GBPostProcessing 'that'
void GBPostProcessingFree(GBPostProcessing** that) {
    // Check argument
    if (that == NULL || *that == NULL)
        // Nothing to do

```

```

    return;
    // Free memory
    free(*that);
    *that = NULL;
}

// ----- GBSurface -----

// Create a new static GBSurface with dimension 'dim' and type 'type'
// _finalPix is set to 0
// _bgColor is set to white
GBSurface GBSurfaceCreateStatic(const GBSurfaceType type,
    const VecShort2D* const dim) {
    #if BUILDMODE == 0
        if (dim == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'dim' is null");
            PBErrCatch(GenBrushErr);
        }
        if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
                VecGet(dim, 0), VecGet(dim, 1));
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Declare the new GBSurface
    GBSurface ret;
    // Set properties
    ret._type = type;
    ret._dim = *dim;
    ret._bgColor = GBColorWhite;
    ret._layers = GSetCreateStatic();
    // Allocate memory for the final pixels
    ret._finalPix = PBErrMalloc(GenBrushErr,
        sizeof(GBPixel) * VecGet(dim, 0) * VecGet(dim, 1));
    memset(ret._finalPix, 0,
        sizeof(GBPixel) * VecGet(dim, 0) * VecGet(dim, 1));
    // Flush the surface to initialize the _finalPix with the _bgColor
    GBSurfaceFlush(&ret);
    // Return the new GBSurface
    return ret;
}

// Create a new GBSurface with dimension 'dim' and type 'type'
// _finalPix is set to 0
// _bgColor is set to white
GBSurface* GBSurfaceCreate(const GBSurfaceType type,
    const VecShort2D* const dim) {
    #if BUILDMODE == 0
        if (dim == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'dim' is null");
            PBErrCatch(GenBrushErr);
        }
        if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
                VecGet(dim, 0), VecGet(dim, 1));
            PBErrCatch(GenBrushErr);
        }
    #endif
}

```

```

    // Declare the new GBSurface
    GBSurface *ret = PBErrMalloc(GenBrushErr, sizeof(GBSurface));
    // Set properties
    *ret = GBSurfaceCreateStatic(type, dim);
    // Return the new surface
    return ret;
}

// Free the memory used by the properties of the GBSurface 'that'
void GBSurfaceFreeStatic(GBSurface* const that) {
    // If the pointer is null
    if (that == NULL)
        // Nothing to do
        return;
    // Free the memory
    while (GSetNbElem(&(that->_layers)) > 0) {
        GBLayer* layer = (GBLayer*)GSetPop(&(that->_layers));
        GBLayerFree(&layer);
    }
    free(that->_finalPix);
    that->_finalPix = NULL;
}

// Free the memory used by the GBSurface 'that'
void GBSurfaceFree(GBSurface** that) {
    // If the pointer is null
    if (that == NULL || *that == NULL)
        // Nothing to do
        return;
    // Free the memory
    GBSurfaceFreeStatic(*that);
    free(*that);
    *that = NULL;
}

// Clone the GBSurface 'that'
GBSurface GBSurfaceClone(const GBSurface* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the clone
    GBSurface clone = *that;
    // Clone properties
    clone._finalPix = PBErrMalloc(GenBrushErr,
        sizeof(GBPixel) * GBSurfaceArea(that));
    memcpy(clone._finalPix, GBSurfaceFinalPixels(that),
        sizeof(GBPixel) * GBSurfaceArea(that));
    // Return the clone
    return clone;
}

// Get a GSet of Facoid representing the sub areas of the GBSurface
// 'that' affected by layers with _modified flag equal to true
// If there is no modified sub area return an empty GSet
GSetShapoid* GBSurfaceGetModifiedArea(const GBSurface* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;

```

```

        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the GSet to memorize the areas
    GSetShapoid* areas = GSetShapoidCreate();
    // If the surface has layers
    if (GBSurfaceNbLayer(that) > 0) {
        // For each layer of the surface
        GSetIterForward iter =
            GSetIterForwardCreateStatic(GBSurfaceLayers(that));
        do {
            // Get the current layer
            GBLayer* layer = GSetIterGet(&iter);
            // If the layer is modified
            if (GBLayerIsModified(layer)) {
                // Get the boundary in surface of this layer
                Facoid* bound =
                    GBLayerGetBoundaryInSurface(layer, that, false);
                // If the boundary is not empty
                if (bound != NULL) {
                    // Add the boundary to the areas taking care there is no
                    // overlapping areas
                    FacoidAlignedAddClippedToSet(bound, areas);
                    // Free memory used by the boundary
                    ShapoidFree(&bound);
                }
                // If the layer has been moved or scaled we also need to
                // repaint the area at its previous position/scale
                if (!VecIsEqual(GBLayerPos(layer), GBLayerPrevPos(layer)) ||
                    !VecIsEqual(GBLayerScale(layer), GBLayerPrevScale(layer))) {
                    // Get the boundary in surface of this layer at previous
                    // position
                    bound = GBLayerGetBoundaryInSurface(layer, that, true);
                    // If the boundary is not empty
                    if (bound != NULL) {
                        // Add the boundary to the areas taking care there is no
                        // overlapping areas
                        FacoidAlignedAddClippedToSet(bound, areas);
                        // Free memory used by the boundary
                        ShapoidFree(&bound);
                    }
                    // Immediately update the previous scale to avoid it
                    // to be applied to next prevPos
                    if (!VecIsEqual(GBLayerScale(layer),
                        GBLayerPrevScale(layer))) {
                        layer->_prevScale = layer->_scale;
                    }
                }
            }
        } while (GSetIterStep(&iter));
    }
    // Return the areas
    return areas;
}

// Update the final pixels according to layers of the GBSurface 'that'
// Update only pixels affected by layers with the _modified flag
// equals to true
void GBSurfaceUpdate(GBSurface* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {

```



```

    GenBrushErr->_type = PBErrTypeNullPointer;
    sprintf(GenBrushErr->_msg, "'that' is null");
    PBErrCatch(GenBrushErr);
}
#endif
// If the surface has layers
if (GBSurfaceNbLayer(that) > 0) {
    // Get the areas needing to be updated
    GSetShapoid* areas = GBSurfaceGetModifiedArea(that);
    // Declare some vectors to memorize pixel coordinates
    VecShort2D from = VecShortCreateStatic2D();
    VecShort2D to = VecShortCreateStatic2D();
    VecShort2D pCoord = VecShortCreateStatic2D();
    VecShort2D pLayer = VecShortCreateStatic2D();
    // Declare 3 sets for the blending of pixels
    GSet setBg = GSetCreateStatic();
    GSet setIn = GSetCreateStatic();
    GSet setFg = GSetCreateStatic();
    // For each area
    while (GSetNbElem(areas) > 0) {
        // Get the current area
        Facoid* area = (Facoid*)GSetPop(areas);
        // Facoid values are float, we need to convert to short for
        // pixel coordinates
        for (int i = 2; i--;) {
            VecSet(&from, i, (short)round(ShapoidPosGet(area, i)));
            VecSet(&to, i, (short)round(ShapoidPosGet(area, i) +
                ShapoidAxisGet(area, i, i)));
        }
        // For each pixel in the current area
        VecCopy(&pCoord, &from);
        do {
            // For each layer
            GSetIterForward iter =
                GSetIterForwardCreateStatic(GBSurfaceLayers(that));
            do {
                // Get the current layer
                GBLayer* layer = GSetIterGet(&iter);
                // Get the position of the current pixel in layer coordinates
                VecCopy(&pLayer, &pCoord);
                VecSet(&pLayer, 0, (int)floor(
                    ((float)VecGet(&pLayer, 0)) /
                    VecGet(GBLayerScale(layer), 0)));
                VecSet(&pLayer, 1, (int)floor(
                    ((float)VecGet(&pLayer, 1)) /
                    VecGet(GBLayerScale(layer), 1)));
                VecOp(&pLayer, 1.0, GBLayerPos(layer), -1.0);
                // If the current pixel is inside the layer
                if (GBLayerIsPosInside(layer, &pLayer)) {
                    // Add the stacked pixels of the layer to the appropriate
                    // set
                    switch (GBLayerGetStackPos(layer)) {
                        case GBLayerStackPosBg:
                            GSetAppendSet(&setBg, GBLayerPixel(layer, &pLayer));
                            break;
                        case GBLayerStackPosInside:
                            GSetAppendSortedSet(&setIn,
                                GBLayerPixel(layer, &pLayer));
                            break;
                        case GBLayerStackPosFg:
                            GSetAppendSet(&setFg, GBLayerPixel(layer, &pLayer));
                            break;
                    }
                }
            } while (GSetIterForwardNext(&iter));
        } while (GSetIterForwardNext(&iter));
    }
}

```

```

        default:
            break;
    }
}
} while (GSetIterStep(&iter));
// Merge the 3 stacks
GSetAppendSet(&setBg, &setIn);
GSetAppendSet(&setBg, &setFg);
// Update the final pixel with the blend of the stack
GBPixel* finalPix = GBSurfaceFinalPixel(that, &pCoord);
*finalPix = GBPixelStackBlend(&setBg, GBSurfaceBgColor(that));
// Empty the sets of stacked pixels
GSetFlush(&setBg);
GSetFlush(&setIn);
GSetFlush(&setFg);
} while (VecShiftStep(&pCoord, &from, &to));
// Free the memory used by the area
ShapoidFree(&area);
}
// Free memory
GSetFree(&areas);
// Reset the modified flag of layers
GBSurfaceSetLayersModified(that, false);
}
}

// Reset all the final pix of the GBSurface 'that' to its
// background color, and reset all the modified flag of layers to true
void GBSurfaceFlush(GBSurface* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Set all the pixel to the background color
    for (int iPix = GBSurfaceArea(that); iPix--;)
        memcpy(that->_finalPix + iPix, &(that->_bgColor), sizeof(GBPixel));
    // Reset the modified flag of layers
    GBSurfaceSetLayersModified(that, true);
}

// Apply the post processing 'post' to the final pixels in the
// GBSurface 'that'
void GBSurfacePostProcess(GBSurface* const that,
    const GBPostProcessing* const post) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (post == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'post' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Call the appropriate post processing
    switch(GBPostProcessingGetType(post)) {
        case GBPPTypNormalizeHue:

```

```

        GBSurfaceNormalizeHue(that);
        break;
    case GBPPTypedOrderedDithering:
        GBSurfaceOrderedDithering(that);
        break;
    case GBPPTypedFloydSteinbergDithering:
        GBSurfaceFloydSteinbergDithering(that);
        break;
    default:
        return;
}
}

// Normalize in hue the final pixels of the GBSurface 'that'
void GBSurfaceNormalizeHue(GBSurface* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare a variable to memorize the maximum possible intensity
    float maxIntensity = 255.0;
    // Declare two variables to memorize the minimum and maximum hue
    // intensity
    float min = maxIntensity;
    float max = 0.0;
    // Search the minimum and maximum intensity
    VecShort2D p = VecShortCreateStatic2D();
    do {
        GBPixel* pix = GBSurfaceFinalPixel(that, &p);
        float intensity = (float)MAX(pix->_rgba[GBPixelRed],
            MAX(pix->_rgba[GBPixelGreen], pix->_rgba[GBPixelBlue]));
        if (intensity > max)
            max = intensity;
        intensity = (float)MIN(pix->_rgba[GBPixelRed],
            MIN(pix->_rgba[GBPixelGreen], pix->_rgba[GBPixelBlue]));
        if (intensity < min)
            min = intensity;
    } while (VecStep(&p, GBSurfaceDim(that)));
    // If the image is not already normalized and is normalizable
    if (!ISEQUALF(min, max) && (min >= 1.0 || max <= maxIntensity)) {
        // Declare a variable for optimization
        float c = maxIntensity / (max - min);
        // Normalize each final pixel color
        VecSetNull(&p);
        do {
            GBPixel* pix = GBSurfaceFinalPixel(that, &p);
            float intensity = ((float)(pix->_rgba[GBPixelRed]) - min) * c;
            pix->_rgba[GBPixelRed] =
                (unsigned char)round(MIN(255.0, MAX(0.0, intensity)));
            intensity = ((float)(pix->_rgba[GBPixelGreen]) - min) * c;
            pix->_rgba[GBPixelGreen] =
                (unsigned char)round(MIN(255.0, MAX(0.0, intensity)));
            intensity = ((float)(pix->_rgba[GBPixelBlue]) - min) * c;
            pix->_rgba[GBPixelBlue] =
                (unsigned char)round(MIN(255.0, MAX(0.0, intensity)));
        } while (VecStep(&p, GBSurfaceDim(that)));
    }
}
}

```

```

// Apply ordered dithering to the final pixels of the GBSurface 'that'
void GBSurfaceOrderedDithering(GBSurface* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Declare the filter matrix
    unsigned char filter[2][2] = {{64, 128}, {192, 0}};
    // Loop on the final pixels of the surface
    VecShort2D p = VecShortCreateStatic2D();
    do {
        // Get the pixel
        GBPixel* pix = GBSurfaceFinalPixel(that, &p);
        // Apply the filter to each channel of the pixel
        for (int iRgb = 4; iRgb--;) {
            if (pix->_rgba[iRgb] > filter[VecGet(&p, 1) % 2][VecGet(&p, 0) % 2]) {
                pix->_rgba[iRgb] = 255;
            } else {
                pix->_rgba[iRgb] = 0;
            }
        }
    } while (VecStep(&p, GBSurfaceDim(that)));
}

// Apply Floyd-Steinberg dithering to the final pixels of the GBSurface 'that'
void GBSurfaceFloydSteinbergDithering(GBSurface* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Declare the error propagation matrix
    float* error = PBErrMalloc(GenBrushErr,
        GBSurfaceArea(that) * 4L * sizeof(float));
    for (long i = GBSurfaceArea(that) * 4; i--;) {
        error[i] = 0.0;
    }
    // Loop on the final pixels of the surface
    VecShort2D p = VecShortCreateStatic2D();
    do {
        // Get the pixel
        GBPixel* pix = GBSurfaceFinalPixel(that, &p);
        // Get the index of the current pixel
        long ip = GBPosIndex(&p, GBSurfaceDim(that)) * 4;
        // For each channel of the pixel
        for (int iRgb = 4; iRgb--;) {
            // Get the corrected value of the pixel for this channel
            float corrVal = (float)(pix->_rgba[iRgb]) - error[ip + iRgb];
            // Get the new value of the pixel for this channel
            unsigned char newVal = 0;
            if (corrVal > 127) {
                newVal = 255;
            }
            // Get the error on this pixel
            float err = ((float)newVal - (float)(pix->_rgba[iRgb])) / 16.0;
            // Propagate error to neighbours
            VecShort2D q = p;

```

```

    VecSet(&q, 1, VecGet(&p, 1) + 1);
    if (GBSurfaceIsPosInside(that, &q)) {
        long iq = GBPosIndex(&q, GBSurfaceDim(that)) * 4 + iRgb;
        error[iq] += err * 7.0;
    }
    VecSet(&q, 0, VecGet(&q, 0) + 1);
    if (GBSurfaceIsPosInside(that, &q)) {
        long iq = GBPosIndex(&q, GBSurfaceDim(that)) * 4 + iRgb;
        error[iq] += err * 1.0;
    }
    VecSet(&q, 1, VecGet(&q, 1) - 1);
    if (GBSurfaceIsPosInside(that, &q)) {
        long iq = GBPosIndex(&q, GBSurfaceDim(that)) * 4 + iRgb;
        error[iq] += err * 5.0;
    }
    VecSet(&q, 1, VecGet(&q, 1) - 1);
    if (GBSurfaceIsPosInside(that, &q)) {
        long iq = GBPosIndex(&q, GBSurfaceDim(that)) * 4 + iRgb;
        error[iq] += err * 3.0;
    }
    // Update the value of the pixel for this channel
    pix->rgba[iRgb] = newVal;
}
} while (VecStep(&p, GBSurfaceDim(that)));
// Free memory
free(error);
}

// ----- GBSurfaceImage -----

// Create a new GBSurfaceImage with dimension 'dim'
GBSurfaceImage* GBSurfaceImageCreate(const VecShort2D* const dim) {
#ifdef BUILDMODE == 0
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
}
#endif
// Declare the new GBSurfaceImage
GBSurfaceImage* ret = PBErrMalloc(GenBrushErr,
    sizeof(GBSurfaceImage));
// Set properties
ret->_surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, dim);
ret->_fileName = NULL;
// Return the new surface
return ret;
}

// Free the memory used by the GBSurfaceImage 'that'
void GBSurfaceImageFree(GBSurfaceImage** that) {
    // If the pointer is null
    if (that == NULL || *that == NULL)
        // Nothing to do
        return;
    // Free the memory

```

```

GBSurfaceFreeStatic((GBSurface*)(*that));
if ((*that)->_fileName != NULL) {
    free((*that)->_fileName);
    (*that)->_fileName = NULL;
}
free(*that);
*that = NULL;
}

// Clone the GBSurfaceImage 'that'
GBSurfaceImage* GBSurfaceImageClone(const GBSurfaceImage* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the clone
    GBSurfaceImage* clone =
        GBSurfaceImageCreate(GBSurfaceDim((GBSurface*)that));
    // Declare a variable to memorize the newly allocated stack of pixels
    GBPixel* nFinal = clone->_surf._finalPix;
    // Clone properties
    memcpy(clone, that, sizeof(GBSurface));
    clone->_surf._finalPix = nFinal;
    memcpy(clone->_surf._finalPix,
        GBSurfaceFinalPixels((GBSurface*)that),
        sizeof(GBPixel) * GBSurfaceArea((GBSurface*)that));
    clone->_fileName = NULL;
    GBSurfaceImageSetFileName(clone, GBSurfaceImageFileName(that));
    // Return the clone
    return clone;
}

// Save a GBSurfaceImage 'that'
// If the filename is not set do nothing and return false
// Return true if it could save the surface, false else
// For any other format than tga the surface is first saved in a temporary
// file /tmp/genbrush.tga and then converted using the 'convert' command
bool GBSurfaceImageSave(const GBSurfaceImage* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (that->_fileName == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that->_fileName' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If the file name is null, do nothing
    if (that->_fileName == NULL)
        return false;
    // Call the appropriate function depending on file extension
    if (strcmp(that->_fileName + strlen(that->_fileName) - 4,
        ".tga") == 0 ||
        strcmp(that->_fileName + strlen(that->_fileName) - 4,
        ".TGA") == 0)
        return GBSurfaceImageSaveAsTGA(that);

```

```

else {
    // Dirty trick to be able to export in any format until proper
    // implementation is added
    char cmd[1000];
    char* origPath = strdup(that->_fileName);
    sprintf(
        that->_fileName,
        "/tmp/genbrush.tga");
    if (GBSurfaceImageSaveAsTGA(that) == false)
        return false;
    sprintf(
        cmd,
        "convert %s %s",
        that->_fileName,
        origPath);
    int retcmd = system(cmd);
    sprintf(
        cmd,
        "rm %s",
        that->_fileName);
    sprintf(
        that->_fileName,
        "%s",
        origPath);
    free(origPath);
    if (retcmd != 0)
        return false;
    retcmd = system(cmd);
    if (retcmd != 0)
        return false;
    return true;
}
return false;
}

// Save the GBSurfaceImage 'that' as a TGA file
// Return false if the image couldn't be saved, true else
bool GBSurfaceImageSaveAsTGA(const GBSurfaceImage* const that) {
    int ret;
    // Open the file
    FILE* fptr = fopen(that->_fileName, "w");
    // If we couldn't open the file
    if (fptr == NULL)
        // Stop here
        return false;
    // Declare a header
    GBTGAHeader h;
    // Create the header
    h._idLength = 0;
    h._colorMapType = 0;
    h._dataTypeCode = 2;
    h._colorMapOrigin = 0;
    h._colorMapLength = 0;
    h._colorMapDepth = 0;
    h._width = VecGet(GBSurfaceDim((GBSurface*)that), 0);
    h._height = VecGet(GBSurfaceDim((GBSurface*)that), 1);
    h._xOrigin = 0;
    h._yOrigin = 0;
    h._bitsPerPixel = 32;
    h._imageDescriptor = 0;

    // Write the header

```

```

ret = putc(h._idLength, fptr);
if (ret == EOF) {
    fclose(fptr);
    return false;
}
ret = putc(h._colorMapType, fptr);
if (ret == EOF) {
    fclose(fptr);
    return false;
}
ret = putc(h._dataTypeCode, fptr);
if (ret == EOF) {
    fclose(fptr);
    return false;
}
ret = fwrite(&(h._colorMapOrigin), 2, 1, fptr);
if (ret == 0) {
    fclose(fptr);
    return false;
}
ret = fwrite(&(h._colorMapLength), 2, 1, fptr);
if (ret == 0) {
    fclose(fptr);
    return false;
}
ret = putc(h._colorMapDepth, fptr);
if (ret == EOF) {
    fclose(fptr);
    return false;
}
ret = fwrite(&(h._xOrigin), 2, 1, fptr);
if (ret == 0) {
    fclose(fptr);
    return false;
}
ret = fwrite(&(h._yOrigin), 2, 1, fptr);
if (ret == 0) {
    fclose(fptr);
    return false;
}
ret = fwrite(&(h._width), 2, 1, fptr);
if (ret == 0) {
    fclose(fptr);
    return false;
}
ret = fwrite(&(h._height), 2, 1, fptr);
if (ret == 0) {
    fclose(fptr);
    return false;
}
ret = putc(h._bitsPerPixel, fptr);
if (ret == EOF) {
    fclose(fptr);
    return false;
}
ret = putc(h._imageDescriptor, fptr);
if (ret == EOF) {
    fclose(fptr);
    return false;
}
}
// Declare a variable to memorize the final layer's pixel
GBPixel* pix = GBSurfaceFinalPixels((GBSurface*)that);

```



```

// For each pixel
for (int y = 0; y < h._height; ++y) {
    for (int x = 0; x < h._width; ++x) {
        // Get the index of the pixel
        int i = y * h._width + x;
        // Write the pixel values
        ret = putc(pix[i]._rgba[GBPixelBlue], fptr);
        if (ret == EOF) {
            fclose(fptr);
            return false;
        }
        ret = putc(pix[i]._rgba[GBPixelGreen], fptr);
        if (ret == EOF) {
            fclose(fptr);
            return false;
        }
        ret = putc(pix[i]._rgba[GBPixelRed], fptr);
        if (ret == EOF) {
            fclose(fptr);
            return false;
        }
        ret = putc(pix[i]._rgba[GBPixelAlpha], fptr);
        if (ret == EOF) {
            fclose(fptr);
            return false;
        }
    }
}
// Close the file
fclose(fptr);
// Return the success code
return true;
}

// Create a new GBSurfaceImage with one layer containing the content
// of the image located at 'fileName' and dimensions equal to the
// dimensions of the image
// If the image couldn't be loaded return NULL
GBSurfaceImage* GBSurfaceImageCreateFromFile(
    const char* const fileName) {
    #if BUILDMODE == 0
        if (fileName == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'fileName' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // If the file name is null, return NULL
    if (fileName == NULL)
        return NULL;
    // Call the appropriate function depending on file extension
    if (strcmp(fileName + strlen(fileName) - 4, ".tga") == 0 ||
        strcmp(fileName + strlen(fileName) - 4, ".TGA") == 0)
        return GBSurfaceImageCreateFromTGA(fileName);
    return NULL;
}

// Create a new GBSurfaceImage with one layer containing the content
// of the TGA image located at 'fileName' and dimensions equal to the
// dimensions of the image
// If the image couldn't be loaded return NULL
GBSurfaceImage* GBSurfaceImageCreateFromTGA(const char* const fileName) {

```

```

#if BUILDMODE == 0
    if (fileName == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'fileName' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
// Load the image into a GBLayer
GBLayer* layer = GBLayerCreateFromFileTGA(fileName);
// If we couldn't load the image
if (layer == NULL)
    // Return null
    return NULL;
// Create a new GBSurfaceImage with same dimension as the layer
GBSurfaceImage* surf = GBSurfaceImageCreate(GBLayerDim(layer));
// Set the background color to transparent
GBPixel transparent = GBColorTransparent;
GBSurfaceSetBgColor((GBSurface*)surf, &transparent);
// Add the layer to the surf
GSetAppend(GBSurfaceLayers((GBSurface*)surf), layer);
// Update the surface
GBSurfaceUpdate((GBSurface*)surf);
// Return the new surface
return surf;
}

// ----- GBEye -----

// Return a new GBEye with type 'type'
// scale is initialized to (1,1), trans to (0,0) and rot to 0
GBEye GBEyeCreateStatic(const GBEyeType type) {
    // Declare a GBEye
    GBEye that;
    // Set properties
    that._type = type;
    that._scale = VecFloatCreateStatic3D();
    VecSet(&(that._scale), 0, 1.0); VecSet(&(that._scale), 1, 1.0);
    VecSet(&(that._scale), 2, 1.0);
    that._orig = VecFloatCreateStatic2D();
    VecSet(&(that._orig), 0, 0.0); VecSet(&(that._orig), 1, 0.0);
    that._theta = 0.0;
    // Allocate memory for the projection matrix
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 3); VecSet(&dim, 1, 3);
    that._proj = MatFloatCreate(&dim);
    // Return the new GBEye
    return that;
}

// Free the memory used by the GBEye
void GBEyeFreeStatic(GBEye* const that) {
    if (that == NULL)
        return;
    // Free memory
    MatFree(&(that->_proj));
}

// Update the projection matrix of the GBEye according to scale, rot
// and origin
void GBEyeUpdateProj(GBEye* const that) {
#if BUILDMODE == 0
    if (that == NULL) {

```

```

        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare a variable to memorize the values of the projection matrix
    // order is: (0,0),(0,1),(0,2),(1,0),...
    float val[12] = {0.0};
    // Set the values according to the eye type
    switch (that->_type) {
        case GBEyeTypeOrtho:
            GBEyeOrthoGetProjVal((GBEyeOrtho*)that, val);
            break;
        case GBEyeTypeIsometric:
            GBEyeIsometricGetProjVal((GBEyeIsometric*)that, val);
            break;
        default:
            break;
    }
    // Set the values to the matrix
    VecShort2D index = VecShortCreateStatic2D();
    VecShort2D dim = MatGetDim(that->_proj);
    int iVal = 0;
    do {
        MatSet(that->_proj, &index, val[iVal]);
        ++iVal;
    } while (VecStep(&index, &dim));
}

// Return the projection through the GBEye 'that' of the Point 'point'
VecFloat* GBEyeGetProjectedPoint(const GBEye* const that,
    const VecFloat* const point) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (point == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'point' is null");
            PBErrCatch(GenBrushErr);
        }
    }
#endif
    // Allocate memory for the output vector
    VecFloat* ret = VecClone(point);
    // Create a VecFloat3D to perform the product with the projection
    // matrix
    VecFloat3D v = VecFloatCreateStatic3D();
    for (long i = MIN(VecGetDim(point), 3); i--;)
        VecSet(&v, i, VecGet(point, i));
    // Perform the product
    VecFloat* w = MatGetProdVec(that->_proj, &v);
    // Translate to origin
    for (int i = 2; i--;)
        VecSet(w, i, VecGet(w, i) + VecGet(&(that->_orig), i));
    // Copy the values into the result
    for (long i = MIN(VecGetDim(point), 3); i--;)
        VecSet(ret, i, VecGet(w, i));
    // Free the memory used for the product
    VecFree(&w);
    // Return the result

```

```

    return ret;
}

// Return the projection through the GBEye 'that' of the SCurve 'curve'
SCurve* GBEyeGetProjectedCurve(const GBEye* const that,
    const SCurve* const curve) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (curve == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'curve' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Get a copy of the curve
    SCurve* ret = SCurveClone(curve);
    // Replace each curve's control point by its projection
    GSetIterForward iter =
        GSetIterForwardCreateStatic(SCurveCtrls(ret));
    do {
        VecFloat* ctrl = (VecFloat*)GSetIterGet(&iter);
        VecFloat* v = GBEyeGetProjectedPoint(that, ctrl);
        VecCopy(ctrl, v);
        VecFree(&v);
    } while (GSetIterStep(&iter));
    // Return the projected curve
    return ret;
}

// Return the projection through the GBEye 'that' of the Shapoid 'shap'
Shapoid* GBEyeGetProjectedShapoid(const GBEye* const that,
    const Shapoid* const shap) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (shap == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'shap' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Clone the shapoid
    Shapoid* ret = ShapoidClone(shap);
    // Project the origin of the shapoid
    VecFloat* proj = GBEyeGetProjectedPoint(that, ShapoidPos(ret));
    ShapoidSetPos(ret, proj);
    VecFree(&proj);
    // Project each axis
    GSetVecFloat* set = GSetVecFloatCreate();
    for (int iAxis = ShapoidGetDim(ret); iAxis--;) {
        proj = GBEyeGetProjectedPoint(that, ShapoidAxis(ret, iAxis));
        GSetPush(set, proj);
    }
    ShapoidSetAllAxis(ret, set);
    while (GSetNbElem(set) > 0) {

```

```

    proj = GSetPop(set);
    VecFree(&proj);
}
GSetFree(&set);
// Return the new shapoid
return ret;
}

// ----- GBEyeOrtho -----

// Return a new GBEyeOrtho with orientation 'view'
// scale is initialized to (1,1), trans to (0,0) and rot to 0
GBEyeOrtho* GBEyeOrthoCreate(const GBEyeOrthoView view) {
    // Allocate memory
    GBEyeOrtho* that = PBErrMalloc(GenBrushErr, sizeof(GBEyeOrtho));
    // Set properties
    that->_view = view;
    that->_eye = GBEyeCreateStatic(GBEyeTypeOrtho);
    GBEyeUpdateProj((GBEye*)that);
    // Return the new GBEyeOrtho
    return that;
}

// Free the memory used by the GBEyeOrtho
void GBEyeOrthoFree(GBEyeOrtho** that) {
    if (that == NULL || *that == NULL)
        return;
    // Free memory
    GBEyeFreeStatic((GBEye*)*that);
    free(*that);
    *that = NULL;
}

// Get the value for the projection matrix of a GBEyeOrtho
void GBEyeOrthoGetProjVal(const GBEyeOrtho* const that,
    float* const val) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (val == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'val' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Declare variable for optimization
    float cosTheta = cos(GBEyeGetRot(that));
    float sinTheta = sin(GBEyeGetRot(that));
    float scaleX = VecGet(GBEyeScale(that), 0);
    float scaleY = VecGet(GBEyeScale(that), 1);
    float scaleZ = VecGet(GBEyeScale(that), 2);
    // Set the values according to the orientation
    switch (that->_view) {
        case GBEyeOrthoViewFront:
            val[0] = scaleX * cosTheta;
            val[1] = scaleX * sinTheta;
            val[2] = 0.0;
            val[3] = scaleY * -sinTheta;
            val[4] = scaleY * cosTheta;

```

```

    val[5] = 0.0;
    val[6] = 0.0;
    val[7] = 0.0;
    val[8] = scaleZ;
    break;
case GBEyeOrthoViewRear:
    val[0] = scaleX * -cosTheta;
    val[1] = scaleX * -sinTheta;
    val[2] = 0.0;
    val[3] = scaleY * -sinTheta;
    val[4] = scaleY * cosTheta;
    val[5] = 0.0;
    val[6] = 0.0;
    val[7] = 0.0;
    val[8] = -scaleZ;
    break;
case GBEyeOrthoViewTop:
    val[0] = scaleX * cosTheta;
    val[1] = scaleX * sinTheta;
    val[2] = 0.0;
    val[3] = 0.0;
    val[4] = 0.0;
    val[5] = -scaleZ;
    val[6] = scaleY * -sinTheta;
    val[7] = scaleY * cosTheta;
    val[8] = 0.0;
    break;
case GBEyeOrthoViewBottom:
    val[0] = scaleX * cosTheta;
    val[1] = scaleX * sinTheta;
    val[2] = 0.0;
    val[3] = 0.0;
    val[4] = 0.0;
    val[5] = scaleZ;
    val[6] = scaleY * sinTheta;
    val[7] = scaleY * -cosTheta;
    val[8] = 0.0;
    break;
case GBEyeOrthoViewLeft:
    val[0] = 0.0;
    val[1] = 0.0;
    val[2] = scaleZ;
    val[3] = scaleY * -sinTheta;
    val[4] = scaleY * cosTheta;
    val[5] = 0.0;
    val[6] = scaleX * -cosTheta;
    val[7] = scaleX * -sinTheta;
    val[8] = 0.0;
    break;
case GBEyeOrthoViewRight:
    val[0] = 0.0;
    val[1] = 0.0;
    val[2] = -scaleZ;
    val[3] = scaleY * -sinTheta;
    val[4] = scaleY * cosTheta;
    val[5] = 0.0;
    val[6] = scaleX * cosTheta;
    val[7] = scaleX * sinTheta;
    val[8] = 0.0;
    break;
default:
    break;

```

```

    }
}

// Process the object of the GBObjPod 'pod' to update the viewed object
// through the GBEyeOrtho 'that'
void GBEyeOrthoProcess(const GBEyeOrtho* const that,
    GBObjPod* const pod) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pod == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pod' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    VecFloat* point = NULL;
    SCurve* curve = NULL;
    Shapoid* shap = NULL;
    switch (GBObjPodGetType(pod)) {
        case GBObjTypePoint:
            point = GBEyeGetProjectedPoint((GBEye*)that,
                GBObjPodGetObjAsPoint(pod));
            GBObjPodSetEyePoint(pod, point);
            break;
        case GBObjTypeSCurve:
            curve = GBEyeGetProjectedCurve((GBEye*)that,
                GBObjPodGetObjAsSCurve(pod));
            GBObjPodSetEyeSCurve(pod, curve);
            break;
        case GBObjTypeShapoid:
            shap = GBEyeGetProjectedShapoid((GBEye*)that,
                GBObjPodGetObjAsShapoid(pod));
            GBObjPodSetEyeShapoid(pod, shap);
            break;
        default:
            break;
    }
}

// ----- GBEyeIsometric -----

// Return a new GBEyeIsometric with orientation 'view'
// scale is initialized to (1,1), trans to (0,0) and rot to 0
// thetaY is initialized to pi/4 and thetaRight to pi/4
GBEyeIsometric* GBEyeIsometricCreate() {
    // Allocate memory
    GBEyeIsometric* that = PBErrMalloc(GenBrushErr,
        sizeof(GBEyeIsometric));
    // Set properties
    that->_thetaY = PBMath_QUARTERPI;
    that->_thetaRight = PBMath_QUARTERPI;
    that->_eye = GBEyeCreateStatic(GBEyeTypeIsometric);
    GBEyeUpdateProj((GBEye*)that);
    // Return the new GBEyeIsometric
    return that;
}

// Free the memory used by the GBEyeIsometric 'that'

```

```

void GBEyeIsometricFree(GBEyeIsometric** that) {
    if (that == NULL || *that == NULL)
        return;
    // Free memory
    GBEyeFreeStatic((GBEye*)*that);
    free(*that);
    *that = NULL;
}

// Process the object of the GBObjPod 'pod' to update the viewed object
// through the GBEyeIsometric 'that'
void GBEyeIsometricProcess(const GBEyeIsometric* const that,
    GBObjPod* const pod) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pod == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pod' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    VecFloat* point = NULL;
    SCurve* curve = NULL;
    Shapoid* shap = NULL;
    switch (GBObjPodGetType(pod)) {
        case GBObjTypePoint:
            point = GBEyeGetProjectedPoint((GBEye*)that,
                GBObjPodGetObjAsPoint(pod));
            GBObjPodSetEyePoint(pod, point);
            break;
        case GBObjTypeSCurve:
            curve = GBEyeGetProjectedCurve((GBEye*)that,
                GBObjPodGetObjAsSCurve(pod));
            GBObjPodSetEyeSCurve(pod, curve);
            break;
        case GBObjTypeShapoid:
            shap = GBEyeGetProjectedShapoid((GBEye*)that,
                GBObjPodGetObjAsShapoid(pod));
            GBObjPodSetEyeShapoid(pod, shap);
            break;
        default:
            break;
    }
}

// Get the value for the projection matrix of a GBEyeIsometric
void GBEyeIsometricGetProjVal(const GBEyeIsometric* const that,
    float* val) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (val == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'val' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
}

```



```

    }
#endif
    // Declare variables for optimization
    float scaleX = VecGet(GBEyeScale(that), 0);
    float scaleY = VecGet(GBEyeScale(that), 1);
    float scaleZ = VecGet(GBEyeScale(that), 2);
    float cosTheta = cos(GBEyeGetRot(that));
    float sinTheta = sin(GBEyeGetRot(that));
    float cosThetaY = cos(GBEyeIsometricGetRotY(that));
    float sinThetaY = sin(GBEyeIsometricGetRotY(that));
    float cosThetaR = cos(GBEyeIsometricGetRotRight(that));
    float sinThetaR = sin(GBEyeIsometricGetRotRight(that));
    // Set the values
    val[0] = scaleX * cosTheta * cosThetaY -
        scaleY * sinTheta * sinThetaY * sinThetaR;
    val[1] = scaleX * sinTheta * cosThetaY +
        scaleY * cosTheta * sinThetaY * sinThetaR;
    val[2] = scaleZ * sinThetaY * cosThetaR;

    val[3] = -1.0 * scaleY * sinTheta * cosThetaR;
    val[4] = scaleY * cosTheta * cosThetaR;
    val[5] = -scaleZ * sinThetaR;

    val[6] = -1.0 * (scaleX * cosTheta * sinThetaY +
        scaleY * sinTheta * cosThetaY * sinThetaR);
    val[7] = -1.0 * scaleX * sinTheta * sinThetaY +
        scaleY * cosTheta * cosThetaY * sinThetaR;
    val[8] = scaleZ * cosThetaY * cosThetaR;
}

// ----- GBHand -----

// Create a new GBHand with type 'type'
GBHand GBHandCreateStatic(const GBHandType type) {
    // Declare the new hand
    GBHand hand;
    // Set properties
    hand._type = type;
    // Return the new hand
    return hand;
}

// Free the memory used by the GBHand 'that'
void GBHandFreeStatic(GBHand* const that) {
    // Nothing to do
    (void)that;
}

// ----- GBHandDefault -----

// Create a new GBHandDefault
GBHandDefault* GBHandDefaultCreate() {
    // Declare the new hand
    GBHandDefault* hand = PBErrMalloc(GenBrushErr, sizeof(GBHandDefault));
    // Set properties
    hand->_hand = GBHandCreateStatic(GBHandTypeDefault);
    // Return the new hand
    return hand;
}

// Free the memory used by the GBHandDefault 'that'
void GBHandDefaultFree(GBHandDefault** that) {

```

```

// Check argument
if (that == NULL || *that == NULL)
    return;
// Free memory
GBHandFreeStatic((GBHand*)(*that));
free(*that);
*that = NULL;
}

// Process the viewed projection of the object in GBObjPod 'pod' into
// its handed projection through the GBHandDefault 'that'
void GBHandDefaultProcess(const GBHandDefault* const that,
    GBObjPod* const pod) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pod == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pod' is null");
        PBErrCatch(GenBrushErr);
    }
    if (GBObjPodEyeObj(pod) == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "Viewed object of 'pod' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    (void)that;
    // Empty all the sets
    GSetVecFloat* setPoints = GBObjPodGetHandObjAsPoints(pod);
    while (GSetNbElem(setPoints) > 0) {
        VecFloat* point = GSetPop(setPoints);
        VecFree(&point);
    }
    GSetShapoid* setShapoids = GBObjPodGetHandObjAsShapoids(pod);
    while (GSetNbElem(setShapoids) > 0) {
        Shapoid* shap = GSetPop(setShapoids);
        ShapoidFree(&shap);
    }
    GSetSCurve* setSCurves = GBObjPodGetHandObjAsSCurves(pod);
    while (GSetNbElem(setSCurves) > 0) {
        SCurve* curve = GSetPop(setSCurves);
        SCurveFree(&curve);
    }
    // Simply copy the viewed object as it is according to its type
    switch (GBObjPodGetType(pod)) {
        case GBObjTypePoint:
            // Add a copy of the viewed point
            GSetAppend(setPoints, VecClone(GBObjPodGetEyeObjAsPoint(pod)));
            break;
        case GBObjTypeShapoid:
            // Add a copy of the viewed shapoid
            GSetAppend(setShapoids,
                ShapoidClone(GBObjPodGetEyeObjAsShapoid(pod)));
            break;
        case GBObjTypeSCurve:
            // Add a copy of the viewed scurve
            GSetAppend(setSCurves,
                SCurveClone(GBObjPodGetEyeObjAsSCurve(pod)));

```

```

        break;
    default:
        break;
    }
}

// ----- GBTool -----

// Create a static GBTool with GBToolType 'type'
GBTool GBToolCreateStatic(const GBToolType type) {
    // Declare the GBTool
    GBTool that;
    // Set properties
    that._type = type;
    // Return the tool
    return that;
}

// Free the memory used by the GBTool 'that'
void GBToolFreeStatic(GBTool* const that) {
    // Nothing to do
    (void)that;
}

// ----- GBToolPlotter -----

// Create a new GBToolPlotter
GBToolPlotter* GBToolPlotterCreate() {
    // Declare the new GBToolPlotter
    GBToolPlotter* that = PBErrMalloc(GenBrushErr, sizeof(GBToolPlotter));
    // Set properties
    that->_tool = GBToolCreateStatic(GBToolTypePlotter);
    // Return the new tool
    return that;
}

// Free the memory used by the GBToolPlotter 'that'
void GBToolPlotterFree(GBToolPlotter** that) {
    // Check argument
    if (that == NULL || *that == NULL)
        // Nothing to do
        return;
    // Free memory
    GBToolFreeStatic(&((*that)->_tool));
    free(*that);
    *that = NULL;
}

// Draw the object in the GBObjPod 'pod' with the GBToolPlotter 'that'
void GBToolPlotterDraw(const GBToolPlotter* const that,
    const GBObjPod* const pod) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pod == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pod' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
}

```

```

#endif
// Loop on the Points drawn by hand
if (GSetNbElem(&(pod->_handPoints)) > 0) {
    GSetIterForward iter =
        GSetIterForwardCreateStatic(&(pod->_handPoints));
    do {
        // Get the point
        VecFloat* point = GSetIterGet(&iter);
        // Draw the point
        GBToolPlotterDrawPoint(that, point, pod);
    } while (GSetIterStep(&iter));
}
// Loop on the Shapoids drawn by hand
if (GSetNbElem(&(pod->_handShapoids)) > 0) {
    GSetIterForward iter =
        GSetIterForwardCreateStatic(&(pod->_handShapoids));
    do {
        // Get the shapoid
        Shapoid* shap = GSetIterGet(&iter);
        // Draw the shapoid
        GBToolPlotterDrawShapoid(that, shap, pod);
    } while (GSetIterStep(&iter));
}
// Loop on the SCurves drawn by hand
if (GSetNbElem(&(pod->_handSCurves)) > 0) {
    GSetIterForward iter =
        GSetIterForwardCreateStatic(&(pod->_handSCurves));
    do {
        // Get the curve
        SCurve* curve = GSetIterGet(&iter);
        // Draw the curve
        GBToolPlotterDrawSCurve(that, curve, pod);
    } while (GSetIterStep(&iter));
}
}

// Draw the Point 'point' in the GBObjPod 'pod' with the
// GBToolPlotter 'that'
void GBToolPlotterDrawPoint(const GBToolPlotter* const that,
    const VecFloat* const point, const GBObjPod* const pod) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pod == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pod' is null");
            PBErrCatch(GenBrushErr);
        }
        if (point == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'point' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Get the position in layer
    VecShort2D posLayer = VecShortCreateStatic2D();
    for (int i = 2; i--;)
        VecSet(&posLayer, i, (short)round(VecGet(point, i)));
    // Get the color from the ink

```

```

// As the point as no internal parameters create a null 3d vector
// instead
VecFloat3D null = VecFloatCreateStatic3D();
GBPixel pixColor = GBInkGet(GBObjPodInk(pod), that, pod, &null,
    point, &posLayer);
// Get the depth
float depth = 0.0;
if (VecGetDim(point) > 2)
    depth = VecGet(point, 2);
// Add the pixel at the point position in the layer
GBLayerAddPixelSafe(GBObjPodLayer(pod), &posLayer,
    &pixColor, depth);
}

// Draw the Shapoid 'shap' in the GBObjPod 'pod' with the
// GBToolPlotter 'that'
void GBToolPlotterDrawShapoid(const GBToolPlotter* const that,
    const Shapoid* const shap, const GBObjPod* const pod) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pod == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pod' is null");
        PBErrCatch(GenBrushErr);
    }
    if (shap == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'shap' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Get the bounding box of the shapoid in layer
    Facoid* bound = ShapoidGetBoundingBox(shap);
    // Declare two vectors for the VecShiftStep
    VecShort* from = VecShortCreate(ShapoidGetDim(bound));
    VecShort* to = VecShortCreate(ShapoidGetDim(bound));
    // Initialise the values of the vectors for the VecShiftStep
    for (int iAxis = ShapoidGetDim(bound); iAxis--;) {
        if (iAxis < 2) {
            VecSet(from, iAxis,
                (short)round(MAX(ShapoidPosGet(bound, iAxis), 0.0)));
            short v = (short)round(ShapoidPosGet(bound, iAxis) +
                ShapoidAxisGet(bound, iAxis, iAxis)) + 1;
            VecSet(to, iAxis,
                MIN(v, VecGet(GBLayerDim(GBObjPodLayer(pod)), iAxis)));
        } else {
            VecSet(from, iAxis,
                (short)round(ShapoidPosGet(bound, iAxis)));
            short v = (short)round(ShapoidPosGet(bound, iAxis) +
                ShapoidAxisGet(bound, iAxis, iAxis)) + 1;
            VecSet(to, iAxis, v);
        }
    }
    // Loop on pixels in layers inside the bounding box
    VecShort* posLayer = VecClone(from);
    VecFloat* posLayerFloat = VecFloatCreate(VecGetDim(posLayer));
    do {
        for (long iAxis = VecGetDim(posLayer); iAxis--;) {

```

```

        VecSet(posLayerFloat, iAxis,
            (float)VecGet(posLayer, iAxis) + 0.5);
    }
    // If this pixel is inside the Shapoid
    if (ShapoidIsPosInside(shap, posLayerFloat)) {
        // Get the current internal coordinates
        VecFloat* posIn = ShapoidImportCoord(shap, posLayerFloat);
        // Get the current external coordinates
        VecFloat* posExt =
            ShapoidExportCoord(shap, posIn);
        // Get the ink at this position
        GBPixel pixColor = GBInkGet(GBObjPodInk(pod), that, pod,
            posIn, posExt, posLayer);
        // Get the depth
        float depth = 0.0;
        if (VecGetDim(posLayerFloat) > 2)
            depth = VecGet(posLayerFloat, 2);
        // Add the pixel to the layer
        GBLayerAddPixelSafe(GBObjPodLayer(pod), (VecShort2D*)posLayer,
            &pixColor, depth);
        // Free memory
        VecFree(&posIn);
        VecFree(&posExt);
    }
} while (VecShiftStep(posLayer, from, to));
// Free memory
VecFree(&from);
VecFree(&to);
VecFree(&posLayer);
VecFree(&posLayerFloat);
ShapoidFree(&bound);
}

// Draw the SCurve 'curve' in the GBObjPod 'pod' with the
// GBToolPlotter 'that'
void GBToolPlotterDrawSCurve(const GBToolPlotter* const that,
    const SCurve* const curve, const GBObjPod* const pod) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pod == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pod' is null");
        PBErrCatch(GenBrushErr);
    }
    if (curve == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'curve' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Get the approximate length of the curve
    float length = SCurveGetApproxLen(curve);
    // Calculate the delta step based on the approximate length
    float delta = 0.5 / length;
    // Create an iterator on the curve
    SCurveIter iter = SCurveIterCreateStatic(curve, delta);
    // Declare a vector to store the internal position as a vector
    VecFloat* posIn = VecFloatCreate(1);

```

```

// Declare a vector to memorize the position in layer as short
VecShort* posLayer = VecShortCreate(SCurveGetDim(curve));
// Declare a vector to memorize the
VecShort* prevPosLayer = VecShortCreate(SCurveGetDim(curve));
// Loop on the curve internal position
do {
    // Get the internal position
    float p = SCurveIterGetPos(&iter);
    // Get the position in layer
    VecFloat* posLayerFloat = SCurveIterGet(&iter);
    for (long iAxis = VecGetDim(posLayer); iAxis--;)
        VecSet(posLayer, iAxis,
            (short)round(VecGet(posLayerFloat, iAxis)));
    // Ensure the position is different (at pixel level) with the
    // previous one, except for the first step (p==0.0)
    if (ISEQUALF(p, 0.0) == true ||
        VecIsEqual(posLayer, prevPosLayer) == false) {
        // Get the internal position as a vector
        VecSet(posIn, 0, p);
        // Get the external position
        VecFloat* posExt = SCurveGet(GBObjPodGetObjAsSCurve(pod), p);
        // Get the ink at this position
        GBPixel pixColor = GBInkGet(GBObjPodInk(pod), that, pod,
            posIn, posExt, posLayer);
        // Get the depth
        float depth = 0.0;
        if (VecGetDim(posLayerFloat) > 2)
            depth = VecGet(posLayerFloat, 2);
        // Add the pixel to the layer
        GBLayerAddPixelSafe(GBObjPodLayer(pod), (VecShort2D*)posLayer,
            &pixColor, depth);
        // Free memory
        VecFree(&posExt);
        // Set the previous position
        VecCopy(prevPosLayer, posLayer);
    }
    // Free memory
    VecFree(&posLayerFloat);
} while (SCurveIterStep(&iter));
// Free memory
VecFree(&posIn);
VecFree(&posLayer);
VecFree(&prevPosLayer);
}

// ----- GBToolPen -----

// Create a new GBToolPen with the given 'shape' and default
// 'softness' value of 1.0
GBToolPen* GBToolPenCreate(const Shapoid* shape) {
    // Declare the new GBToolPen
    GBToolPen* that = PBErrMalloc(GenBrushErr, sizeof(GBToolPen));
    // Set properties
    that->_tool = GBToolCreateStatic(GBToolTypePen);
    that->_shape = ShapoidClone(shape);
    that->_softness = 1.0;
    // Return the new tool
    return that;
}

// Free the memory used by the GBToolPen 'that'
void GBToolPenFree(GBToolPen** that) {

```

```

// Check argument
if (that == NULL || *that == NULL)
    // Nothing to do
    return;
// Free memory
ShapoidFree(&((*that)->_shape));
GBToolFreeStatic(&((*that)->_tool));
free(*that);
*that = NULL;
}

// Draw the object in the GBObjPod 'pod' with the GBToolPen 'that'
void GBToolPenDraw(const GBToolPen* const that,
    const GBObjPod* const pod) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pod == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pod' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Loop on the Points drawn by hand
    if (GSetNbElem(&(pod->_handPoints)) > 0) {
        GSetIterForward iter =
            GSetIterForwardCreateStatic(&(pod->_handPoints));
        do {
            // Get the point
            VecFloat* point = GSetIterGet(&iter);
            // Draw the point
            GBToolPenDrawPoint(that, point, pod);
        } while (GSetIterStep(&iter));
    }
    // Loop on the Shapoids drawn by hand
    if (GSetNbElem(&(pod->_handShapoids)) > 0) {
        GSetIterForward iter =
            GSetIterForwardCreateStatic(&(pod->_handShapoids));
        do {
            // Get the shapoid
            Shapoid* shap = GSetIterGet(&iter);
            // Draw the shapoid
            GBToolPenDrawShapoid(that, shap, pod);
        } while (GSetIterStep(&iter));
    }
    // Loop on the SCurves drawn by hand
    if (GSetNbElem(&(pod->_handSCurves)) > 0) {
        GSetIterForward iter =
            GSetIterForwardCreateStatic(&(pod->_handSCurves));
        do {
            // Get the curve
            SCurve* curve = GSetIterGet(&iter);
            // Draw the curve
            GBToolPenDrawSCurve(that, curve, pod);
        } while (GSetIterStep(&iter));
    }
}

// Draw the Point 'point' in the GBObjPod 'pod' with the

```



```

// GBTToolPen 'that'
void GBTToolPenDrawPoint(const GBTToolPen* const that,
    const VecFloat* const point, const GBObjPod* const pod) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pod == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pod' is null");
            PBErrCatch(GenBrushErr);
        }
        if (point == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'point' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Move the shapoid of the pen to the location of the point
    ShapoidSetCenterPos(GBTToolPenShape(that), point);
    // Plot the shapoid of the pen
    GBTToolPlotterDrawShapoid(
        (GBTToolPlotter*)that, GBTToolPenShape(that), pod);
    // Move the shapoid of the pen back to the origin
    VecFloat* orig = VecFloatCreate(VecGetDim(point));
    ShapoidSetCenterPos(GBTToolPenShape(that), orig);
    VecFree(&orig);
}

// Draw the Shapoid 'shap' in the GBObjPod 'pod' with the
// GBTToolPen 'that'
void GBTToolPenDrawShapoid(const GBTToolPen* const that,
    const Shapoid* const shap, const GBObjPod* const pod) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pod == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pod' is null");
            PBErrCatch(GenBrushErr);
        }
        if (shap == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'shap' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Get the bounding box of the shapoid in layer
    Facoid* bound = ShapoidGetBoundingBox(shap);
    // Declare two vectors for the VecShiftStep
    VecShort* from = VecShortCreate(ShapoidGetDim(bound));
    VecShort* to = VecShortCreate(ShapoidGetDim(bound));
    // Initialise the values of the vectors for the VecShiftStep
    for (int iAxis = ShapoidGetDim(bound); iAxis--;) {
        if (iAxis < 2) {
            VecSet(from, iAxis,
                (short)round(MAX(ShapoidPosGet(bound, iAxis), 0.0)));

```

```

        short v = (short)round(ShapoidPosGet(bound, iAxis) +
            ShapoidAxisGet(bound, iAxis, iAxis)) + 1;
        VecSet(to, iAxis,
            MIN(v, VecGet(GBLayerDim(GBObjPodLayer(pod)), iAxis)));
    } else {
        VecSet(from, iAxis,
            (short)round(ShapoidPosGet(bound, iAxis)));
        short v = (short)round(ShapoidPosGet(bound, iAxis) +
            ShapoidAxisGet(bound, iAxis, iAxis)) + 1;
        VecSet(to, iAxis, v);
    }
}
// Loop on pixels in layers inside the bounding box
VecShort* posLayer = VecClone(from);
VecFloat* posLayerFloat = VecFloatCreate(VecGetDim(posLayer));
do {
    for (long iAxis = VecGetDim(posLayer); iAxis--;) {
        VecSet(posLayerFloat, iAxis,
            (float)VecGet(posLayer, iAxis) + 0.5);
    }
    // If this pixel is inside the Shapoid
    if (ShapoidIsPosInside(shap, posLayerFloat)) {
        // Move the shapoid of the pen to the location of the
        // current point
        ShapoidSetCenterPos(GBToolPenShape(that), posLayerFloat);
        // Plot the shapoid of the pen
        GBToolPlotterDrawShapoid(
            (GBToolPlotter*)that, GBToolPenShape(that), pod);
    }
} while (VecShiftStep(posLayer, from, to));
// Move the shapoid of the pen back to the origin
VecFloat* orig = VecFloatCreate(ShapoidGetDim(shap));
ShapoidSetCenterPos(GBToolPenShape(that), orig);
VecFree(&orig);
// Free memory
VecFree(&from);
VecFree(&to);
VecFree(&posLayer);
VecFree(&posLayerFloat);
ShapoidFree(&bound);
}

// Draw the SCurve 'curve' in the GBObjPod 'pod' with the
// GBToolPen 'that'
void GBToolPenDrawSCurve(const GBToolPen* const that,
    const SCurve* const curve, const GBObjPod* const pod) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pod == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pod' is null");
        PBErrCatch(GenBrushErr);
    }
    if (curve == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'curve' is null");
        PBErrCatch(GenBrushErr);
    }
}

```

```

#endif
// Get the approximate length of the curve
float length = SCurveGetApproxLen(curve);
// Calculate the delta step based on the approximate length
float delta = 0.5 / length;
// Create an iterator on the curve
SCurveIter iter = SCurveIterCreateStatic(curve, delta);
// Declare a vector to store the internal position as a vector
VecFloat* posIn = VecFloatCreate(1);
// Declare a vector to memorize the position in layer as short
VecShort* posLayer = VecShortCreate(SCurveGetDim(curve));
// Declare a vector to memorize the
VecShort* prevPosLayer = VecShortCreate(SCurveGetDim(curve));
// Loop on the curve internal position
do {
    // Get the internal position
    float p = SCurveIterGetPos(&iter);
    // Get the position in layer
    VecFloat* posLayerFloat = SCurveIterGet(&iter);
    for (long iAxis = VecGetDim(posLayer); iAxis--;)
        VecSet(posLayer, iAxis,
            (short)round(VecGet(posLayerFloat, iAxis)));
    // Ensure the position is different (at pixel level) with the
    // previous one, except for the first step (p==0.0)
    if (ISEQUALF(p, 0.0) == true ||
        VecIsEqual(posLayer, prevPosLayer) == false) {
        // Move the shapoid of the pen to the location of the
        // current point
        ShapoidSetCenterPos(GBToolPenShape(that), posLayerFloat);
        // Plot the shapoid of the pen
        GBToolPlotterDrawShapoid(
            (GBToolPlotter*)that, GBToolPenShape(that), pod);
        // Set the previous position
        VecCopy(prevPosLayer, posLayer);
    }
    // Free memory
    VecFree(&posLayerFloat);
} while (SCurveIterStep(&iter));
// Move the shapoid of the pen back to the origin
VecFloat* orig = VecFloatCreate(SCurveGetDim(curve));
ShapoidSetCenterPos(GBToolPenShape(that), orig);
VecFree(&orig);
// Free memory
VecFree(&posIn);
VecFree(&posLayer);
VecFree(&prevPosLayer);
}

// ----- GBInk -----

// Entry point for the GBTool<>Draw function to get the color of the
// appropriate GBInk according to the type of 'that'
// posInternal represents the position in the object internal space
// posExternal represents the position in the global coordinates system
// posLayer represents the position in the destination layer
GBPixel _GBInkGet(const GBInk* const that, const GBTool* const tool,
    const GBObjPod* const pod, const VecFloat* const posInternal,
    const VecFloat* const posExternal, const VecShort* const posLayer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
    }

```

```

        PBErCatch(GenBrushErr);
    }
#endif
    // Currently unused, voided and left for forward compatibility
    (void)tool; (void)pod;
    (void)posInternal; (void)posLayer;
    // Declare the result pixel
    GBPixel pix = GBColorTransparent;
    // Call the appropriate function according to the type of ink
    switch (GBInkGetType(that)) {
        case GBInkTypeSolid:
            pix = GBInkSolidGet((GBInkSolid*)that);
            break;
        default:
            break;
    }
    // Modification of the ink by the tool
    if (tool != NULL && GBToolGetType(tool) == GBToolTypePen) {
        float strength = ShapoidGetPosDepth(
            GBToolPenShape((GBToolPen*)tool), posExternal);
        strength = pow(strength, GBToolPenGetSoftness((GBToolPen*)tool));
        pix._rgba[GBPixelAlpha] =
            (unsigned char)((float)(pix._rgba[GBPixelAlpha]) * strength);
    }
    // Return the result pixel
    return pix;
}

// ----- GBInk -----

// Free the memory used by the GBInk 'that'
void GBInkFree(GBInk* const that) {
    // Nothing to do
    (void)that;
}

// ----- GBInkSolid -----

// Create a new GBInkSolid with color 'col'
GBInkSolid* GBInkSolidCreate(const GBPixel* const col) {
    #if BUILDMODE == 0
        if (col == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'col' is null");
            PBErCatch(GenBrushErr);
        }
    #endif
    // Declare the new GBInkSolid
    GBInkSolid* ink = PBErMalloc(GenBrushErr, sizeof(GBInkSolid));
    // Set properties
    ink->_ink._type = GBInkTypeSolid;
    ink->_color = *col;
    // Return the new ink
    return ink;
}

// Free the memory used by the GBInkSolid 'that'
void GBInkSolidFree(GBInkSolid** that) {
    // Check argument
    if (that == NULL || *that == NULL)
        // Nothing to do
        return;
}

```

```

    // Free memory
    GBInkFree(&((*that)->_ink));
    free(*that);
    *that = NULL;
}

// ----- GBObjPod -----

// Create a new GBObjPod for a Point at position 'pos'
// drawn with 'eye', 'hand', 'tool' and 'ink' in layer 'layer'
// 'pos' must be a vector of 2 or more dimensions
// If 'eye', 'hand', 'tool', 'ink' or 'layer' is null return null
GBObjPod* _GBObjPodCreatePoint(VecFloat* const pos, GBEye* const eye,
    GBHand* const hand, GBTool* const tool, GBInk* const ink,
    GBLayer* const layer) {
#ifdef BUILDMODE == 0
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGetDim(pos) < 2) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg,
            "'pos' 's dimension is invalid (%ld>=2)",
            VecGetDim(pos));
        PBErrCatch(GenBrushErr);
    }
#endif
    // Check that the parameters are not null
    if (eye == NULL || hand == NULL || tool == NULL ||
        ink == NULL || layer == NULL)
        return NULL;
    // Declare the new GBObjPod
    GBObjPod* pod = PBErrMalloc(GenBrushErr, sizeof(GBObjPod));
    // Set properties
    pod->_type = GBObjTypePoint;
    pod->_srcPoint = pos;
    pod->_eyePoint = NULL;
    pod->_handPoints = GSetVecFloatCreateStatic();
    pod->_handShapoids = GSetShapoidCreateStatic();
    pod->_handSCurves = GSetSCurveCreateStatic();
    pod->_eye = eye;
    pod->_hand = hand;
    pod->_tool = tool;
    pod->_ink = ink;
    pod->_layer = layer;
    // Process the Point through eye and hand
    GBObjPodProcess(pod);
    // Return the new pod
    return pod;
}

// Create a new GBObjPod for the Shapoid 'shap'
// drawn with 'eye', 'hand', 'tool' and 'ink' in layer 'layer'
// 'shap' 's dimension must be 2 or more
// If 'eye', 'hand', 'tool', 'ink' or 'layer' is null return null
GBObjPod* _GBObjPodCreateShapoid(Shapoid* const shap, GBEye* const eye,
    GBHand* const hand, GBTool* const tool, GBInk* const ink,
    GBLayer* const layer) {
#ifdef BUILDMODE == 0
    if (shap == NULL) {

```

```

    GenBrushErr->_type = PErrTypeNullPointer;
    sprintf(GenBrushErr->_msg, "'shap' is null");
    PErrCatch(GenBrushErr);
}
if (ShapoidGetDim(shap) < 2) {
    GenBrushErr->_type = PErrTypeInvalidArg;
    sprintf(GenBrushErr->_msg,
        "'shap' 's dimension is invalid (%d>=2)",
        ShapoidGetDim(shap));
    PErrCatch(GenBrushErr);
}
#endif
// Check that the parameters are not null
if (eye == NULL || hand == NULL || tool == NULL ||
    ink == NULL || layer == NULL)
    return NULL;
// Declare the new GBObjPod
GBObjPod* pod = PErrMalloc(GenBrushErr, sizeof(GBObjPod));
// Set properties
pod->_type = GBObjTypeShapoid;
pod->_srcShapoid = shap;
pod->_eyeShapoid = NULL;
pod->_handPoints = GSetVecFloatCreateStatic();
pod->_handShapoids = GSetShapoidCreateStatic();
pod->_handSCurves = GSetSCurveCreateStatic();
pod->_eye = eye;
pod->_hand = hand;
pod->_tool = tool;
pod->_ink = ink;
pod->_layer = layer;
// Process the Shapoid through eye and hand
GBObjPodProcess(pod);
// Return the new pod
return pod;
}

// Create a new GBObjPod for the SCurve 'curve'
// drawn with 'eye', 'hand', 'tool' and 'ink' in layer 'layer'
// 'curve' 's dimension must be 2 or more
// If 'eye', 'hand', 'tool', 'ink' or 'layer' is null return null
GBObjPod* _GBObjPodCreateSCurve(SCurve* const curve, GBEye* const eye,
    GBHand* const hand, GBTool* const tool, GBInk* const ink,
    GBLayer* const layer) {
#ifdef BUILDMODE == 0
    if (curve == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'curve' is null");
        PErrCatch(GenBrushErr);
    }
    if (SCurveGetDim(curve) < 2) {
        GenBrushErr->_type = PErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg,
            "'curve' 's dimension is invalid (%d>=2)",
            SCurveGetDim(curve));
        PErrCatch(GenBrushErr);
    }
}
#endif
// Check that the parameters are not null
if (eye == NULL || hand == NULL || tool == NULL ||
    ink == NULL || layer == NULL)
    return NULL;
// Declare the new GBObjPod

```

```

GBObjPod* pod = PBErrMalloc(GenBrushErr, sizeof(GBObjPod));
// Set properties
pod->_type = GBObjTypeSCurve;
pod->_srcSCurve = curve;
pod->_eyeSCurve = NULL;
pod->_handPoints = GSetVecFloatCreateStatic();
pod->_handShapoids = GSetShapoidCreateStatic();
pod->_handSCurves = GSetSCurveCreateStatic();
pod->_eye = eye;
pod->_hand = hand;
pod->_tool = tool;
pod->_ink = ink;
pod->_layer = layer;
// Process the SCurve through eye and hand
GBObjPodProcess(pod);
// Return the new pod
return pod;
}

// Free the memory used by the GBObjPod 'that'
void GBObjPodFree(GBObjPod** that) {
    // Check argument
    if (that == NULL || *that == NULL)
        // Nothing to do
        return;
    // Free memory
    switch (GBObjPodGetType(*that)) {
        case GBObjTypePoint:
            VecFree(&((*that)->_eyePoint));
            break;
        case GBObjTypeShapoid:
            ShapoidFree(&((*that)->_eyeShapoid));
            break;
        case GBObjTypeSCurve:
            SCurveFree(&((*that)->_eyeSCurve));
            break;
        default:
            break;
    }
    while (GSetNbElem(&((*that)->_handPoints)) > 0) {
        VecFloat* point = GSetPop(&((*that)->_handPoints));
        VecFree(&point);
    }
    while (GSetNbElem(&((*that)->_handShapoids)) > 0) {
        Shapoid* shap = GSetPop(&((*that)->_handShapoids));
        ShapoidFree(&shap);
    }
    while (GSetNbElem(&((*that)->_handSCurves)) > 0) {
        SCurve* curve = GSetPop(&((*that)->_handSCurves));
        SCurveFree(&curve);
    }
    free(*that);
    *that = NULL;
}

// ----- GenBrush -----

// Create a new GenBrush with a GBSurface of type GBSurfaceTypeImage
// and dimensions 'dim'
GenBrush* GBCreateImage(const VecShort2D* const dim) {
#ifdef BUILDMODE == 0
    if (dim == NULL) {

```

```

        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the new GenBrush
    GenBrush* ret = PBErrMalloc(GenBrushErr, sizeof(GenBrush));
    // Set properties
    ret->_surf = (GBSurface*)GBSurfaceImageCreate(dim);
    ret->_pods = GSetCreateStatic();
    ret->_postProcs = GSetCreateStatic();
    // Return the new GenBrush
    return ret;
}

// Create a new GenBrush with one layer containing the content
// of the image located at 'fileName' and dimensions equal to the
// dimensions of the image
// If the image couldn't be loaded return NULL
GenBrush* GBCreateFromFile(const char* const fileName) {
    // Declare the new GenBrush
    GenBrush* ret = NULL;
    // Load the image in a surface
    GBSurfaceImage *img = GBSurfaceImageCreateFromFile(fileName);
    if (img != NULL) {
        // Declare the new GenBrush
        ret = PBErrMalloc(GenBrushErr, sizeof(GenBrush));
        // Set properties
        ret->_surf = (GBSurface*)img;
        ret->_pods = GSetCreateStatic();
        ret->_postProcs = GSetCreateStatic();
        GBSetFileName(ret, fileName);
    }
    // Return the new GenBrush
    return ret;
}

// Free memory used by the GenBrush 'that'
void GBFree(GenBrush** that) {
    // If the pointer is null
    if (that == NULL || *that == NULL)
        // Nothing to do
        return;
    // Free memory
    switch (GBGetType(*that)) {
        case GBSurfaceTypeDefault:
            GBSurfaceFree(&((*that)->_surf));
            break;
        case GBSurfaceTypeImage:
            GBSurfaceImageFree((GBSurfaceImage*)&((*that)->_surf));
            break;
#ifdef BUILDWITHGRAPHICLIB == 1
        case GBSurfaceTypeWidget:
            GBSurfaceWidgetFree((GBSurfaceWidget*)&((*that)->_surf));
            break;
    }
}

```



```

#endif
    default:
        break;
    }
    GBRemoveAllPod(*that);
    GBRemoveAllPostProcess(*that);
    free(*that);
    *that = NULL;
}

// Get the dimensions of the GenBrush 'that'
VecShort2D* GBDim(const GenBrush* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PErrCatch(GenBrushErr);
        }
    #endif
    return GBSurfaceDim(that->_surf);
}

// Update the GBSurface of the GenBrush 'that'
void GBUpdate(GenBrush* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PErrCatch(GenBrushErr);
        }
    #endif
    // Refresh the layers that have been modified
    // If there is layers
    if (GBGetNbLayer(that) > 0) {
        // Declare an iterator on the layers
        GSetIterForward iter =
            GSetIterForwardCreateStatic(GBSurfaceLayers(GBSurf(that)));
        // Loop on the layers
        do {
            // Get the current layer
            GBLayer* layer = GSetIterGet(&iter);
            // If this layer has been modified
            if (GBLayerIsModified(layer))
                // Refresh the layer content
                GBUpdateLayer(that, layer);
        } while (GSetIterStep(&iter));
    }
    // Request the update of the surface
    GBSurfaceUpdate(GBSurf(that));
    // Apply the post processing
    if (GSetNbElem(GBPPostProcs(that)) > 0) {
        GSetIterForward iter =
            GSetIterForwardCreateStatic(GBPPostProcs(that));
        do {
            GBPostProcessing* post = GSetIterGet(&iter);
            GBSurfacePostProcess(GBSurf(that), post);
        } while (GSetIterStep(&iter));
    }
}

// Update the content of the layer 'layer' of the GenBrush 'that'
// Flush the content of the layer and redraw all the pod attached to it

```

```

void GBUpdateLayer(GenBrush* const that, GBLayer* const layer) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (layer == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'layer' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Flush the content of the layer
    GBLayerFlush(layer);
    // If there is no pods
    if (GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod is attached to the requested layer
        if (pod->_layer == layer)
            // Redraw the pod
            GBToolDraw(GBObjPodTool(pod), pod);
    } while (GSetIterStep(&iter));
}

// Render the GBSurface (save on disk, display on screen, ...) of
// the GenBrush 'that'
bool GBRender(GenBrush* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare a variable to memorize the success of rendering
    bool status = false;
    switch (GBSurfaceGetType(that->_surf)) {
        case GBSurfaceTypeImage:
            status = GBSurfaceImageSave((GBSurfaceImage*)(that->_surf));
            break;
#ifdef BUILDWITHGRAPHICLIB == 1
        case GBSurfaceTypeWidget:
            GBSurfaceWidgetRender((GBSurfaceWidget*)(that->_surf));
            status = true;
            break;
        case GBSurfaceTypeApp:
            status = GBSurfaceAppRender((GBSurfaceApp*)(that->_surf));
            break;
#endif
        default:
            break;
    }
    // Return the status of rendering
    return status;
}

```

```

}

// Remove from the list of pods of the GenBrush 'that' those who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBRemovePod(that, elemA, NULL, NULL, NULL, NULL, NULL) removes all
// the pods related to the object 'elemA'
// GBRemovePod(that, elemA, NULL, handA, NULL, NULL, NULL) removes
// all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it removes all the pods
void _GBRemovePod(GenBrush* const that, const void* const obj,
    const GBEye* const eye, const GBHand* const hand,
    const GBTool* const tool, const GBInk* const ink,
    const GBLayer* const layer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If there is no pods
    if (GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Declare a variable for the end condition of the loop
    bool flag = true;
    // Loop on pods
    while (flag) {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filters
        if ((obj == NULL || (void*)(pod->_srcPoint) == obj) &&
            (eye == NULL || pod->_eye == eye) &&
            (hand == NULL || pod->_hand == hand) &&
            (tool == NULL || pod->_tool == tool) &&
            (ink == NULL || pod->_ink == ink) &&
            (layer == NULL || pod->_layer == layer)) {
            // Remove the pod and move to the next one
            GBObjPodFree(&pod);
            flag = GSetIterRemoveElem(&iter);
        } else {
            // Else the pod doesn't match the filters
            // Move to the next pod
            flag = GSetIterStep(&iter);
        }
    }
}

// Set the eye to 'toEye' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodEye(that, toEye, elemA, NULL, NULL, NULL, NULL)
// affects all the pods related to the object 'elemA'
// GBSetPodEye(that, toEye, elemA, NULL, handA, NULL, NULL)
// affects all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toEye' is null, do nothing
void _GBSetPodEye(GenBrush* const that, GBEye* const toEye,
    const void* const obj, const GBEye* const eye,

```

```

    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If 'toEye' is null or there is no pods
    if (toEye == NULL || GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filters
        if ((obj == NULL || (void*)(pod->_srcPoint) == obj) &&
            (eye == NULL || pod->_eye == eye) &&
            (hand == NULL || pod->_hand == hand) &&
            (tool == NULL || pod->_tool == tool) &&
            (ink == NULL || pod->_ink == ink) &&
            (layer == NULL || pod->_layer == layer))
            // Set the eye of the pod
            pod->_eye = toEye;
    } while (GSetIterStep(&iter));
}

// Set the hand to 'toHand' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodEye(that, toHand, elemA, NULL, NULL, NULL, NULL, NULL)
// affects all the pods related to the object 'elemA'
// GBSetPodEye(that, toHand, elemA, NULL, handA, NULL, NULL, NULL)
// affects all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toHand' is null, do nothing
void _GBSetPodHand(GenBrush* const that, GBHand* const toHand,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If 'toHand' is null or there is no pods
    if (toHand == NULL || GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filters

```

```

        if ((obj == NULL || (void*)(pod->_srcPoint) == obj) &&
            (eye == NULL || pod->_eye == eye) &&
            (hand == NULL || pod->_hand == hand) &&
            (tool == NULL || pod->_tool == tool) &&
            (ink == NULL || pod->_ink == ink) &&
            (layer == NULL || pod->_layer == layer))
            // Set the hand of the pod
            pod->_hand = toHand;
    } while (GSetIterStep(&iter));
}

// Set the tool to 'toTool' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetsPodTool(that, toTool, elemA, NULL, NULL, NULL, NULL) affects
// all the pods related to the object 'elemA'
// GBSetsPodTool(that, toTool, elemA, NULL, handA, NULL, NULL) affects
// all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toTool' is null, do nothing
void _GBSetsPodTool(GenBrush* const that, GBTool* const toTool,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If 'toTool' is null or there is no pods
    if (toTool == NULL || GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filters
        if ((obj == NULL || (void*)(pod->_srcPoint) == obj) &&
            (eye == NULL || pod->_eye == eye) &&
            (hand == NULL || pod->_hand == hand) &&
            (tool == NULL || pod->_tool == tool) &&
            (ink == NULL || pod->_ink == ink) &&
            (layer == NULL || pod->_layer == layer))
            // Set the tool of the pod
            pod->_tool = toTool;
    } while (GSetIterStep(&iter));
}

// Set the ink to 'toInk' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetsPodTool(that, toTool, elemA, NULL, NULL, NULL, NULL) affects
// all the pods related to the object 'elemA'
// GBSetsPodTool(that, toTool, elemA, NULL, handA, NULL, NULL) affects
// all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toInk' is null, do nothing

```

```

void _GBSetPodInk(GenBrush* const that, GBInk* const toInk,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If 'toInk' is null or there is no pods
    if (toInk == NULL || GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filters
        if ((obj == NULL || (void*)(pod->_srcPoint) == obj) &&
            (eye == NULL || pod->_eye == eye) &&
            (hand == NULL || pod->_hand == hand) &&
            (tool == NULL || pod->_tool == tool) &&
            (ink == NULL || pod->_ink == ink) &&
            (layer == NULL || pod->_layer == layer))
            // Set the tool of the pod
            pod->_ink = toInk;
    } while (GSetIterStep(&iter));
}

// Set the layer to 'toLayer' in the pods of the GenBrush 'that' who
// match the 'obj', 'eye', 'hand', 'tool', 'ink' and 'layer'
// Null arguments are ignored. For example:
// GBSetPodLayer(that, toLayer, elemA, NULL, NULL, NULL, NULL)
// affects all the pods related to the object 'elemA'
// GBSetPodLayer(that, toLayer, elemA, NULL, handA, NULL, NULL, NULL)
// affects all the pods related to both the object 'elemA' AND 'handA'
// If all the filters are null it affects all the pods
// If 'toLayer' is null, do nothing
void _GBSetPodLayer(GenBrush* const that, GBLayer* const toLayer,
    const void* const obj, const GBEye* const eye,
    const GBHand* const hand, const GBTool* const tool,
    const GBInk* const ink, const GBLayer* const layer) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If 'toLayer' is null or there is no pods
    if (toLayer == NULL || GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod

```

```

    GBObjPod* pod = GSetIterGet(&iter);
    // If the pod matches the filters
    if ((obj == NULL || (void*)(pod->_srcPoint) == obj) &&
        (eye == NULL || pod->_eye == eye) &&
        (hand == NULL || pod->_hand == hand) &&
        (tool == NULL || pod->_tool == tool) &&
        (ink == NULL || pod->_ink == ink) &&
        (layer == NULL || pod->_layer == layer))
        // Set the layer of the pod
        pod->_layer = toLayer;
} while (GSetIterStep(&iter));
}

// Set to true the modified flag of the layers of pods attached to the
// object 'obj' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromObj(GenBrush* const that,
    const void* const obj) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (obj == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'obj' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // If there is no pods
    if (GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filter
        if (GBObjPodObj(pod) == obj) {
            // Reprocess the object
            GBObjPodProcess(pod);
            // Set the layer flag
            GBLayerSetModified(pod->_layer, true);
        }
    } while (GSetIterStep(&iter));
}

// Set to true the modified flag of the layers of pods attached to the
// GBEye 'eye' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromEye(GenBrush* const that,
    const GBEye* const eye) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (eye == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'eye' is null");
        }
    #endif
}

```

```

        PBErCatch(GenBrushErr);
    }
#endif
    // If there is no pods
    if (GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filter
        if (GBObjPodEye(pod) == eye) {
            // Reprocess the object
            GBObjPodProcess(pod);
            // Set the layer flag
            GBLayerSetModified(pod->_layer, true);
        }
    } while (GSetIterStep(&iter));
}

// Set to true the modified flag of the layers of pods attached to the
// GBInk 'ink' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromInk(GenBrush* const that,
    const GBInk* const ink) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErCatch(GenBrushErr);
        }
        if (ink == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'ink' is null");
            PBErCatch(GenBrushErr);
        }
    }
#endif
    // If there is no pods
    if (GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filter
        if (pod->_ink == ink)
            // Set the layer flag
            GBLayerSetModified(pod->_layer, true);
    } while (GSetIterStep(&iter));
}

// Set to true the modified flag of the layers of pods attached to the
// GBHand 'hand' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromHand(GenBrush* const that,
    const GBHand* const hand) {
    #if BUILDMODE == 0
        if (that == NULL) {

```



```

        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
    if (hand == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'hand' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    // If there is no pods
    if (GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filter
        if (GBObjPodHand(pod) == hand) {
            GBHandProcess(GBObjPodHand(pod), pod);
            // Set the layer flag
            GBLayerSetModified(pod->_layer, true);
        }
    } while (GSetIterStep(&iter));
}

// Set to true the modified flag of the layers of pods attached to the
// GBTool 'tool' in the list of pods of the GenBrush 'that'
void _GBNotifyChangeFromTool(GenBrush* const that,
    const GBTool* const tool) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PErrCatch(GenBrushErr);
        }
        if (tool == NULL) {
            GenBrushErr->_type = PErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'tool' is null");
            PErrCatch(GenBrushErr);
        }
    #endif
    // If there is no pods
    if (GBGetNbPod(that) == 0)
        // Nothing to do
        return;
    // Declare an iterator on the set of pods
    GSetIterForward iter = GSetIterForwardCreateStatic(&(that->_pods));
    // Loop on pods
    do {
        // Get the current pod
        GBObjPod* pod = GSetIterGet(&iter);
        // If the pod matches the filter
        if (pod->_tool == tool)
            // Set the layer flag
            GBLayerSetModified(pod->_layer, true);
    } while (GSetIterStep(&iter));
}

```

```

// Return a clone of the GenBrush 'that' with its final surface scaled
// to the dimensions 'dim' according to the scaling method 'scaleMethod'
GenBrush* GBScale(const GenBrush* const that,
    const VecShort2D* const dim, const GBScaleMethod scaleMethod) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the scaled version of the GenBrush
    GenBrush* scaledGB = NULL;
    // Call the appropriate scaling method
    switch (scaleMethod) {
        case GBScaleMethod_AvgNeighbour:
            scaledGB = GBScaleAvgNeighbour(that, dim);
            break;
        default:
            break;
    }
    // Return the scaled version of the GenBrush
    return scaledGB;
}

// Return a clone of the GenBrush 'that' with its final surface flipped
// relatively to the 'iAxis'-th axis
GenBrush* GBFlip(const GenBrush* const that,
    const long iAxis) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (iAxis < 0 || iAxis > 1) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'iAxis' is invalid (0<=%ld<=1)",
            iAxis);
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the flipped version of the GenBrush
    GenBrush* flippedGB = GBCreateImage(GBDim(that));
    // Loop on the pixels of the final surface
    VecShort2D pos = VecShortCreateStatic2D();
    do {
        // Get the pixel in the original image
        GBPixel* pix =
            GBSurfaceFinalPixel(GBSurf(that), &pos);
        // Get the position in the flipped GenBrush

```

```

    VecShort2D posFlipped = pos;
    VecSet(&posFlipped, iAxis,
        VecGet(GBDim(that), iAxis) - VecGet(&pos, iAxis) - 1);
    // Get the pixel in the flipped image
    GBPixel* pixFlipped =
        GBSurfaceFinalPixel(GBSurf(flippedGB), &posFlipped);
    // Set the pixel in the flipped version of the GenBrush
    *pixFlipped = *pix;
} while (VecStep(&pos, GBDim(that)));

// Return the flipped version of the GenBrush
return flippedGB;
}

// Return a clone of the GenBrush 'that' with its final surface scaled
// to the dimensions 'dim' according to the scaling method AvgNeighbour
GenBrush* GBScaleAvgNeighbour(const GenBrush* const that,
    const VecShort2D* const dim) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the scaled version of the GenBrush
    GenBrush* scaledGB = GBCreateImage(dim);
    // Calculate the scale factors along each axis
    VecFloat2D scaleFactor = VecFloatCreateStatic2D();
    VecSet(&scaleFactor, 0,
        (float)VecGet(dim, 0) / (float)VecGet(GBDim(that), 0));
    VecSet(&scaleFactor, 1,
        (float)VecGet(dim, 1) / (float)VecGet(GBDim(that), 1));
    // Declare variables to calculate the average of pixels in the
    // original image
    int nbPix = 0;
    VecFloat* avgPix = VecFloatCreate(4);
    // Declare a variable to loop on the scaled image
    VecShort2D posScaled = VecShortCreateStatic2D();
    // Loop on pixels of the scaled image
    do {
        // Get the floating point position in the original image of
        // the lower left and upper right of the 3x3 cell around for this
        // pixel
        VecFloat2D posLLFloat = VecFloatCreateStatic2D();
        VecSet(&posLLFloat, 0,
            (float)(VecGet(&posScaled, 0) - 1) / VecGet(&scaleFactor, 0));
        VecSet(&posLLFloat, 1,
            (float)(VecGet(&posScaled, 1) - 1) / VecGet(&scaleFactor, 1));
        VecFloat2D posURFloat = VecFloatCreateStatic2D();

```

```

    VecSet(&posURFloat, 0,
        (float)(VecGet(&posScaled, 0) + 1) / VecGet(&scaleFactor, 0));
    VecSet(&posURFloat, 1,
        (float)(VecGet(&posScaled, 1) + 1) / VecGet(&scaleFactor, 1));
    // Get the integer position in the original image of
    // the lower left and upper right of the 3x3 cell around for this
    // pixel
    // Ensure the positions are inside the original image
    VecShort2D posLL = VecShortCreateStatic2D();
    VecSet(&posLL, 0, MAX(0, (short)floor(VecGet(&posLLFloat, 0))));
    VecSet(&posLL, 1, MAX(0, (short)floor(VecGet(&posLLFloat, 1))));
    VecShort2D posUR = VecShortCreateStatic2D();
    VecSet(&posUR, 0,
        MIN(VecGet(GBDim(that), 0), (short)floor(VecGet(&posURFloat, 0))));
    VecSet(&posUR, 1,
        MIN(VecGet(GBDim(that), 1), (short)floor(VecGet(&posURFloat, 1))));
    // Init the variables to calculate the average of pixels in the
    // original image
    nbPix = 0;
    VecSetNull(&avgPix);
    // Declare a variable to loop on the original image
    VecShort2D posOrig = posLL;
    // Loop on the pixels of the original image
    do {
        // Get the pixel in the original image
        const GBPixel* pix = GBSurfaceFinalPixel(GBSurf(that), &posOrig);
        // Calculate the average pixel
        ++nbPix;
        for (int i = 4; i--;)
            VecSet(&avgPix, i, VecGet(&avgPix, i) + (float)(pix->rgba[i]));
    } while (VecShiftStep(&posOrig, &posLL, &posUR));
    // Calculate the average pixel
    VecScale(&avgPix, 1.0 / (float)nbPix);
    // Get the pixel in the original image
    GBPixel* pixScaled =
        GBSurfaceFinalPixel(GBSurf(scaledGB), &posScaled);
    // Update the pixel in the scaled image with the average pixel
    for (int i = 4; i--;)
        pixScaled->rgba[i] = (unsigned char)VecGet(&avgPix, i);
    } while (VecStep(&posScaled, dim));
    // Free memory
    VecFree(&avgPix);
    // Return the scaled version of the GenBrush
    return scaledGB;
}

// Return a clone of the GenBrush 'that' with its final surface cropped
// to the dimensions 'dim' from the lower right position 'posLR'
// If the cropping area is partially or totally outside of the
// original image, pixels outside of the image are filled with
// 'fillPix' or left to their default value (cf GBSurfaceCreate) if
// 'fillPix' is NULL
GenBrush* GBCrop(const GenBrush* const that,
    const VecShort2D* const posLR, const VecShort2D* const dim,
    const GBPixel* const fillPix) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (dim == NULL) {

```

```

        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare the cropped version of the GenBrush
    GenBrush* croppedGB = GBCreateImage(dim);
    // Declare a variable to loop on the cropped image
    VecShort2D posCropped = VecShortCreateStatic2D();
    // Loop on pixels of the scaled image
    do {
        // Get the position in the original image
        VecShort2D posOrig = VecGetOp(posLR, 1, &posCropped, 1);
        // Get the pixel in the original image
        const GBPixel* pixOrig =
            GBSurfaceFinalPixelSafe(GBSurf(that), &posOrig);
        // If the pixel is inside the image
        if (pixOrig != NULL) {
            // Copy the pixel in the cropped image
            GBSurfaceSetFinalPixel(GBSurf(croppedGB), &posCropped, pixOrig);
        } else if (fillPix != NULL) {
            // Copy the filling pixel in the cropped image
            GBSurfaceSetFinalPixel(GBSurf(croppedGB), &posCropped, fillPix);
        }
    } while (VecStep(&posCropped, dim));
    // Return the cropped version of the GenBrush
    return croppedGB;
}

// Duplicate the final pixels of the GenBrush 'src' to the
// GenBrush 'dest' for the area starting at 'posSrc' in 'src' and
// 'posDest' in 'dest' and having dimension 'dim'
// The fragment must be fully included in both 'src' and 'dest'
void GBCopyFragment(const GenBrush* const src, GenBrush* const dest,
    const VecShort2D* const posSrc, const VecShort2D* const posDest,
    const VecShort2D* const dim) {
#ifdef BUILDMODE == 0
    if (src == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'src' is null");
        PBErrCatch(GenBrushErr);
    }
    if (dest == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dest' is null");
        PBErrCatch(GenBrushErr);
    }
    if (posSrc == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'posSrc' is null");
        PBErrCatch(GenBrushErr);
    }
    if (posDest == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'posDest' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
}

```

```

    }
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare a variable to loop on pixels
    VecShort2D pos = VecShortCreateStatic2D();

    // Loop on pixels
    do {

        // Get the position in the source
        VecShort2D pSrc = VecGetOp(&pos, 1, posSrc, 1);

        // Get the position in the destination
        VecShort2D pDest = VecGetOp(&pos, 1, posDest, 1);

        // Get the pixel from the source
        GBPixel pix = GBGetFinalPixel(src, &pSrc);

        // Set the pixel in the destination
        GBSetFinalPixel(dest, &pDest, &pix);

    } while (VecStep(&pos, dim));
}

// Return a value between 0.0 and 1.0, such as 1.0 means 'gbA' and 'gbB'
// are identical, 0.0 means they are completely different
// The value is calculated as the average of the difference between
// rgba of final pixels of 'gbA' and final pixels of 'gbB'
// 'gbA' and 'gbB' must be of same dimensions
float GBGetSimilarity(const GenBrush* const gbA, GenBrush* const gbB) {
#ifdef BUILDMODE == 0
    if (gbA == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'gbA' is null");
        PBErrCatch(GenBrushErr);
    }
    if (gbB == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'gbB' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(GBDim(gbA), GBDim(gbB)) == false) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg,
            "'gbA' and 'gbB' have different dimensions");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Declare a variable to memorize the similarity
    float similarity = 0.0;

    // Declare a variable to loop on pixels
    VecShort2D pos = VecShortCreateStatic2D();

    // Loop on pixels
    do {

```

```

    // Get the pixels
    GBPixel pixA = GBGetFinalPixel(gbA, &pos);
    GBPixel pixB = GBGetFinalPixel(gbB, &pos);

    // Update the similarity
    float diff = 0.0;
    for (int iRgba = 4; iRgba--;)
        diff +=
            fabs(
                ((float)(pixA._rgba[iRgba]) -
                 (float)(pixB._rgba[iRgba])) / 255.0);
    similarity += diff / 4.0;

} while (VecStep(&pos, GBDim(gbA)));

// Calculate the average of similarity
similarity = 1.0 - similarity / GBArea(gbA);

// Return the similarity
return similarity;
}

// ===== GTK Functions =====
#if BUILDWITHGRAPHICLIB == 1
#include "genbrush-GTK.c"
#endif

```

## 3.2 genbrush-inline.c

```

// ===== GENBRUSH-static inline.C =====

// ===== Functions implementation =====

// ----- GBPixel -----

// Return true if the GBPixel 'that' and 'tho' are the same, else false.
#if BUILDMODE != 0
static inline
#endif
bool GBPixelIsSame(const GBPixel* const that, const GBPixel* const tho) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
    if (tho == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'tho' is null");
        PErrCatch(GenBrushErr);
    }
}
#endif
return (memcmp(that, tho, sizeof(GBPixel)) == 0);
}

// ----- GBLayer -----

// Get the area of the layer (width * height)
#if BUILDMODE != 0

```

```

static inline
#endif
int GBLayerArea(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (int)VecGet(&(that->_dim), 0) *
        (int)VecGet(&(that->_dim), 1);
}

// Get the position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D* GBLayerPos(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (VecShort2D*)&(that->_pos);
}

// Get a copy of the position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBLayerGetPos(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_pos;
}

// Set the position of the GBLayer 'that' to 'pos'
// If the flag _modified==false _prevPos is first set to _pos
// and _modified is set to true
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetPos(GBLayer* const that, const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
}

```



```

#endif
    if (!(that->_modified)) {
        GBLayerSetModified(that, true);
        that->_prevPos = that->_pos;
    }
    that->_pos = *pos;
}

// Get the previous position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D* GBLayerPrevPos(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (VecShort2D*)&(that->_prevPos);
}

// Get a copy of the previous position of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBLayerGetPrevPos(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_prevPos;
}

// Get the scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D* GBLayerScale(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (VecFloat2D*)&(that->_scale);
}

// Get a copy of the scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D GBLayerGetScale(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
    }
#endif
}

```

```

        PBErriCatch(GenBrushErr);
    }
#endif
    return that->_scale;
}

// Set the scale of the GBLayer 'that' to 'scale'
// If the flag _modified==false _prevScale is first set to _scale
// and _modified is set to true
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetScale(GBLayer* const that, const VecFloat2D* const scale) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErriTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErriCatch(GenBrushErr);
    }
    if (scale == NULL) {
        GenBrushErr->_type = PBErriTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'scale' is null");
        PBErriCatch(GenBrushErr);
    }
#endif
    if (!(that->_modified)) {
        GBLayerSetModified(that, true);
        that->_prevScale = that->_scale;
    }
    that->_scale = *scale;
}

// Get the previous scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D* GBLayerPrevScale(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErriTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErriCatch(GenBrushErr);
    }
#endif
    return (VecFloat2D*)&(that->_prevScale);
}

// Get a copy of the previous scale of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecFloat2D GBLayerGetPrevScale(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErriTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErriCatch(GenBrushErr);
    }
#endif
    return that->_prevScale;
}

```

```

// Get the dimensions of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D* GBLayerDim(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (VecShort2D*)&(that->_dim);
}

// Get a copy of the dimensions of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBLayerGetDim(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_dim;
}

// Get a copy of the blend mode of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
GBLayerBlendMode GBLayerGetBlendMode(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_blendMode;
}

// Set the blend mode of the GBLayer 'that' to 'blend'
// Set the flag _modified to true
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetBlendMode(GBLayer* const that,
    const GBLayerBlendMode blend) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    GBLayerSetModified(that, true);
    that->_blendMode = blend;
}

```

```

// Get a copy of the modified flag of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
bool GBLayerIsModified(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_modified;
}

// Set the modified flag of the GBLayer 'that' to 'flag'
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetModified(GBLayer* const that, const bool flag) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    that->_modified = flag;
}

// Get a copy of the isFlushed flag of the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
bool GBLayerIsFlushed(const GBLayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_isFlushed;
}

// Set the isFlushed flag of the GBLayer 'that' to 'flag'
#if BUILDMODE != 0
static inline
#endif
void GBLayerSetFlushed(GBLayer* const that, const bool flag) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    that->_isFlushed = flag;
}

// Get a copy of the stack position of the GBLayer 'that'

```

```

#if BUILDMODE != 0
static inline
#endif
GBlayerStackPosition GBlayerGetStackPos(const GBlayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_stackPos;
}

// Set the stack position of the GBlayer 'that' to 'pos'
// Set the flag _modified to true
#if BUILDMODE != 0
static inline
#endif
void GBlayerSetStackPos(GBlayer* const that,
    const GBlayerStackPosition pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    GBlayerSetModified(that, true);
    that->_stackPos = pos;
}

// Get the stacked pixels of the GBlayer 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBlayerPixels(const GBlayer* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_pix;
}

// Get the stacked pixels of the GBlayer 'that' at position 'pos'
// 'pos' must be inside the layer
#if BUILDMODE != 0
static inline
#endif
GSet* GBlayerPixel(const GBlayer* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
    }
#endif
}

```

```

        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
    if (!GBlayerIsPosInside(that, pos)) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is out of the layer (%d,%d)",
            VecGet(pos, 0), VecGet(pos, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    int iPix = GBPosIndex(pos, GBlayerDim(that));
    return that->_pix + iPix;
}

// Get the stacked pixels of the GBlayer 'that' at position 'pos'
// If 'pos' is out of the layer return NULL
#if BUILDMODE != 0
static inline
#endif
GSet* GBlayerPixelSafe(const GBlayer* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (!GBlayerIsPosInside(that, pos))
        return NULL;
    else
        return GBlayerPixel(that, pos);
}

// Add the pixel 'pix' with depth 'depth' on top of the stack at
// position 'pos' of GBlayer 'that'
// Set the flag _modified to true
// 'pos' must be inside the layer
// If the pixel is completely transparent (_rgba[GBPixelAlpha]==0)
// do nothing
#if BUILDMODE != 0
static inline
#endif
void GBlayerAddPixel(GBlayer* const that, const VecShort2D* const pos,
    const GBPixel* const pix, const float depth) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pix == NULL) {

```

```

        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pix' is null");
        PBErrCatch(GenBrushErr);
    }
    if (!GBLayerIsPosInside(that, pos)) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is out of the layer (%d,%d)",
            VecGet(pos, 0), VecGet(pos, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    // If the pixel is transparent
    if (pix->_rgba[GBPixelAlpha] == 0)
        // Do nothing
        return;
    int iPix = GBPosIndex(pos, GBLayerDim(that));
    GBStackedPixel* clone = PBErrMalloc(GenBrushErr,
        sizeof(GBStackedPixel));
    clone->_val = *pix;
    clone->_depth = depth;
    clone->_blendMode = GBLayerGetBlendMode(that);
    GSetAppend(that->_pix + iPix, clone);
}

// Add the pixel 'pix' with depth 'depth' on top of the stack at
// position 'pos' of GBLayer 'that'
// Set the flag _modified to true
// If 'pos' is out of the layer do nothing
// If the pixel is completely transparent (_rgba[GBPixelAlpha]==0)
// do nothing
#if BUILDMODE != 0
static inline
#endif
void GBLayerAddPixelSafe(GBLayer* const that,
    const VecShort2D* const pos, const GBPixel* const pix,
    const float depth) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pos == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pos' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pix == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pix' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    if (GBLayerIsPosInside(that, pos))
        GBLayerAddPixel(that, pos, pix, depth);
}

// Return true if the position 'pos' is inside the layer 'that'
// boundary, false else
#if BUILDMODE != 0
static inline
#endif

```

```

bool GBLayerIsPosInside(const GBLayer* const that,
    const VecShort2D* const pos) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pos == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pos' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    if (VecGet(pos, 0) >= 0 &&
        VecGet(pos, 1) >= 0 &&
        VecGet(pos, 0) < VecGet(GBLayerDim(that), 0) &&
        VecGet(pos, 1) < VecGet(GBLayerDim(that), 1))
        return true;
    else
        return false;
}

// Delete all the stacked pixels in the GBLayer 'that'
#if BUILDMODE != 0
static inline
#endif
void GBLayerFlush(GBLayer* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    if (GBLayerIsFlushed(that)) {
        for (int iPix = GBLayerArea(that); iPix--;) {
            GSet *stack = that->_pix + iPix;
            while (GSetNbElem(stack) > 0) {
                GBStackedPixel *pix = GSetPop(stack);
                free(pix);
            }
        }
    }
}

// ----- GBPostProcessing -----

// Return the type of the GBPostProcessing 'that'
#if BUILDMODE != 0
static inline
#endif
GBPPTType GBPostProcessingGetType(const GBPostProcessing* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    return that->_type;
}

```



```

// ----- GBSurface -----

// Return true if the GBSurface 'that' has same dimension and same
// values for _finalPix as GBSurface 'surf'
// Else, return false
#if BUILDMODE != 0
static inline
#endif
bool GBSurfaceIsSameAs(const GBSurface* const that,
    const GBSurface* const surf) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (surf == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'surf' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
// Display different pixels, for debugging purpose
// *VecShort2D p = VecShortCreateStatic2D();
do {
    GBPixel* pA = GBSurfaceFinalPixel(that, &p);
    GBPixel* pB = GBSurfaceFinalPixel(surf, &p);
    if (pA->_rgba[0] != pB->_rgba[0] ||
        pA->_rgba[1] != pB->_rgba[1] ||
        pA->_rgba[2] != pB->_rgba[2] ||
        pA->_rgba[3] != pB->_rgba[3]) {
        VecPrint(&p, stdout);
        printf(" %d,%d,%d,%d %d,%d,%d,%d\n",
            pA->_rgba[0], pA->_rgba[1], pA->_rgba[2], pA->_rgba[3],
            pB->_rgba[0], pB->_rgba[1], pB->_rgba[2], pB->_rgba[3]);
    }
} while (VecStep(&p, GBSurfaceDim(that)));*/

if (VecIsEqual(GBSurfaceDim(that), GBSurfaceDim(surf)) &&
    memcmp(GBSurfaceFinalPixels(that), GBSurfaceFinalPixels(surf),
        sizeof(GBPixel) * VecGet(GBSurfaceDim(that), 0) *
        VecGet(GBSurfaceDim(that), 1)) == 0)
    return true;
else
    return false;
}

// Get the type of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
GBSurfaceType GBSurfaceGetType(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return that->_type;
}

```

```

// Get a copy of the dimensions of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBSurfaceGetDim(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_dim;
}

// Get the dimensions of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D* GBSurfaceDim(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (VecShort2D*)&(that->_dim);
}

// Get the final pixels of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceFinalPixels(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_finalPix;
}

// Get the final pixel at position 'pos' of the GBSurface 'that'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceFinalPixel(const GBSurface* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
    }
#endif
}

```

```

        PBErCatch(GenBrushErr);
    }
    if (!GBSurfaceIsPosInside(that, pos)) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is out of the surface (%d,%d)",
            VecGet(pos, 0), VecGet(pos, 1));
        PBErCatch(GenBrushErr);
    }
}
#endif
int iPix = GBPosIndex(pos, GBSurfaceDim(that));
return that->_finalPix + iPix;
}

// Get a copy of the final pixel at position 'pos' of the GBSurface
// 'that'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
GBPixel GBSurfaceGetFinalPixel(const GBSurface* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErCatch(GenBrushErr);
    }
    if (!GBSurfaceIsPosInside(that, pos)) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is out of the surface (%d,%d)",
            VecGet(pos, 0), VecGet(pos, 1));
        PBErCatch(GenBrushErr);
    }
}
#endif
int iPix = GBPosIndex(pos, GBSurfaceDim(that));
return that->_finalPix[iPix];
}

// Set the final pixel at position 'pos' of the GBSurface 'that' to
// the pixel 'pix'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetFinalPixel(GBSurface* const that,
    const VecShort2D* const pos, const GBPixel* const pix) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErCatch(GenBrushErr);
    }
}

```

```

    if (!GBSurfaceIsPosInside(that, pos)) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is out of the surface (%d,%d)",
            VecGet(pos, 0), VecGet(pos, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    int iPix = GBPosIndex(pos, GBSurfaceDim(that));
    that->_finalPix[iPix] = *pix;
}

// Get the final pixel at position 'pos' of the GBSurface 'that'
// If 'pos' is out of the surface return NULL
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceFinalPixelSafe(const GBSurface* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBSurfaceIsPosInside(that, pos))
        return GBSurfaceFinalPixel(that, pos);
    else
        return NULL;
}

// Get a copy of the final pixel at position 'pos' of the GBSurface
// 'that'
// If 'pos' is out of the surface return a transparent pixel
#if BUILDMODE != 0
static inline
#endif
GBPixel GBSurfaceGetFinalPixelSafe(const GBSurface* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBSurfaceIsPosInside(that, pos))
        return GBSurfaceGetFinalPixel(that, pos);
    else
        return GBColorTransparent;
}

```

```

// Set the final pixel at position 'pos' of the GBSurface 'that' to
// the pixel 'pix'
// If 'pos' is out of the surface do nothing
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetFinalPixelSafe(GBSurface* const that,
    const VecShort2D* const pos, const GBPixel* const pix) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pix == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pix' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBSurfaceIsPosInside(that, pos))
        GBSurfaceSetFinalPixel(that, pos, pix);
}

// Get the area of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
long GBSurfaceArea(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return VecGet(&(that->_dim), 0) * VecGet(&(that->_dim), 1);
}

// Get the background color of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBSurfaceBgColor(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (GBPixel*)&(that->_bgColor);
}

// Get a copy of the background color of the GBSurface 'that'
#if BUILDMODE != 0
static inline

```

```

#endif
GBPixel GBSurfaceGetBgColor(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_bgColor;
}

// Set the background color of the GBSurface 'that' to 'col'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetBgColor(GBSurface* const that,
    const GBPixel* const col) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (col == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'col' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    that->_bgColor = *col;
}

// Return true if the position 'pos' is inside the GBSurface 'that'
// boundary, false else
#if BUILDMODE != 0
static inline
#endif
bool GBSurfaceIsPosInside(const GBSurface* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (VecGet(pos, 0) >= 0 &&
        VecGet(pos, 1) >= 0 &&
        VecGet(pos, 0) < VecGet(GBSurfaceDim(that), 0) &&
        VecGet(pos, 1) < VecGet(GBSurfaceDim(that), 1))
        return true;
    else
        return false;
}

// Get the seet of layers of the GBSurface 'that'

```

```

#if BUILDMODE != 0
static inline
#endif
GSet* GBSurfaceLayers(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (GSet*)&(that->_layers);
}

// Add a new GBLayer with dimensions 'dim' to the top of the stack
// of layers of the GBSurface 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBSurfaceAddLayer(GBSurface* const that,
    const VecShort2D* const dim) {
#if BUILDMODE == 0
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    // Create the layer
    GBLayer* layer = GBLayerCreate(dim);
    // Add the new layer to the set of layers
    GSetAppend(&(that->_layers), layer);
    // Return the new layer
    return layer;
}

// 'fileName' to the top of the stack of layers of the GBSurface
// 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBSurfaceAddLayerFromFile(GBSurface* const that,
    const char* const fileName) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (fileName == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'fileName' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
}

```

```

#endif
    // Create the layer from the file
    GBLayer* layer = GBLayerCreateFromFile(fileName);
    // If we could create the layer
    if (layer != NULL)
        // Add the layer to the surface
        GSetAppend(&(that->_layers), layer);
    // Return the new layer
    return layer;
}

// Get the 'iLayer'-th layer of the GBSurface 'that'
// 'iLayer' must be valid
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBSurfaceLayer(const GBSurface* const that, const int iLayer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (iLayer < 0 || iLayer >= GSetNbElem(&(that->_layers))) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'iLayer' is invalid (0<=%d<=%ld)",
            iLayer, GSetNbElem(&(that->_layers)));
        PBErrCatch(GenBrushErr);
    }
}
#endif
return (GBLayer*)GSetGet(&(that->_layers), iLayer);
}

// Get the number of layer of the GBSurface 'that'
#if BUILDMODE != 0
static inline
#endif
int GBSurfaceNbLayer(const GBSurface* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
}
#endif
return GSetNbElem(&(that->_layers));
}

// Set the _modified flag of all layers of the GBSurface 'that'
// to 'flag'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetLayersModified(GBSurface* const that, const bool flag) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
}
#endif
// If there are layers

```



```

    if (GBSurfaceNbLayer(that) > 0) {
        // Declare an iterator on the set of layers
        GSetIterForward iter =
            GSetIterForwardCreateStatic(GBSurfaceLayers(that));
        do {
            GBLayer* layer = GSetIterGet(&iter);
            GBLayerSetModified(layer, flag);
        } while (GSetIterStep(&iter));
    }
}

// Set the stack position of the GBLayer 'layer' into the set of
// layers of the GBSurface 'that' to 'pos'
// If 'layer' can't be found in the surface do nothing
// 'pos' must be valid (0<='pos'<nbLayers)
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetLayerStackPos(GBSurface* const that,
    GBLayer* const layer, const int pos) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (layer == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'layer' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pos < 0 || pos >= GSetNbElem(&(that->_layers))) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'pos' is invalid (0<=%d<%ld)",
                pos, GSetNbElem(&(that->_layers)));
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Get the current index of the layer to move
    int curPos = GSetGetIndexFirst(&(that->_layers), layer);
    // If we could find the layer
    if (curPos != -1) {
        // Move the layer
        GSetMoveElem(&(that->_layers), curPos, pos);
        // Set the _modified flag
        GBLayerSetModified(layer, true);
    }
}

// Remove the GBLayer 'layer' from the set of layers of the
// GBSurface 'that'
// The memory used by 'layer' is freed
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceRemoveLayer(GBSurface* const that, GBLayer* layer) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
}

```

```

    if (layer == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'layer' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Remove the layer from the set
    GSetRemoveAll(&(that->_layers), layer);
    // Free the memory
    GBLayerFree(&layer);
}

// ----- GBSurfaceImage -----

// Get the filename of the GBSurfaceImage 'that'
#if BUILDMODE != 0
static inline
#endif
char* GBSurfaceImageFileName(const GBSurfaceImage* const that) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    return that->_fileName;
}

// Set the filename of the GBSurfaceImage 'that' to 'fileName'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceImageSetFileName(GBSurfaceImage* const that,
    const char* const fileName) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // If the filename is already allocated, free memory
    if (that->_fileName != NULL) {
        free(that->_fileName);
    }
    // If the new filename is not null
    if (fileName != NULL) {
        // Allocate memory and copy the new filename
        that->_fileName = PBErrMalloc(GenBrushErr,
            sizeof(char) * (strlen(fileName) + 1));
        strcpy(that->_fileName, fileName);
    }
}

// ----- GBEye -----

// Return the type of the GBEye 'that'
#if BUILDMODE != 0
static inline
#endif
GBEyeType _GBEyeGetType(const GBEye* const that) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return that->_type;
}

// Get the scale of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat3D* _GBEyeScale(const GBEye* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return (VecFloat3D*)&(that->_scale);
}

// Get a copy of the scale of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat3D _GBEyeGetScale(const GBEye* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return that->_scale;
}

// Get the translation of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat2D* _GBEyeOrig(const GBEye* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return (VecFloat2D*)&(that->_orig);
}

// Get a copy of the translation of the GBEye
#if BUILDMODE != 0
static inline
#endif
VecFloat2D _GBEyeGetOrig(const GBEye* const that) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_orig;
}

// Get the rotation of the GBEye (in radians)
#if BUILDMODE != 0
static inline
#endif
float _GBEyeGetRot(const GBEye* const that) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    return that->_theta;
}

// Set the scale of the GBEye
#if BUILDMODE != 0
static inline
#endif
void GBEyeSetScaleVec(GBEye* const that, const VecFloat3D* const scale) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (scale == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'scale' is null");
            PBErrCatch(GenBrushErr);
        }
        if (ISEQUALF(VecGet(scale, 0), 0.0) == true ||
            ISEQUALF(VecGet(scale, 1), 0.0) == true) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'scale' is invalid (%f!=0 && %f!=0)",
                VecGet(scale, 0), VecGet(scale, 1));
            PBErrCatch(GenBrushErr);
        }
    #endif
    VecCopy(&(that->_scale), scale);
    // Update the projection matrix
    GBEyeUpdateProj(that);
}

#if BUILDMODE != 0
static inline
#endif
void GBEyeSetScaleFloat(GBEye* const that, const float scale) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
        }
    #endif
}

```

```

        PBErCatch(GenBrushErr);
    }
    if (ISEQUALF(scale, 0.0) == true) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'scale' is invalid (%f!=0)", scale);
        PBErCatch(GenBrushErr);
    }
#endif
    for (int i = 3; i--;)
        VecSet(&(that->_scale), i, scale);
    // Update the projection matrix
    GBEyeUpdateProj(that);
}

// Set the origin of the GBEye
#if BUILDMODE != 0
static inline
#endif
void _GBEyeSetOrig(GBEye* const that, const VecFloat2D* const orig) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
    if (orig == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'orig' is null");
        PBErCatch(GenBrushErr);
    }
#endif
    that->_orig = *orig;
    // Update the projection matrix
    GBEyeUpdateProj(that);
}

// Set the rotation of the GBEye (in radians)
#if BUILDMODE != 0
static inline
#endif
void _GBEyeSetRot(GBEye* const that, const float theta) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
#endif
    that->_theta = theta;
    // Update the projection matrix
    GBEyeUpdateProj(that);
}

// Get the matrix projection of the eye
#if BUILDMODE != 0
static inline
#endif
MatFloat* _GBEyeProj(const GBEye* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeNullPointer;

```

```

        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_proj;
}

// Call the appropriate GBEye<>Process according to the type of the
// GBEye 'that'
#if BUILDMODE != 0
static inline
#endif
void _GBEyeProcess(const GBEye* const that, GBObjPod* const pod) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pod == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pod' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Call the appropriate function according to the type of eye
    switch (that->_type) {
        case GBEyeTypeOrtho:
            GBEyeOrthoProcess((GBEyeOrtho*)that, pod);
            break;
        case GBEyeTypeIsometric:
            GBEyeIsometricProcess((GBEyeIsometric*)that, pod);
            break;
        default:
            switch (GBObjPodGetType(pod)) {
                case GBObjTypePoint:
                    GBObjPodSetEyePoint(pod,
                        VecClone(GBObjPodGetObjAsPoint(pod)));
                    break;
                case GBObjTypeSCurve:
                    GBObjPodSetEyeSCurve(pod,
                        SCurveClone(GBObjPodGetObjAsSCurve(pod)));
                    break;
                case GBObjTypeShapoid:
                    GBObjPodSetEyeShapoid(pod,
                        ShapoidClone(GBObjPodGetObjAsShapoid(pod)));
                    break;
                default:
                    break;
            }
            break;
    }
}

// ----- GBEyeOrtho -----

// Set the orientation the GBEyeOrtho
#if BUILDMODE != 0
static inline
#endif
void GBEyeOrthoSetView(GBEyeOrtho* const that,
    const GBEyeOrthoView view) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    that->_view = view;
    // Update the projection matrix
    GBEyeUpdateProj((GBEye*)that);
}

// ----- GBEyeIsometric -----

// Set the angle around Y of the GBEyeOrtho to 'theta' (in radians)
#if BUILDMODE != 0
static inline
#endif
void GBEyeIsometricSetRotY(GBEyeIsometric* const that,
    const float theta) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    that->_thetaY = theta;
    GBEyeUpdateProj((GBEye*)that);
}

// Set the angle around Right of the GBEyeOrtho to 'theta'
// (in radians, in [-pi/2, pi/2])
// If 'theta' is out of range it is automatically bounded
// (ex: pi -> pi/2)
#if BUILDMODE != 0
static inline
#endif
void GBEyeIsometricSetRotRight(GBEyeIsometric* const that,
    const float theta) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Ensure 'theta' is in bounds
    float safeTheta = theta;
    if (safeTheta > PBMath_HALFPI)
        safeTheta = PBMath_HALFPI;
    else if (safeTheta < -PBMath_HALFPI)
        safeTheta = -PBMath_HALFPI;
    that->_thetaRight = safeTheta;
    GBEyeUpdateProj((GBEye*)that);
}

// Get the angle around Y of the GBEyeOrtho 'that'
#if BUILDMODE != 0
static inline
#endif
float GBEyeIsometricGetRotY(const GBEyeIsometric* const that) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_thetaY;
}

// Get the angle around Right of the GBEyeOrtho 'that'
#if BUILDMODE != 0
static inline
#endif
float GBEyeIsometricGetRotRight(const GBEyeIsometric* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_thetaRight;
}

// ----- GBHand -----

// Return the type of the GBHand 'that'
#if BUILDMODE != 0
static inline
#endif
GBHandType _GBHandGetType(const GBHand* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_type;
}

// Call the appropriate GBHand<>Process according to the type of the
// GBHand 'that'
#if BUILDMODE != 0
static inline
#endif
void _GBHandProcess(const GBHand* const that, GBObjPod* const pod) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // If 'pod' has no viewed object do nothing
    if (GBObjPodEyeObj(pod) == NULL)
        return;
    // Call the appropriate function depending on the type of hand
    switch (that->_type) {
        case GBHandTypeDefault:
            GBHandDefaultProcess((GBHandDefault*)that, pod);

```



```

        break;
    default:
        break;
    }
}

// ----- GBTool -----

// Return a copy of the type of the GBTool 'that'
#if BUILDMODE != 0
static inline
#endif
GBToolType GBToolGetType(const GBTool* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_type;
}

// ----- GBInkSolid -----

// Return the type of the GBInk 'that'
#if BUILDMODE != 0
static inline
#endif
GBInkType _GBInkGetType(const GBInk* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_type;
}

// ----- GInkSolid -----

// Get the color of the GBInkSolid 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel GBInkSolidGet(const GBInkSolid* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_color;
}

// Set the color of the GBInkSolid 'that' to 'col'
#if BUILDMODE != 0
static inline
#endif
void GBInkSolidSet(GBInkSolid* const that, const GBPixel* const col) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
    if (col == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'col' is null");
        PErrCatch(GenBrushErr);
    }
}
#endif
that->_color = *col;
}

// ----- GBTool -----

// Function to call the appropriate GBTool<>Draw function according to
// type of GBTool 'that'
#if BUILDMODE != 0
static inline
#endif
void _GBToolDraw(const GBTool* const that, GBObjPod* const pod) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
    if (pod == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pod' is null");
        PErrCatch(GenBrushErr);
    }
}
#endif
switch (GBToolGetType(that)) {
    case GBToolTypePlotter:
        GBToolPlotterDraw((GBToolPlotter*)that, pod);
        break;
    case GBToolTypePen:
        GBToolPenDraw((GBToolPen*)that, pod);
        break;
    default:
        break;
}
}

// ----- GBToolPen -----

// Function to get the shape of GBToolPen 'that'
#if BUILDMODE != 0
static inline
#endif
Shapoid* GBToolPenShape(const GBToolPen* that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
}
#endif
return that->_shape;
}

```

```

}

// Function to set the shape of GBToolPen 'that' to a clone of 'shape'
#if BUILDMODE != 0
static inline
#endif
void GBToolPenSetShape(GBToolPen* that, const Shapoid* shape) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    ShapoidFree(&(that->_shape));
    that->_shape = ShapoidClone(shape);
}

// Function to get the softness of GBToolPen 'that'
#if BUILDMODE != 0
static inline
#endif
float GBToolPenGetSoftness(const GBToolPen* that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_softness;
}

// Function to set the softness of GBToolPen 'that' to 'softness'
// 'softness' > 0.0, the bigger the softener the pen is
#if BUILDMODE != 0
static inline
#endif
void GBToolPenSetSoftness(GBToolPen* that, float softness) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (softness <= PBMath_EPSILON) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'softness' is invalid (%f>0.0)", softness);
        PBErrCatch(GenBrushErr);
    }
#endif
    that->_softness = softness;
}

// ----- GBObjPod -----

// Process the object in the GBObjPod 'that' to update the resulting
// object when some components of the pod have changed
#if BUILDMODE != 0
static inline
#endif
void GBObjPodProcess(GBObjPod* const that) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    GBEyeProcess(GBObjPodEye(that), that);
    GBHandProcess(GBObjPodHand(that), that);
}

// Return the type of the object in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBObjType GBObjPodGetType(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    return that->_type;
}

// Return the object in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
void* GBObjPodObj(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    return that->_srcPoint;
}

// Return the object viewed by its attached eye in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
void* GBObjPodEyeObj(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    return that->_eyePoint;
}

// Return the object processed as Points by its attached hand in the
// GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GSetVecFloat* GBObjPodGetHandObjAsPoints(const GBObjPod* const that) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return (GSetVecFloat*)&(that->_handPoints);
}

// Return the object processed as Shapoids by its attached hand in the
// GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GSetShapoid* GBObjPodGetHandObjAsShapoids(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return (GSetShapoid*)&(that->_handShapoids);
}

// Return the object processed as SCurves by its attached hand in the
// GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GSetSCurve* GBObjPodGetHandObjAsSCurves(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return (GSetSCurve*)&(that->_handSCurves);
}

// Return the eye in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBEye* GBObjPodEye(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
return that->_eye;
}

// Return the hand in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBHand* GBObjPodHand(const GBObjPod* const that) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    return that->_hand;
}

// Return the tool in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBTool* GBObjPodTool(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    return that->_tool;
}

// Return the ink in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBInk* GBObjPodInk(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    return that->_ink;
}

// Return the layer in the GBObjPod 'that'
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBObjPodLayer(const GBObjPod* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PErrCatch(GenBrushErr);
    }
#endif
    return that->_layer;
}

// Set the Point viewed by its attached eye in the GBObjPod 'that'
// to 'point'
// If 'point' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEyePoint(GBObjPod* const that, VecFloat* const point) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (point != NULL) {
        if (that->_eyePoint != NULL)
            VecFree(&(that->_eyePoint));
        that->_eyePoint = point;
    }
}

// Set the Shapoid viewed by its attached eye in the GBObjPod 'that'
// to 'shap'
// If 'shap' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEyeShapoid(GBObjPod* const that, Shapoid* const shap) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (shap != NULL) {
        if (that->_eyeShapoid != NULL)
            ShapoidFree(&(that->_eyeShapoid));
        that->_eyeShapoid = shap;
    }
}

// Set the SCurve viewed by its attached eye in the GBObjPod 'that'
// to 'curve'
// If 'curve' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEyeSCurve(GBObjPod* const that, SCurve* const curve) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (curve != NULL) {
        if (that->_eyeSCurve != NULL)
            SCurveFree(&(that->_eyeSCurve));
        that->_eyeSCurve = curve;
    }
}

// Set the eye in the GBObjPod 'that' to 'eye'
// If 'eye' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetEye(GBObjPod* const that, GBEye* const eye) {

```

```

#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (eye != NULL)
        that->_eye = eye;
}

// Set the hand in the GBObjPod 'that' to 'hand'
// If 'hand' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetHand(GBObjPod* const that, GBHand* const hand) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (hand != NULL)
        that->_hand = hand;
}

// Set the tool in the GBObjPod 'that' to 'tool'
// If 'tool' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetTool(GBObjPod* const that, GBTool* const tool) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (tool != NULL)
        that->_tool = tool;
}

// Set the ink in the GBObjPod 'that' to 'ink'
// If 'ink' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void _GBObjPodSetInk(GBObjPod* const that, GBInk* const ink) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (ink != NULL)
        that->_ink = ink;
}

```



```

// Set the layer in the GBObjPod 'that' to 'layer'
// If 'layer' is null do nothing
#if BUILDMODE != 0
static inline
#endif
void GBObjPodSetLayer(GBObjPod* const that, GBLayer* const layer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (layer != NULL)
        that->_layer = layer;
}

// ----- GenBrush -----

// Get the GBSurface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBSurface* GBSurf(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_surf;
}

// Get the set of pods of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBPods(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return (GSet*)&(that->_pods);
}

// Get a copy of the dimensions of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
VecShort2D GBGetDim(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return GBSurfaceGetDim(that->_surf);
}

```

```

}

// Get the final pixels of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBFinalPixels(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return GBSurfaceFinalPixels(that->_surf);
}

// Get the final pixel at position 'pos' of the GBSurface of the GB
// 'that'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBFinalPixel(const GenBrush* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
    if (!GBIsPosInside(that, pos)) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is out of the surface (%d,%d)",
            VecGet(pos, 0), VecGet(pos, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    return GBSurfaceFinalPixel(GBSurf(that), pos);
}

// Get a copy of the final pixel at position 'pos' of the GBSurface
// of the GB 'that'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
GBPixel GBGetFinalPixel(const GenBrush* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
    }
#endif
}

```

```

        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
    if (!GBIsPosInside(that, pos)) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is out of the surface (%d,%d)",
            VecGet(pos, 0), VecGet(pos, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
    return GBSurfaceGetFinalPixel(GBSurf(that), pos);
}

// Set the final pixel at position 'pos' of the GBSurface of the GB
// 'that' to the pixel 'pix'
// 'pos' must be in the surface
#if BUILDMODE != 0
static inline
#endif
void GBSetFinalPixel(GenBrush* const that, const VecShort2D* const pos,
    const GBPixel* const pix) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pos == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pos' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pix == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'pix' is null");
            PBErrCatch(GenBrushErr);
        }
        if (!GBIsPosInside(that, pos)) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'pos' is out of the surface (%d,%d)",
                VecGet(pos, 0), VecGet(pos, 1));
            PBErrCatch(GenBrushErr);
        }
    #endif
    GBSurfaceSetFinalPixel(GBSurf(that), pos, pix);
}

// Get the final pixel at position 'pos' of the GBSurface of the GB
// 'that'
// If 'pos' is out of the surface return NULL
#if BUILDMODE != 0
static inline
#endif
GBPixel* GBFinalPixelSafe(const GenBrush* const that,
    const VecShort2D* const pos) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pos == NULL) {

```

```

        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBIsPosInside(that, pos))
        return GBSurfaceFinalPixel(GBSurf(that), pos);
    else
        return NULL;
}

// Get a copy of the final pixel at position 'pos' of the GBSurface
// of the GB 'that'
// If 'pos' is out of the surface return a transparent pixel
#if BUILDMODE != 0
static inline
#endif
GBPixel GBGetFinalPixelSafe(const GenBrush* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBIsPosInside(that, pos))
        return GBSurfaceGetFinalPixel(GBSurf(that), pos);
    else
        return GBColorTransparent;
}

// Set the final pixel at position 'pos' of the GBSurface of the GB
// 'that' to the pixel 'pix'
// If 'pos' is out of the surface do nothing
#if BUILDMODE != 0
static inline
#endif
void GBSetFinalPixelSafe(GenBrush* const that,
    const VecShort2D* const pos, const GBPixel* const pix) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pix == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pix' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
}

```

```

        if (GBIsPosInside(that, pos))
            GBSurfaceSetFinalPixel(GBSurf(that), pos, pix);
    }

    // Get the type of the GBSurface of the GenBrush 'that'
    #if BUILDMODE != 0
    static inline
    #endif
    GBSurfaceType GBGetType(const GenBrush* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
        return GBSurfaceGetType(that->_surf);
    }

    // Get the background color of the GBSurface of the GenBrush 'that'
    #if BUILDMODE != 0
    static inline
    #endif
    GBCol* GBBgColor(const GenBrush* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
        return GBSurfaceBgColor(GBSurf(that));
    }

    // Get a copy of the background color of the GBSurface of the
    // GenBrush 'that'
    #if BUILDMODE != 0
    static inline
    #endif
    GBCol* GBGetBgColor(const GenBrush* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
        return GBSurfaceGetBgColor(GBSurf(that));
    }

    // Set the background color of the GBSurface of the GenBrush
    // 'that' to 'col'
    #if BUILDMODE != 0
    static inline
    #endif
    void GBSetBgColor(GenBrush* const that, const GBCol* const col) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    }

```

```

    if (col == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'col' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    GBSurfaceSetBgColor(GBSurf(that), col);
}

// Get the filename of the GBSurfaceImage of the GenBrush 'that'
// Return NULL if the surface is not a GBSurfaceImage
#if BUILDMODE != 0
static inline
#endif
char* GBFileName(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBGetType(that) == GBSurfaceTypeImage)
        return GBSurfaceImageFileName((GBSurfaceImage*)GBSurf(that));
    else
        return NULL;
}

// Set the filename of the GBSurfaceImage of the GenBrush 'that'
// to 'fileName'
// Do nothing if the surface is not a GBSurfaceImage
#if BUILDMODE != 0
static inline
#endif
void GBSetFileName(GenBrush* const that, const char* const fileName) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBGetType(that) == GBSurfaceTypeImage)
        GBSurfaceImageSetFileName((GBSurfaceImage*)GBSurf(that), fileName);
}

// Get the area of the GBSurface of the Genbrush 'that'
#if BUILDMODE != 0
static inline
#endif
long GBArea(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return GBSurfaceArea(GBSurf(that));
}

// Return true if the position 'pos' is inside the GBSurface of the

```

```

// GenBrush 'that'
// boundary, false else
#if BUILDMODE != 0
static inline
#endif
bool GBIsPosInside(const GenBrush* const that,
    const VecShort2D* const pos) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return GBSurfaceIsPosInside(GBSurf(that), pos);
}

// Return the layers of the surface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBLayers(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return GBSurfaceLayers(GBSurf(that));
}

// Add a new GBLayer with dimensions 'dim' to the top of the stack
// of layers of the GBSurface of the GenBrush 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBAddLayer(GenBrush* const that, const VecShort2D* const dim) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (VecGet(dim, 0) <= 0 || VecGet(dim, 1) <= 0) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'dim' is invalid (%d>0,%d>0)",
            VecGet(dim, 0), VecGet(dim, 1));
        PBErrCatch(GenBrushErr);
    }
#endif
}

```

```

    return GBSurfaceAddLayer(GBSurf(that), dim);
}

// Add a new GBLayer with content equals to the image located at
// 'fileName' to the top of the stack
// of layers of the GBSurface of the GenBrush 'that'
// Return the new GBLayer
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBAddLayerFromFile(GenBrush* const that,
    const char* const fileName) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (fileName == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'fileName' is null");
            PBErrCatch(GenBrushErr);
        }
    }
    return GBSurfaceAddLayerFromFile(GBSurf(that), fileName);
}

// Get the 'iLayer'-th layer of the GBSurface of the GenBrush 'that'
// 'iLayer' must be valid
#if BUILDMODE != 0
static inline
#endif
GBLayer* GBLay(const GenBrush* const that, const int iLayer) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (iLayer < 0 ||
            iLayer >= GSetNbElem(GBSurfaceLayers(GBSurf(that)))) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'iLayer' is invalid (0<=%d<%ld)",
                iLayer, GSetNbElem(GBSurfaceLayers(GBSurf(that))));
            PBErrCatch(GenBrushErr);
        }
    }
    return GBSurfaceLayer(GBSurf(that), iLayer);
}

// Get the number of layer of the GBSurface of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
int GBGetNbLayer(const GenBrush* const that) {
    if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    }
}
#endif

```



```

    return GBSurfaceNbLayer(GBSurf(that));
}

// Set the stack position of the GBLayer 'layer' into the set of
// layers of the GBSurface of the GenBrush 'that' to 'pos'
// If 'layer' can't be found in the surface do nothing
// 'pos' must be valid (0<='pos'<nbLayers)
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceSetLayerStackPos(GBSurf(that), GBLayer* const layer,
    const int pos) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (layer == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'layer' is null");
            PBErrCatch(GenBrushErr);
        }
        if (pos < 0 || pos >= GBSurfaceNbLayer(that)) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'pos' is invalid (0<=%d<=%d)",
                pos, GBSurfaceNbLayer(that));
            PBErrCatch(GenBrushErr);
        }
    #endif
    GBSurfaceSetLayerStackPos(GBSurf(that), layer, pos);
}

// Remove the GBLayer 'layer' from the set of layers of the
// GBSurface of the GenBrush 'that'
// The memory used by 'layer' is freed
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceRemoveLayer(GenBrush* const that, GBLayer* layer) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (layer == NULL) {
            GenBrushErr->_type = PBErrTypeInvalidArg;
            sprintf(GenBrushErr->_msg, "'layer' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Remove the graphical elements bounded to this layer
    GBSurfaceRemovePod(that, NULL, NULL, NULL, NULL, NULL, layer);
    // Remove the layer from the surface
    GBSurfaceRemoveLayer(GBSurf(that), layer);
}

// Get the number of pod in the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif

```

```

int GBGetNbPod(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return GSetNbElem(&(that->_pods));
}

// Add a GBObjPod for the Point at position 'pos' to the GenBrush 'that'
// drawn with 'eye', 'hand' and 'tool' in layer 'layer'
// 'pos' must be a vector of 2 or more dimensions
// Return the GBObjPod
#if BUILDMODE != 0
static inline
#endif
GBObjPod* _GBAddPoint(GenBrush* const that, VecFloat* const pos,
    GBEye* const eye, GBHand* const hand, GBTool* const tool,
    GBInk* const ink, GBLayer* const layer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (pos == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'pos' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    GBObjPod* pod = GBObjPodCreatePoint(pos, eye, hand, tool, ink, layer);
    GSetAppend(GBPods(that), pod);
    return pod;
}

// Add a GBObjPod for the Shapoid 'shap' to the GenBrush 'that'
// drawn with 'eye', 'hand' and 'tool' in layer 'layer'
// 'shap' 's dimension must be 2 or more
// Return the GBObjPod
#if BUILDMODE != 0
static inline
#endif
GBObjPod* _GBAddShapoid(GenBrush* const that, Shapoid* const shap,
    GBEye* const eye, GBHand* const hand, GBTool* const tool,
    GBInk* const ink, GBLayer* const layer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (shap == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'shap' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    GBObjPod* pod = GBObjPodCreateShapoid(shap, eye, hand, tool, ink, layer);
    GSetAppend(&(that->_pods), pod);
}

```

```

    return pod;
}

// Add a GBObjPod for the SCurve 'curve' to the GenBrush 'that'
// drawn with 'eye', 'hand' and 'tool' in layer 'layer'
// 'curve' 's dimension must be 2 or more
// Return the GBObjPod
#if BUILDMODE != 0
static inline
#endif
GBObjPod* _GBAddSCurve(GenBrush* const that, SCurve* const curve,
    GBEye* const eye, GBHand* const hand, GBTool* const tool,
    GBInk* const ink, GBLayer* const layer) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (curve == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'curve' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    GBObjPod* pod = GBObjPodCreateSCurve(curve, eye, hand, tool, ink, layer);
    GSetAppend(&(that->_pods), pod);
    return pod;
}

// Reset all the final pix of the surface of the GenBrush 'that' to its
// background color, and reset all the modified flag of layers to true
#if BUILDMODE != 0
static inline
#endif
void GBFlush(GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    GBSurfaceFlush(GBSurf(that));
}

// Return true if the surface of the GenBrush 'that' is same as the
// surface of the GenBrush 'gb'
// Else, return false
#if BUILDMODE != 0
static inline
#endif
bool GBIsSameAs(const GenBrush* const that, const GenBrush* const gb) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (gb == NULL) {
        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'gb' is null");
    }
#endif
}

```

```

        PBErCatch(GenBrushErr);
    }
#endif
    return GBSurfaceIsSameAs(GBSurf(that), GBSurf(gb));
}

// Add a GPostProcessing of type 'type' to the GenBrush 'that'
// Return the GPostProcessing
#if BUILDMODE != 0
static inline
#endif
GPostProcessing* GAddPostProcess(GenBrush* const that,
    const GBPPType type) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
#endif
    GPostProcessing* post = GPostProcessingCreate(type);
    GSetAppend(&(that->_postProcs), post);
    return post;
}

// Remove the GPostProcessing 'post' from the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
void GRemovePostProcess(GenBrush* const that,
    const GPostProcessing* const post) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
#endif
    if (GBGetNbPostProcs(that) > 0) {
        GSetIterForward iter =
            GSetIterForwardCreateStatic(GPostProcs(that));
        bool flag = true;
        do {
            GPostProcessing* p = GSetIterGet(&iter);
            if (post == p) {
                GPostProcessingFree(&p);
                GSetIterRemoveElem(&iter);
            }
        } while (flag == true && GSetIterStep(&iter));
    }
    GSetRemoveFirst(&(that->_postProcs), post);
}

// Remove all the GPostProcessing from the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
void GRemoveAllPostProcess(GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
    }
#endif
}

```

```

        PBErCatch(GenBrushErr);
    }
#endif
    while (GBGetNbPostProcs(that) > 0) {
        GBPostProcessing* post = GSetPop(&(that->_postProcs));
        GBPostProcessingFree(&post);
    }
}

// Get the 'iPost'-th post process of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GBPostProcessing* GBPostProcess(const GenBrush* const that,
    const int iPost) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
#endif
    return GSetGet(&(that->_postProcs), iPost);
}

// Get the GSet of GBPostProcessing of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
GSet* GBPostProcs(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
#endif
    return (GSet*)&(that->_postProcs);
}

// Get the number of GBPostProcessing of the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
int GBGetNbPostProcs(const GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErCatch(GenBrushErr);
    }
#endif
    return GSetNbElem(&(that->_postProcs));
}

// Remove all the GBObjPods from the GenBrush 'that'
#if BUILDMODE != 0
static inline
#endif
void GBRemoveAllPod(GenBrush* const that) {
#if BUILDMODE == 0
    if (that == NULL) {

```

```

        GenBrushErr->_type = PBErrTypeInvalidArg;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    while (GBGetNbPod(that) > 0) {
        GBObjPod* pod = GSetPop(&(that->_pods));
        GBObjPodFree(&pod);
    }
}

// ===== GTK Functions =====

#if BUILDWITHGRAPHICLIB == 1
#include "genbrush-inline-GTK.c"
#endif

```

### 3.3 genbrush-GTK.c

```

// ===== GENBRUSH-GTK.C =====

// ===== Functions declaration =====

// Callback for the 'activate' event on a GBSurfaceApp
void GBSurfaceAppCallbackActivate(GtkApplication* app,
    gpointer data);

// Callback for the 'draw' event on a GBSurfaceApp
gboolean GBSurfaceAppCallbackDraw(GtkWidget *widget, cairo_t *cr,
    gpointer data);

// Callback for the 'config' event on a GBSurfaceApp
gboolean GBSurfaceAppCallbackConfigEvt (GtkWidget *widget,
    GdkEventConfigure *event, gpointer data);

// Callback for the 'draw' event on a GBSurfaceWidget
gboolean GBSurfaceWidgetCallbackDraw(GtkWidget *widget, cairo_t *cr,
    gpointer data);

// Callback for the 'config' event on a GBSurfaceWidget
gboolean GBSurfaceWidgetCallbackConfigEvt(GtkWidget *widget,
    GdkEventConfigure *event, gpointer data);

// ===== Functions implementation =====

// Callback for the 'draw' event on a GBSurfaceApp
gboolean GBSurfaceAppCallbackDraw(GtkWidget *widget, cairo_t *cr,
    gpointer data) {
    (void)widget;
    // Declare a variable to convert the data into the GBSurfaceApp
    GBSurfaceApp* GBApp = (GBSurfaceApp*)data;
    // Paint the final pixels of the GBSurface on the Cairo surface
    // The data in GenBrush are flipped horizontally relatively to
    // the Cairo coordinates system. Thus we need to flip them
    // horizontally.

    // Terrible patch. The code below should do the flipping but
    // instead it splits only half of the surface (???). Can't find
    // the problem, then give up and create a flipped copy of the data

```

```

// and us it instead.
//cairo_scale(cr, 1.0, -1.0);
//cairo_translate(cr, 0, -1 * gtk_widget_get_allocated_height(GBApp->_drawingArea));
//cairo_set_source_surface(cr, GBApp->_cairoSurf, 0, 0);

const VecShort2D* const dim = GBSurfaceDim(&(GBApp->_surf));
unsigned char* origData =
    (unsigned char*)GBSurfaceFinalPixels(&(GBApp->_surf));
for (int iLine = 0; iLine < VecGet(dim, 1); ++iLine) {
    memcpy(GBApp->_flippedData +
        (VecGet(dim, 1) - iLine - 1) * VecGet(dim, 0) * 4,
        origData + iLine * VecGet(dim, 0) * 4,
        sizeof(unsigned char) * VecGet(dim, 0) * 4);
}
cairo_set_source_surface(cr, GBApp->_cairoSurf, 0, 0);

cairo_paint(cr);
return FALSE;
}

// Callback for the 'config' event on a GBSurfaceApp
gboolean GBSurfaceAppCallbackConfigEvt(GtkWidget *widget,
    GdkEventConfigure *event, gpointer data) {
    (void)event;
    // Declare a variable to convert the data into the GBSurfaceApp
    GBSurfaceApp* GBApp = (GBSurfaceApp*)data;
    // Attach the GPixel to the cairo surface
    GBApp->_cairoSurf = cairo_image_surface_create_for_data(
        //(unsigned char* )GBSurfaceFinalPixels(&(GBWidget->_surf)),

        // cf GBSurfaceAppCallbackDraw
        GBApp->_flippedData,

        CAIRO_FORMAT_ARGB32,
        gtk_widget_get_allocated_width(widget),
        gtk_widget_get_allocated_height(widget),
        cairo_format_stride_for_width(CAIRO_FORMAT_ARGB32,
            gtk_widget_get_allocated_width(widget)));
    // Draw the surface
    cairo_t *cr = cairo_create(GBApp->_cairoSurf);
    GBSurfaceAppCallbackDraw(widget, cr, GBApp);
    cairo_destroy (cr);
    return TRUE;
}

// Callback for the activate event on a GBSurfaceApp
void GBSurfaceAppCallbackActivate(GtkApplication* app,
    gpointer data) {
    // Declare a variable to convert the data into the GBSurfaceApp
    GBSurfaceApp* GBApp = (GBSurfaceApp*)data;
    // Create the window
    GBApp->_window = gtk_application_window_new(app);
    // Set the title of the window
    gtk_window_set_title(GTK_WINDOW(GBApp->_window), GBApp->_title);
    // Set the size of the window
    gtk_window_set_default_size(GTK_WINDOW(GBApp->_window),
        VecGet(GBSurfaceDim(&(GBApp->_surf)), 0),
        VecGet(GBSurfaceDim(&(GBApp->_surf)), 1));
    // Set the window as non resizable
    gtk_window_set_resizable(GTK_WINDOW(GBApp->_window), false);
    // Center the window on the screen
    gtk_window_set_position(GTK_WINDOW(GBApp->_window), GTK_WIN_POS_CENTER);
}

```

```

// Create the drawing area
GBApp->_drawingArea = gtk_drawing_area_new();
// Set the size of the drawing area
gtk_widget_set_size_request(GBApp->_drawingArea,
    VecGet(GBSurfaceDim(&(GBApp->_surf)), 0),
    VecGet(GBSurfaceDim(&(GBApp->_surf)), 1));
// Insert the drawing area into the window
gtk_container_add(GTK_CONTAINER(GBApp->_window), GBApp->_drawingArea);
// Connect the events
g_signal_connect(GBApp->_drawingArea, "draw",
    G_CALLBACK (GBSurfaceAppCallbackDraw), GBApp);
g_signal_connect(GBApp->_drawingArea, "configure-event",
    G_CALLBACK (GBSurfaceAppCallbackConfigEvt), GBApp);
if (GBApp->_idleFun != NULL)
    g_timeout_add(GBApp->_idleMs, GBApp->_idleFun, GBApp);
// Display the window
gtk_widget_show_all(GBApp->_window);
}

// Create a new GBSurfaceApp with title 'title' and
// dimensions 'dim'
// The surface is initialized with one layer of white pixels
// (rgba = {255})
GBSurfaceApp* GBSurfaceAppCreate(const VecShort2D* const dim,
    const char* const title) {
#ifdef BUILDMODE == 0
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
    if (title == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'title' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Allocate memory
    GBSurfaceApp* that = PBErrMalloc(GenBrushErr, sizeof(GBSurfaceApp));
    // Set the title of the application
    that->_title = PBErrMalloc(GenBrushErr,
        sizeof(char) * (strlen(title) + 1));
    strcpy(that->_title, title);
    // Create the surface
    that->_surf = GBSurfaceCreateStatic(GBSurfaceTypeApp, dim);
    // Create the application
    that->_app = gtk_application_new(NULL, G_APPLICATION_FLAGS_NONE);
    // Set the idle properties
    that->_idleFun = NULL;
    that->_idleMs = 0;
    // Set the return status
    that->_returnStatus = 0;
    // Connect the 'activate' event
    // Other properties will be set up by the activate event
    g_signal_connect (that->_app, "activate",
        G_CALLBACK (GBSurfaceAppCallbackActivate), that);

    // cf GBSurfaceAppCallbackDraw.
    // Allocate memory for the flipped data
    that->_flippedData = malloc(sizeof(unsigned char) * 4 *
        VecGet(dim, 0) * VecGet(dim, 1));

```



```

    // Return the GBSurfaceApp
    return that;
}

// Set the idle function of the GBSurfaceApp 'that' to 'idleFun'
// with a timeout of 'idleMs'
// The interface of the 'idleFun' is
// gint tick(gpointer data)
// the argument of 'idleFun' is a pointer to GBSurfaceApp
void GBSurfaceSetIdle(GBSurfaceApp* const that,
    gint (*idleFun)(gpointer), int idleMs) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (idleFun == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'idleFun' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Memorize the idle properties
    that->_idleFun = idleFun;
    that->_idleMs = idleMs;
}

// Render the GBSurfaceApp 'that'
// This function block the execution until the app is killed
// Return true if the status of the app when closed was 0, false else
bool GBSurfaceAppRender(GBSurfaceApp* const that) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Run the application
    int argc = 0;
    char* *argv = NULL;
    that->_returnStatus =
        g_application_run(G_APPLICATION(that->_app), argc, argv);
    // After the application has been killed
    // Return the success code
    return (that->_returnStatus == 0 ? true : false);
}

// Free the GBSurfaceApp 'that'
void GBSurfaceAppFree(GBSurfaceApp** that) {
    if (that == NULL || *that == NULL)
        return;
    // Free memory
    g_object_unref((*that)->_app);
    free((*that)->_title);

    // cf GBSurfaceAppCallbackDraw
    free((*that)->_flippedData);
}

```

```

// Free the GBSurfaceWidget 'that'
void GBSurfaceWidgetFree(GBSurfaceWidget** that) {
    (void)that;

    // cf GBSurfaceAppCallbackDraw
    free((*that)->_flippedData);
}

// Create a GenBrush with a blank GBSurfaceApp
GenBrush* GBCreateApp(const VecShort2D* const dim,
    const char* const title) {
    #if BUILDMODE == 0
        if (dim == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'dim' is null");
            PBErrCatch(GenBrushErr);
        }
        if (title == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'title' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    // Allocate memory
    GenBrush* that = PBErrMalloc(GenBrushErr, sizeof(GenBrush));
    // Set properties
    that->_surf = (GBSurface*)GBSurfaceAppCreate(dim, title);
    that->_pods = GSetCreateStatic();
    that->_postProcs = GSetCreateStatic();
    // Return the new GenBrush
    return that;
}

// Set the idle function of the GBSurfaceApp of the GenBrush 'that'
// to 'idleFun' with a timeout of 'idleMs'
// The interface of the 'idleFun' is
// gint tick(gpointer data)
// the argument of 'idleFun' is a pointer to GBSurfaceApp
// If the surface of the app is not a GBSurfaceTypeApp, do nothing
void GBSurfaceSetIdle(GenBrush* that, gint (*idleFun)(gpointer),
    const int idleMs) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErrCatch(GenBrushErr);
        }
        if (idleFun == NULL) {
            GenBrushErr->_type = PBErrTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'idleFun' is null");
            PBErrCatch(GenBrushErr);
        }
    #endif
    if (GBSurfaceGetType(that->_surf) == GBSurfaceTypeApp)
        GBSurfaceSetIdle((GBSurfaceApp*)(that->_surf), idleFun, idleMs);
}

// Create a GenBrush with a blank GBSurfaceWidget and an eye
// of type 'eyeType'
// If 'eyeType' is GBEyeTypeOrtho the view is front
GenBrush* GBCreateWidget(const VecShort2D* const dim) {

```

```

#if BUILDMODE == 0
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
// Allocate memory
GenBrush* that = PBErrMalloc(GenBrushErr, sizeof(GenBrush));
// Set properties
that->_surf = (GBSurface*)GBSurfaceWidgetCreate(dim);
that->_pods = GSetCreateStatic();
that->_postProcs = GSetCreateStatic();
// Return the new GenBrush
return that;
}

// Create a new GBSurfaceWidget with dimensions 'dim'
GBSurfaceWidget* GBSurfaceWidgetCreate(const VecShort2D* const dim) {
#if BUILDMODE == 0
    if (dim == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'dim' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
// Allocate memory
GBSurfaceWidget* that = PBErrMalloc(GenBrushErr,
    sizeof(GBSurfaceWidget));
// Create the surface
that->_surf = GBSurfaceCreateStatic(GBSurfaceTypeWidget, dim);
// Init the cairo_surface pointer
that->_cairoSurf = NULL;
// Create the drawing area
that->_drawingArea = gtk_drawing_area_new();
// Set the size of the drawing area
gtk_widget_set_size_request(that->_drawingArea,
    VecGet(dim, 0), VecGet(dim, 1));
// Connect to the draw event
g_signal_connect(that->_drawingArea, "draw",
    G_CALLBACK (GBSurfaceWidgetCallbackDraw), that);
// Connect to the configure event
g_signal_connect(that->_drawingArea, "configure-event",
    G_CALLBACK (GBSurfaceWidgetCallbackConfigEvt), that);

// cf GBSurfaceAppCallbackDraw.
// Allocate memory for the flipped data
that->_flippedData = malloc(sizeof(unsigned char) * 4 *
    VecGet(dim, 0) * VecGet(dim, 1));

// Return the GBSurfaceWidget
return that;
}

// Callback for the 'draw' event on a GBSurfaceWidget
gboolean GBSurfaceWidgetCallbackDraw(GtkWidget *widget, cairo_t *cr,
    gpointer data) {
    (void)widget;
    // Declare a variable to convert the data into the GBSurfaceApp
    GBSurfaceWidget* GBWidget = (GBSurfaceWidget*)data;
    // Paint the final pixels of the GBSurface on the Cairo surface
    // The data in GenBrush are flipped horizontally relatively to

```

```

// the Cairo coordinates system. Thus we need to flip them
// horizontally.

// Terrible patch. The code below should do the flipping but
// instead it splits only half of the surface (???). Can't find
// the problem, then give up and create a flipped copy of the data
// and use it instead.
//cairo_scale(cr, 1.0, -1.0);
//cairo_translate(cr, 0, -1 * gtk_widget_get_allocated_height(GBWidget->_drawingArea));
//cairo_set_source_surface(cr, GBWidget->_cairoSurf, 0, 0);

const VecShort2D* const dim = GBSurfaceDim(&(GBWidget->_surf));
unsigned char* origData =
    (unsigned char*)GBSurfaceFinalPixels(&(GBWidget->_surf));
for (int iLine = 0; iLine < VecGet(dim, 1); ++iLine) {
    memcpy(GBWidget->_flippedData +
        (VecGet(dim, 1) - iLine - 1) * VecGet(dim, 0) * 4,
        origData + iLine * VecGet(dim, 0) * 4,
        sizeof(unsigned char) * VecGet(dim, 0) * 4);
}

cairo_set_source_surface(cr, GBWidget->_cairoSurf, 0, 0);

cairo_paint (cr);
return FALSE;
}

// Render the GBSurfaceWidget 'that'
void GBSurfaceWidgetRender(const GBSurfaceWidget* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Request the update of the widget area
    gtk_widget_queue_draw_area(that->_drawingArea, 0.0, 0.0,
        gtk_widget_get_allocated_width(that->_drawingArea),
        gtk_widget_get_allocated_height(that->_drawingArea));
}

// Callback for the 'config' event on a GBSurfaceWidget
gboolean GBSurfaceWidgetCallbackConfigEvt(GtkWidget *widget,
    GdkEventConfigure *event, gpointer data) {
    (void)event;
    // Declare a variable to convert the data into the GBSurfaceApp
    GBSurfaceWidget* GBWidget = (GBSurfaceWidget*)data;
    // Attach the GBPixel to the cairo surface
    if (GBWidget->_cairoSurf != NULL)
        free(GBWidget->_cairoSurf);
    GBWidget->_cairoSurf = cairo_image_surface_create_for_data(
        //(unsigned char* )GBSurfaceFinalPixels(&(GBWidget->_surf)),

        // cf GBSurfaceAppCallbackDraw
        GBWidget->_flippedData,

        CAIRO_FORMAT_ARGB32,
        gtk_widget_get_allocated_width(widget),
        gtk_widget_get_allocated_height(widget),
        cairo_format_stride_for_width(CAIRO_FORMAT_ARGB32,
            gtk_widget_get_allocated_width(widget)));
}

```

```

    // Draw the surface
    cairo_t *cr = cairo_create(GBWidget->_cairoSurf);
    GBSurfaceWidgetCallbackDraw(widget, cr, GBWidget);
    cairo_destroy (cr);
    return TRUE;
}

// Take a snapshot of the GenBrush 'that' and save it to 'fileName'
// Return true if successful, false else
bool _GBScreenshot(
    const GenBrush* const that,
    const char* const fileName) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (fileName == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'fileName' is null");
        PBErrCatch(GenBrushErr);
    }
#endif

    // Get the Surface of the GenBrush
    const GBSurface* surf = GBSurf(that);

    // Call the appropriate function according to the type of the surface
    if (GBSurfaceGetType(surf) == GBSurfaceTypeApp) {

        GBSurfaceAppScreenshot((const GBSurfaceApp*)surf, fileName);

    } else if (GBSurfaceGetType(surf) == GBSurfaceTypeWidget) {

        GBSurfaceWidgetScreenshot((const GBSurfaceWidget*)surf, fileName);

    } else {

        // The surface type is not supported, return the failure code
        return FALSE;

    }

    // Return the success flag
    return TRUE;
}

// Take a snapshot of the GBSurfaceApp 'that' and save it to 'fileName'
// Return true if successful, false else
bool GBSurfaceAppScreenshot(
    const GBSurfaceApp* const that,
    const char* const fileName) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
    if (fileName == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'fileName' is null");
    }
#endif

```

```

        PBErriCatch(GenBrushErr);
    }
#endif

    // Create a temporary GBSurfaceImage from the GBSurface of the
    // GBSurfaceApp
    GBSurfaceImage surf;
    memcpy(&surf, &(that->_surf), sizeof(GBSurface));
    surf._fileName = (char*)fileName;

    // Save the GBSurface as an image
    bool flag = GBSurfaceImageSave(&surf);

    // Return the success flag
    return flag;
}

// Take a snapshot of the GBSurfaceWidget 'that' and save it to 'fileName'
// Return true if successfull, false else
bool GBSurfaceWidgetScreenshot(
    const GBSurfaceWidget* const that,
    const char* const fileName) {
    #if BUILDMODE == 0
        if (that == NULL) {
            GenBrushErr->_type = PBErriTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'that' is null");
            PBErriCatch(GenBrushErr);
        }
        if (fileName == NULL) {
            GenBrushErr->_type = PBErriTypeNullPointer;
            sprintf(GenBrushErr->_msg, "'fileName' is null");
            PBErriCatch(GenBrushErr);
        }
    #endif

    // Create a temporary GBSurfaceImage from the GBSurface of the
    // GBSurfaceWidget
    GBSurfaceImage surf;
    memcpy(&surf, &(that->_surf), sizeof(GBSurface));
    surf._fileName = (char*)fileName;

    // Save the GBSurface as an image
    bool flag = GBSurfaceImageSave(&surf);

    // Return the success flag
    return flag;
}

```

### 3.4 genbrush-inline-GTK.c

```

// ===== GENBRUSH-static inline-GTK.C =====

// ===== Functions implementation =====

// Close the GBSurfaceApp 'that'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceAppClose(const GBSurfaceApp* const that) {
    #if BUILDMODE == 0

```

```

    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    // Request the killing of the drawing area
    gtk_window_close(GTK_WINDOW(that->_window));
}

// Refresh the content of the GBSurfaceApp 'that'
#if BUILDMODE != 0
static inline
#endif
void GBSurfaceAppRefresh(const GBSurfaceApp* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    gtk_widget_queue_draw_area(that->_drawingArea, 0.0, 0.0,
        gtk_widget_get_allocated_width(that->_drawingArea),
        gtk_widget_get_allocated_height(that->_drawingArea));
}

// Return the GtkWidget of the GBSurfaceWidget 'that'
#if BUILDMODE != 0
static inline
#endif
GtkWidget* GBSurfaceWidgetGtkWidget(const GBSurfaceWidget* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_drawingArea;
}

// Return the GtkWidget of the GBSurfaceApp 'that'
#if BUILDMODE != 0
static inline
#endif
GtkWidget* GBSurfaceAppGtkWidget(const GBSurfaceApp* const that) {
#if BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    return that->_drawingArea;
}

// Return the GtkWidget of the GenBrush 'that', or NULL if the surface
// of the GenBrush is not a GBSurfaceWidget
#if BUILDMODE != 0
static inline
#endif

```

```

GtkWidget* GBGetGtkWidget(const GenBrush* const that) {
#ifdef BUILDMODE == 0
    if (that == NULL) {
        GenBrushErr->_type = PBErrTypeNullPointer;
        sprintf(GenBrushErr->_msg, "'that' is null");
        PBErrCatch(GenBrushErr);
    }
#endif
    if (GBSurfaceGetType(that->_surf) == GBSurfaceTypeWidget)
        return GBSurfaceWidgetGtkWidget((GBSurfaceWidget*)(that->_surf));
    else
        return NULL;
}

```

## 4 Makefile

```

# Build mode
# 0: development (max safety, no optimisation)
# 1: release (min safety, optimisation)
# 2: fast and furious (no safety, optimisation)
BUILD_MODE?=0

all: pbmake_wget main

# Automatic installation of the repository PBMake in the parent folder
pbmake_wget:
if [ ! -d ../PBMake ]; then wget https://github.com/BayashiPascal/PBMake/archive/master.zip; unzip master.zip; rm -f

# 0: monolith version, the GBSurface is rendered toward a TGA image
# 1: GTK version, the GBSurface is rendered toward a TGA image or
#    a GtkWidget
BUILDWITHGRAPHICLIB?=0

# Makefile definitions
MAKEFILE_INC=../PBMake/Makefile.inc
include $(MAKEFILE_INC)

# Rules to make the executable
repo=genbrush
$(repo)_EXENAME: \
$(repo)_EXENAME.o \
$(repo)_EXE_DEP \
$(repo)_DEP
$(COMPILER) 'echo "$$(repo)_EXE_DEP' '$$(repo)_EXENAME.o' | tr ' ' '\n' | sort -u' $(LINK_ARG) '$$(repo)_LINK_ARG)

$(repo)_EXENAME.o: \
$(repo)_DIR/'$(repo)_EXENAME.c \
$(repo)_INC_H_EXE \
$(repo)_EXE_DEP
$(COMPILER) $(BUILD_ARG) '$$(repo)_BUILD_ARG' 'echo "$$(repo)_INC_DIR" | tr ' ' '\n' | sort -u' -c '$$(repo)_DIR)/

```

## 5 Unit tests

```

#include <stdlib.h>
#include <stdio.h>
#include <time.h>

```



```

#include <string.h>
#include <time.h>
#include <unistd.h>
#include <sys/time.h>
#include "genbrush.h"

#define RANDOMSEED 0

void UnitTestGBPixelBlendNormal() {
    GBPixel pixA;
    GBPixel pixB;
    pixA = (GBPixel){._rgba[GBPixelRed]=100, ._rgba[GBPixelGreen]=0,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=100};
    pixB = (GBPixel){._rgba[GBPixelRed]=0, ._rgba[GBPixelGreen]=100,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=100};
    GBPixelBlendNormal(&pixA, &pixB);
    if (pixA._rgba[GBPixelRed] != 50 ||
        pixA._rgba[GBPixelGreen] != 50 ||
        pixA._rgba[GBPixelBlue] != 0 ||
        pixA._rgba[GBPixelAlpha] != 100) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelBlendNormal failed");
        PBErrCatch(GenBrushErr);
    }
    pixA = (GBPixel){._rgba[GBPixelRed]=100, ._rgba[GBPixelGreen]=0,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=255};
    pixB = (GBPixel){._rgba[GBPixelRed]=0, ._rgba[GBPixelGreen]=100,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=255};
    GBPixelBlendNormal(&pixA, &pixB);
    if (pixA._rgba[GBPixelRed] != 50 ||
        pixA._rgba[GBPixelGreen] != 50 ||
        pixA._rgba[GBPixelBlue] != 0 ||
        pixA._rgba[GBPixelAlpha] != 255) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelBlendNormal failed");
        PBErrCatch(GenBrushErr);
    }
    pixA = (GBPixel){._rgba[GBPixelRed]=100, ._rgba[GBPixelGreen]=0,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=255};
    pixB = (GBPixel){._rgba[GBPixelRed]=0, ._rgba[GBPixelGreen]=100,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=25};
    GBPixelBlendNormal(&pixA, &pixB);
    if (pixA._rgba[GBPixelRed] != 50 ||
        pixA._rgba[GBPixelGreen] != 50 ||
        pixA._rgba[GBPixelBlue] != 0 ||
        pixA._rgba[GBPixelAlpha] != 140) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelBlendNormal failed");
        PBErrCatch(GenBrushErr);
    }
    printf("UnitTestGBPixelBlendNormal OK\n");
}

void UnitTestGBPixelBlendOver() {
    GBPixel pixA;
    GBPixel pixB;
    pixA = (GBPixel){._rgba[GBPixelRed]=100, ._rgba[GBPixelGreen]=0,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=100};
    pixB = (GBPixel){._rgba[GBPixelRed]=0, ._rgba[GBPixelGreen]=100,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=25};
    GBPixelBlendOver(&pixA, &pixB);
    if (pixA._rgba[GBPixelRed] != 90 ||

```

```

    pixA._rgba[GBPixelGreen] != 10 ||
    pixA._rgba[GBPixelBlue] != 0 ||
    pixA._rgba[GBPixelAlpha] != 125) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelBlendOver failed");
        PErrCatch(GenBrushErr);
    }
    pixA = (GBPixel){._rgba[GBPixelRed]=100, ._rgba[GBPixelGreen]=0,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=255};
    pixB = (GBPixel){._rgba[GBPixelRed]=0, ._rgba[GBPixelGreen]=100,
        ._rgba[GBPixelBlue]=0, ._rgba[GBPixelAlpha]=255};
    GBPixelBlendOver(&pixA, &pixB);
    if (pixA._rgba[GBPixelRed] != 0 ||
        pixA._rgba[GBPixelGreen] != 100 ||
        pixA._rgba[GBPixelBlue] != 0 ||
        pixA._rgba[GBPixelAlpha] != 255) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelBlendOver failed");
        PErrCatch(GenBrushErr);
    }
    printf("UnitTestGBPixelBlendOver OK\n");
}

void UnitTestGBPixelIsSame() {
    GBPixel blue = GBColorBlue;
    GBPixel red = GBColorRed;
    GBPixel rouge = GBColorRed;
    if (GBPixelIsSame(&blue, &red) ||
        !GBPixelIsSame(&rouge, &red)) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelIsSame failed");
        PErrCatch(GenBrushErr);
    }
    printf("UnitTestGBPixelIsSame OK\n");
}

void UnitTestGBPixelConvertRGBHSV() {
    GBPixel blue = GBColorBlue;
    GBPixel red = GBColorRed;
    GBPixel green = GBColorGreen;
    GBPixel white = GBColorWhite;
    GBPixel black = GBColorBlack;
    GBPixel hsv = GBPixelRGB2HSV(&blue);
    if (hsv._hsva[GBPixelAlpha] != 255 ||
        hsv._hsva[GBPixelHue] != 170 ||
        hsv._hsva[GBPixelSaturation] != 255 ||
        hsv._hsva[GBPixelValue] != 255) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelRGB2HSV failed");
        PErrCatch(GenBrushErr);
    }
    GBPixel rgb = GBPixelHSV2RGB(&hsv);
    if (rgb._rgba[GBPixelAlpha] != 255 ||
        rgb._rgba[GBPixelRed] != 0 ||
        rgb._rgba[GBPixelGreen] != 0 ||
        rgb._rgba[GBPixelBlue] != 255) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelHSV2RGB failed");
        PErrCatch(GenBrushErr);
    }
    hsv = GBPixelRGB2HSV(&red);
    if (hsv._hsva[GBPixelAlpha] != 255 ||

```

```

    hsv._hsva[GBPixelHue] != 0 ||
    hsv._hsva[GBPixelSaturation] != 255 ||
    hsv._hsva[GBPixelValue] != 255) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBPixelRGB2HSV failed");
    PBErrCatch(GenBrushErr);
}
rgb = GBPixelHSV2RGB(&hsv);
if (rgb._rgba[GBPixelAlpha] != 255 ||
    rgb._rgba[GBPixelRed] != 255 ||
    rgb._rgba[GBPixelGreen] != 0 ||
    rgb._rgba[GBPixelBlue] != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBPixelHSV2RGB failed");
    PBErrCatch(GenBrushErr);
}
hsv = GBPixelRGB2HSV(&green);
if (hsv._hsva[GBPixelAlpha] != 255 ||
    hsv._hsva[GBPixelHue] != 85 ||
    hsv._hsva[GBPixelSaturation] != 255 ||
    hsv._hsva[GBPixelValue] != 255) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBPixelRGB2HSV failed");
    PBErrCatch(GenBrushErr);
}
rgb = GBPixelHSV2RGB(&hsv);
if (rgb._rgba[GBPixelAlpha] != 255 ||
    rgb._rgba[GBPixelRed] != 0 ||
    rgb._rgba[GBPixelGreen] != 255 ||
    rgb._rgba[GBPixelBlue] != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBPixelHSV2RGB failed");
    PBErrCatch(GenBrushErr);
}
hsv = GBPixelRGB2HSV(&white);
if (hsv._hsva[GBPixelAlpha] != 255 ||
    hsv._hsva[GBPixelHue] != 0 ||
    hsv._hsva[GBPixelSaturation] != 0 ||
    hsv._hsva[GBPixelValue] != 255) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBPixelRGB2HSV failed");
    PBErrCatch(GenBrushErr);
}
rgb = GBPixelHSV2RGB(&hsv);
if (rgb._rgba[GBPixelAlpha] != 255 ||
    rgb._rgba[GBPixelRed] != 255 ||
    rgb._rgba[GBPixelGreen] != 255 ||
    rgb._rgba[GBPixelBlue] != 255) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBPixelHSV2RGB failed");
    PBErrCatch(GenBrushErr);
}
hsv = GBPixelRGB2HSV(&black);
if (hsv._hsva[GBPixelAlpha] != 255 ||
    hsv._hsva[GBPixelHue] != 0 ||
    hsv._hsva[GBPixelSaturation] != 0 ||
    hsv._hsva[GBPixelValue] != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBPixelRGB2HSV failed");
    PBErrCatch(GenBrushErr);
}
rgb = GBPixelHSV2RGB(&hsv);

```

```

    if (rgb._rgba[GBPixelAlpha] != 255 ||
        rgb._rgba[GBPixelRed] != 0 ||
        rgb._rgba[GBPixelGreen] != 0 ||
        rgb._rgba[GBPixelBlue] != 0) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPixelHSV2RGB failed");
        PBErrCatch(GenBrushErr);
    }
    printf("UnitTestGBPixelConvertRGBHSV OK\n");
}

void UnitTestGBPixel() {
    UnitTestGBPixelBlendNormal();
    UnitTestGBPixelBlendOver();
    UnitTestGBPixelIsSame();
    UnitTestGBPixelConvertRGBHSV();
    printf("UnitTestGBPixel OK\n");
}

void UnitTestGBLayerCreateFree() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBLayer* layer = GBLayerCreate(&dim);
    VecShort2D v = VecShortCreateStatic2D();
    if (VecIsEqual(&(layer->_pos), &v) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(&(layer->_prevPos), &v) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(&(layer->_dim), &dim) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (layer->_pix == NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (layer->_blendMode != GBLayerBlendModeDefault) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (layer->_modified == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (layer->_isFlushed == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (layer->_stackPos != GBLayerStackPosBg) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
    }
}

```

```

    PBErriCatch(GenBrushErr);
}
GBLayerFree(&layer);
printf("UnitTestGBLayerCreateFree OK\n");
}

void UnitTestGBLayerArea() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBLayer* layer = GBLayerCreate(&dim);
    if (GBLayerArea(layer) != 12) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerArea failed");
        PBErriCatch(GenBrushErr);
    }
    GBLayerFree(&layer);
    printf("UnitTestGBLayerArea OK\n");
}

void UnitTestGBLayerGetSet() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBLayer* layer = GBLayerCreate(&dim);
    if (GBLayerPos(layer) != &(layer->_pos)) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerPos failed");
        PBErriCatch(GenBrushErr);
    }
    VecShort2D p = VecShortCreateStatic2D();
    VecSet(&p, 0, 1); VecSet(&p, 1, 2);
    GBLayerSetPos(layer, &p);
    if (VecIsEqual(GBLayerPos(layer), &p) == false) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerSetPos failed");
        PBErriCatch(GenBrushErr);
    }
    VecSet(&p, 0, 0); VecSet(&p, 1, 0);
    if (VecIsEqual(&(layer->_prevPos), &p) == false ||
        layer->_modified == false) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerSetPos failed");
        PBErriCatch(GenBrushErr);
    }
    layer->_modified = false;
    VecSet(&p, 0, 3); VecSet(&p, 1, 4);
    GBLayerSetPos(layer, &p);
    VecSet(&p, 0, 1); VecSet(&p, 1, 2);
    if (VecIsEqual(&(layer->_prevPos), &p) == false ||
        layer->_modified == false) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerSetPos failed");
        PBErriCatch(GenBrushErr);
    }
    p = GBLayerGetPos(layer);
    if (VecIsEqual(GBLayerPos(layer), &p) == false) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerGetPos failed");
        PBErriCatch(GenBrushErr);
    }
    if (GBLayerPrevPos(layer) != &(layer->_prevPos)) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerPrevPos failed");
    }
}

```

```

    PBErCatch(GenBrushErr);
}
p = GBLayerGetPrevPos(layer);
if (VecIsEqual(GBLayerPrevPos(layer), &p) == false) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetPrevPos failed");
    PBErCatch(GenBrushErr);
}
if (GBLayerDim(layer) != &(layer->_dim)) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerDim failed");
    PBErCatch(GenBrushErr);
}
p = GBLayerGetDim(layer);
if (VecIsEqual(GBLayerDim(layer), &p) == false) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetDim failed");
    PBErCatch(GenBrushErr);
}
if (GBLayerGetBlendMode(layer) != layer->_blendMode) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetBlendMode failed");
    PBErCatch(GenBrushErr);
}
GBLayerSetBlendMode(layer, GBLayerBlendModeNormal);
if (GBLayerGetBlendMode(layer) != GBLayerBlendModeNormal) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerSetBlendMode failed");
    PBErCatch(GenBrushErr);
}
if (GBLayerIsModified(layer) != true) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerIsModified failed");
    PBErCatch(GenBrushErr);
}
GBLayerSetModified(layer, false);
if (GBLayerIsModified(layer) != false) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerSetModified failed");
    PBErCatch(GenBrushErr);
}
if (GBLayerIsFlushed(layer) != true) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerIsFlushed failed");
    PBErCatch(GenBrushErr);
}
GBLayerSetFlushed(layer, false);
if (GBLayerIsFlushed(layer) != false) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerSetFlushed failed");
    PBErCatch(GenBrushErr);
}
GBLayerSetFlushed(layer, true);
if (GBLayerGetStackPos(layer) != GBLayerStackPosBg) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetStackPos failed");
    PBErCatch(GenBrushErr);
}
GBLayerSetStackPos(layer, GBLayerStackPosFg);
if (GBLayerGetStackPos(layer) != GBLayerStackPosFg ||
    GBLayerIsModified(layer) == false) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
}

```

```

    sprintf(GenBrushErr->_msg, "GBLayerSetStackPos failed");
    PBErCatch(GenBrushErr);
}
if (GBLayerPixels(layer) != layer->_pix) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerPixels failed");
    PBErCatch(GenBrushErr);
}
VecSet(&p, 0, -1); VecSet(&p, 1, 2);
if (GBLayerPixelSafe(layer, &p) != NULL) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerPixelSafe failed");
    PBErCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, 2);
if (GBLayerPixel(layer, &p) != layer->_pix + 9) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerPixel failed");
    PBErCatch(GenBrushErr);
}
if (GBLayerPixelSafe(layer, &p) != layer->_pix + 9) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerPixelSafe failed");
    PBErCatch(GenBrushErr);
}
GBPixel pix = GBColorWhite;
float depth = 1.0;
GBLayerAddPixel(layer, &p, &pix, depth);
if (GSetNbElem(GBLayerPixel(layer, &p)) != 1) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerAddPixel failed");
    PBErCatch(GenBrushErr);
}
VecSet(&p, 0, -1); VecSet(&p, 1, 2);
GBLayerAddPixelSafe(layer, &p, &pix, depth);
VecSet(&p, 0, 1); VecSet(&p, 1, 2);
GBLayerAddPixelSafe(layer, &p, &pix, depth);
if (GSetNbElem(GBLayerPixel(layer, &p)) != 2) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerAddPixelSafe failed");
    PBErCatch(GenBrushErr);
}
if (GBLayerIsPosInside(layer, &p) == false) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerIsPosInside failed");
    PBErCatch(GenBrushErr);
}
VecSet(&p, 0, 10); VecSet(&p, 1, 2);
if (GBLayerIsPosInside(layer, &p) == true) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerIsPosInside failed");
    PBErCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, -2);
if (GBLayerIsPosInside(layer, &p) == true) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerIsPosInside failed");
    PBErCatch(GenBrushErr);
}
GBLayerFlush(layer);
VecSet(&p, 0, 1); VecSet(&p, 1, 2);
if (GSetNbElem(GBLayerPixel(layer, &p)) != 0) {

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```

        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerFlush failed");
        PBErrCatch(GenBrushErr);
    }
    GBLayerFree(&layer);
    printf("UnitTestGBLayerGetSet OK\n");
}

void UnitTestGBLayerCreateFromFile() {
    GBLayer* layer = GBLayerCreateFromFile("./testBottomLeft.tga");
    if (layer == NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreateFromFile failed");
        PBErrCatch(GenBrushErr);
    }
    if (layer->_isFlushed == true) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreate failed");
        PBErrCatch(GenBrushErr);
    }
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 3); VecSet(&dim, 1, 4);
    if (VecIsEqual(&dim, GBLayerDim(layer)) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreateFromFile failed");
        PBErrCatch(GenBrushErr);
    }
    unsigned char check[48] = {
        91,0,163,192, 52,0,202,194, 23,0,231,205,
        153,0,102,200, 106,0,148,192, 64,0,190,193,
        211,0,43,221, 168,0,86,204, 121,0,133,193,
        255,0,0,255, 226,0,28,230, 184,0,70,209
    };
    for (int iPix = 0; iPix < 12; iPix++) {
        GBPixel pix =
            ((GBStackedPixel*)GSetGet(layer->_pix + iPix, 0))->_val;
        if (pix._rgba[GBPixelRed] != check[4 * iPix] ||
            pix._rgba[GBPixelGreen] != check[4 * iPix + 1] ||
            pix._rgba[GBPixelBlue] != check[4 * iPix + 2] ||
            pix._rgba[GBPixelAlpha] != check[4 * iPix + 3]) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBLayerCreateFromFile1 failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBLayerFree(&layer);
    layer = GBLayerCreateFromFile("./testTopLeft.tga");
    if (layer == NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreateFromFile failed");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(&dim, GBLayerDim(layer)) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerCreateFromFile failed");
        PBErrCatch(GenBrushErr);
    }
    for (int iPix = 0; iPix < 12; iPix++) {
        GBPixel pix =
            ((GBStackedPixel*)GSetGet(layer->_pix + iPix, 0))->_val;
        if (pix._rgba[GBPixelRed] != check[4 * iPix] ||
            pix._rgba[GBPixelGreen] != check[4 * iPix + 1] ||

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        pix._rgba[GBPixelBlue] != check[4 * iPix + 2] ||
        pix._rgba[GBPixelAlpha] != check[4 * iPix + 3]) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBLayerCreateFromFile2 failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBLayerFree(&layer);
    printf("UnitTestGBLayerCreateFromFile OK\n");
}

void UnitTestGBLayerGetBoundaryInSurface() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 800); VecSet(&dim, 1, 600);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    VecSet(&dim, 0, 200); VecSet(&dim, 1, 100);
    GBLayer* layer = GBLayerCreate(&dim);
    VecShort2D pos = VecShortCreateStatic2D();
    VecSet(&pos, 0, 10); VecSet(&pos, 1, 10);
    GBLayerSetPos(layer, &pos);
    Facoid* bound = GBLayerGetBoundaryInSurface(layer, surf, false);
    VecFloat2D p = VecFloatCreateStatic2D();
    VecFloat2D u = VecFloatCreateStatic2D();
    VecFloat2D v = VecFloatCreateStatic2D();
    VecSet(&p, 0, 10); VecSet(&p, 1, 10);
    VecSet(&u, 0, 201); VecSet(&u, 1, 0);
    VecSet(&v, 0, 0); VecSet(&v, 1, 101);
    if (VecIsEqual(ShapoidPos(bound), &p) == false ||
        VecIsEqual(ShapoidAxis(bound, 0), &u) == false ||
        VecIsEqual(ShapoidAxis(bound, 1), &v) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (1)");
        PBErrCatch(GenBrushErr);
    }
    ShapoidFree(&bound);
    VecSet(&pos, 0, 700); VecSet(&pos, 1, 10);
    GBLayerSetPos(layer, &pos);
    bound = GBLayerGetBoundaryInSurface(layer, surf, false);
    VecSet(&p, 0, 700); VecSet(&p, 1, 10);
    VecSet(&u, 0, 100); VecSet(&u, 1, 0);
    VecSet(&v, 0, 0); VecSet(&v, 1, 101);
    if (VecIsEqual(ShapoidPos(bound), &p) == false ||
        VecIsEqual(ShapoidAxis(bound, 0), &u) == false ||
        VecIsEqual(ShapoidAxis(bound, 1), &v) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (2)");
        PBErrCatch(GenBrushErr);
    }
    ShapoidFree(&bound);
    VecSet(&pos, 0, -100); VecSet(&pos, 1, 10);
    GBLayerSetPos(layer, &pos);
    bound = GBLayerGetBoundaryInSurface(layer, surf, false);
    VecSet(&p, 0, 0); VecSet(&p, 1, 10);
    VecSet(&u, 0, 101); VecSet(&u, 1, 0);
    VecSet(&v, 0, 0); VecSet(&v, 1, 101);
    if (VecIsEqual(ShapoidPos(bound), &p) == false ||
        VecIsEqual(ShapoidAxis(bound, 0), &u) == false ||
        VecIsEqual(ShapoidAxis(bound, 1), &v) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (3)");
        PBErrCatch(GenBrushErr);
    }
}

```

```

ShapoidFree(&bound);
VecSet(&pos, 0, 10); VecSet(&pos, 1, 550);
GBLayerSetPos(layer, &pos);
bound = GBLayerGetBoundaryInSurface(layer, surf, false);
VecSet(&p, 0, 10); VecSet(&p, 1, 550);
VecSet(&u, 0, 201); VecSet(&u, 1, 0);
VecSet(&v, 0, 0); VecSet(&v, 1, 50);
if (VecIsEqual(ShapoidPos(bound), &p) == false ||
    VecIsEqual(ShapoidAxis(bound, 0), &u) == false ||
    VecIsEqual(ShapoidAxis(bound, 1), &v) == false) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (4)");
    PBErrCatch(GenBrushErr);
}
ShapoidFree(&bound);
VecSet(&pos, 0, 10); VecSet(&pos, 1, -50);
GBLayerSetPos(layer, &pos);
bound = GBLayerGetBoundaryInSurface(layer, surf, false);
VecSet(&p, 0, 10); VecSet(&p, 1, 0);
VecSet(&u, 0, 201); VecSet(&u, 1, 0);
VecSet(&v, 0, 0); VecSet(&v, 1, 51);
if (VecIsEqual(ShapoidPos(bound), &p) == false ||
    VecIsEqual(ShapoidAxis(bound, 0), &u) == false ||
    VecIsEqual(ShapoidAxis(bound, 1), &v) == false) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (5)");
    PBErrCatch(GenBrushErr);
}
ShapoidFree(&bound);
VecSet(&pos, 0, -300); VecSet(&pos, 1, -150);
GBLayerSetPos(layer, &pos);
bound = GBLayerGetBoundaryInSurface(layer, surf, false);
if (bound != NULL) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (6)");
    PBErrCatch(GenBrushErr);
}
VecSet(&pos, 0, 1000); VecSet(&pos, 1, 1000);
GBLayerSetPos(layer, &pos);
bound = GBLayerGetBoundaryInSurface(layer, surf, false);
if (bound != NULL) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (7)");
    PBErrCatch(GenBrushErr);
}
VecSet(&pos, 0, 0); VecSet(&pos, 1, 1000);
GBLayerSetPos(layer, &pos);
bound = GBLayerGetBoundaryInSurface(layer, surf, false);
if (bound != NULL) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (8)");
    PBErrCatch(GenBrushErr);
}
VecSet(&pos, 0, 1000); VecSet(&pos, 1, 0);
GBLayerSetPos(layer, &pos);
bound = GBLayerGetBoundaryInSurface(layer, surf, false);
if (bound != NULL) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBLayerGetBoundaryInSurface failed (9)");
    PBErrCatch(GenBrushErr);
}
GBLayerFree(&layer);

```

```

    GBSurfaceFree(&surf);
    printf("UnitTestGBLayerGetBoundaryInSurface OK\n");
}

void UnitTestGBLayer() {
    UnitTestGBLayerCreateFree();
    UnitTestGBLayerArea();
    UnitTestGBLayerGetSet();
    UnitTestGBLayerCreateFromFile();
    UnitTestGBLayerGetBoundaryInSurface();

    printf("UnitTestGBLayer OK\n");
}

void UnitTestGBPostProcessingCreateFree() {
    GBPostProcessing pp =
        GBPostProcessingCreateStatic(GBPPTTypeNormalizeHue);
    if (pp._type != GBPPTTypeNormalizeHue) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPostProcessingCreateStatic failed");
        PBErrCatch(GenBrushErr);
    }
    GBPostProcessing* pp2 =
        GBPostProcessingCreate(GBPPTTypeNormalizeHue);
    if (pp2->_type != GBPPTTypeNormalizeHue) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPostProcessingCreate failed");
        PBErrCatch(GenBrushErr);
    }
    GBPostProcessingFree(&pp2);
    if (pp2 != NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPostProcessingFree failed");
        PBErrCatch(GenBrushErr);
    }
    printf("UnitTestGBPostProcessingCreateFree OK\n");
}

void UnitTestGBPostProcessingGetSet() {
    GBPostProcessing pp =
        GBPostProcessingCreateStatic(GBPPTTypeNormalizeHue);
    if (GBPostProcessingGetType(&pp) != GBPPTTypeNormalizeHue) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBPostProcessingGetType failed");
        PBErrCatch(GenBrushErr);
    }
    printf("UnitTestGBPostProcessingGetSet OK\n");
}

void UnitTestGBPostProcessing() {
    UnitTestGBPostProcessingCreateFree();
    UnitTestGBPostProcessingGetSet();

    printf("UnitTestGBPostProcessing OK\n");
}

void UnitTestGBSurfaceCreateFree() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 800); VecSet(&dim, 1, 600);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    if (surf->_type != GBSurfaceTypeImage) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
    }
}

```

```

        sprintf(GenBrushErr->_msg, "GBSurfaceCreate failed");
        PBErCatch(GenBrushErr);
    }
    if (VecIsEqual(&(surf->_dim), &dim) == false) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceCreate failed");
        PBErCatch(GenBrushErr);
    }
    GBPixel white = GBColorWhite;
    if (memcmp(&(surf->_bgColor), &white, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceCreate failed");
        PBErCatch(GenBrushErr);
    }
    if (surf->_finalPix == NULL) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceCreate failed");
        PBErCatch(GenBrushErr);
    }
    if (GSetNbElem(&(surf->_layers)) != 0) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceCreate failed");
        PBErCatch(GenBrushErr);
    }
    GBSurfaceFree(&surf);
    printf("UnitTestGBSurfaceCreateFree OK\n");
}

void UnitTestGBSurfaceGetSet() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    if (GBSurfaceGetType(&surf) != GBSurfaceTypeImage) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceGetType failed");
        PBErCatch(GenBrushErr);
    }
    VecShort2D d = GBSurfaceGetDim(&surf);
    if (VecIsEqual(&d, &dim) == false) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceGetDim failed");
        PBErCatch(GenBrushErr);
    }
    if (VecIsEqual(GBSurfaceDim(&surf), &dim) == false) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceDim failed");
        PBErCatch(GenBrushErr);
    }
    if (GBSurfaceFinalPixels(&surf) != surf._finalPix) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceFinalPix failed");
        PBErCatch(GenBrushErr);
    }
    GBPixel black = GBColorBlack;
    GBSurfaceSetBgColor(&surf, &black);
    if (memcmp(&(surf._bgColor), &black, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceSetBgColor failed");
        PBErCatch(GenBrushErr);
    }
    if (memcmp(GBSurfaceBgColor(&surf), &black, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
    }
}

```

```

    sprintf(GenBrushErr->_msg, "GBSurfaceBgColor failed");
    PBErCatch(GenBrushErr);
}
GBPixel bgCol = GBSurfaceGetBgColor(&surf);
if (memcmp(&(surf._bgColor), &bgCol, sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceGetBgColor failed");
    PBErCatch(GenBrushErr);
}
VecShort2D p = VecShortCreateStatic2D();
VecSet(&p, 0, 1); VecSet(&p, 1, 2);
if (GBSurfaceFinalPixel(&surf, &p) != surf._finalPix + 9) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceFinalPixel failed");
    PBErCatch(GenBrushErr);
}
if (GBSurfaceFinalPixelSafe(&surf, &p) != surf._finalPix + 9) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceFinalPixelSafe failed");
    PBErCatch(GenBrushErr);
}
GBPixel white = GBColorWhite;
GBSurfaceSetFinalPixel(&surf, &p, &white);
if (memcmp(GBSurfaceFinalPixel(&surf, &p), &white,
    sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceSetFinalPixel failed");
    PBErCatch(GenBrushErr);
}
GBPixel pix = GBSurfaceGetFinalPixel(&surf, &p);
if (memcmp(&pix, &white, sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceGetFinalPixel failed");
    PBErCatch(GenBrushErr);
}
if (GBSurfaceIsPosInside(&surf, &p) == false) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceIsPosInside failed");
    PBErCatch(GenBrushErr);
}
VecSet(&p, 0, -1); VecSet(&p, 1, 2);
if (GBSurfaceIsPosInside(&surf, &p) == true) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceIsPosInside failed");
    PBErCatch(GenBrushErr);
}
GBPixel transparent = GBColorTransparent;
pix = GBSurfaceGetFinalPixelSafe(&surf, &p);
if (memcmp(&pix, &transparent, sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceGetFinalPixelSafe failed");
    PBErCatch(GenBrushErr);
}
if (GBSurfaceFinalPixelSafe(&surf, &p) != NULL) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceFinalPixelSafe failed");
    PBErCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, 10);
if (GBSurfaceIsPosInside(&surf, &p) == true) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceIsPosInside failed");
}

```

```

    PBErrCatch(GenBrushErr);
}
GBSurfaceSetFinalPixelSafe(&surf, &p, &white);
VecSet(&p, 0, 2); VecSet(&p, 1, 1);
GBPixel blue = GBColorBlue;
GBSurfaceSetFinalPixelSafe(&surf, &p, &blue);
if (memcmp(GBSurfaceFinalPixel(&surf, &p), &blue,
    sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceSetFinalPixelSafe failed");
    PBErrCatch(GenBrushErr);
}
if (GBSurfaceLayers(&surf) != &(surf._layers)) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceLayers failed");
    PBErrCatch(GenBrushErr);
}
GBSurfaceFreeStatic(&surf);
printf("UnitTestGBSurfaceGetSet OK\n");
}

void UnitTestGBSurfaceArea() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    if (GBSurfaceArea(&surf) != 12) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceArea failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceFreeStatic(&surf);
    printf("UnitTestGBSurfaceArea OK\n");
}

void UnitTestGBSurfaceClone() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    GBSurface clone = GBSurfaceClone(&surf);
    if (GBSurfaceGetType(&surf) != GBSurfaceGetType(&clone)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceClone failed");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(GBSurfaceDim(&surf), GBSurfaceDim(&clone)) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceClone failed");
        PBErrCatch(GenBrushErr);
    }
    if (memcmp(&(surf._bgColor), &(clone._bgColor),
        sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceClone failed");
        PBErrCatch(GenBrushErr);
    }
    if (surf._finalPix == clone._finalPix) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceClone failed");
        PBErrCatch(GenBrushErr);
    }
    if (memcmp(surf._finalPix, clone._finalPix,
        sizeof(GBPixel) * GBSurfaceArea(&surf)) != 0) {

```

```

        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceClone failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceFreeStatic(&surf);
    GBSurfaceFreeStatic(&clone);
    printf("UnitTestGBSurfaceClone OK\n");
}

void UnitTestGBSurfaceAddRemoveLayer() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    GBLayer* layerA = GBSurfaceAddLayer(&surf, &dim);
    if (layerA == NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceAddLayer failed");
        PBErrCatch(GenBrushErr);
    }
    if (GSetNbElem(GBSurfaceLayers(&surf)) != 1) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceAddLayer failed");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(GBLayerDim(layerA), &dim) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceAddLayer failed");
        PBErrCatch(GenBrushErr);
    }
    GBLayer* layerB = GBSurfaceAddLayer(&surf, &dim);
    GBSurfaceRemoveLayer(&surf, layerA);
    if ((GBLayer*)(surf._layers._head->_data) != layerB) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceRemoveLayer failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceFreeStatic(&surf);
    printf("UnitTestGBSurfaceAddRemoveLayer OK\n");
}

void UnitTestGBSurfaceGetLayerNbLayer() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    GBLayer* layers[3] = {NULL};
    for (int iLayer = 0; iLayer < 3; ++iLayer)
        layers[iLayer] = GBSurfaceAddLayer(&surf, &dim);
    if (GBSurfaceNbLayer(&surf) != 3) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceNbLayer failed");
        PBErrCatch(GenBrushErr);
    }
    for (int iLayer = 0; iLayer < 3; ++iLayer) {
        if (GBSurfaceLayer(&surf, iLayer) != layers[iLayer]) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBSurfaceGetLayer failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBSurfaceFreeStatic(&surf);
    printf("UnitTestGBSurfaceGetLayer OK\n");
}

```

```

void UnitTestGBSurfaceSetLayersModified() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    GBLayer* layers[3] = {NULL};
    for (int iLayer = 0; iLayer < 3; ++iLayer)
        layers[iLayer] = GBSurfaceAddLayer(&surf, &dim);
    GBSurfaceSetLayersModified(&surf, false);
    for (int iLayer = 0; iLayer < 3; ++iLayer) {
        if (GBLayerIsModified(layers[iLayer]) != false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBSurfaceSetLayersModified failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBSurfaceSetLayersModified(&surf, true);
    for (int iLayer = 0; iLayer < 3; ++iLayer) {
        if (GBLayerIsModified(layers[iLayer]) != true) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBSurfaceSetLayersModified failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBSurfaceFreeStatic(&surf);
    printf("UnitTestGBSurfaceSetLayersModified OK\n");
}

void UnitTestGBSurfaceSetLayerStackPos() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    GBLayer* layers[3] = {NULL};
    for (int iLayer = 0; iLayer < 3; ++iLayer)
        layers[iLayer] = GBSurfaceAddLayer(&surf, &dim);
    GBSurfaceSetLayerStackPos(&surf, layers[2], 0);
    GBSurfaceSetLayerStackPos(&surf, layers[0], 2);
    if (GBSurfaceLayer(&surf, 0) != layers[2] ||
        GBSurfaceLayer(&surf, 1) != layers[1] ||
        GBSurfaceLayer(&surf, 2) != layers[0] ||
        GBLayerIsModified(layers[0]) != true ||
        GBLayerIsModified(layers[1]) != true ||
        GBLayerIsModified(layers[2]) != true) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceSetLayerPos failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceFreeStatic(&surf);
    printf("UnitTestGBSurfaceSetLayerPos OK\n");
}

void UnitTestGBSurfaceGetModifiedArea() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 100); VecSet(&dim, 1, 100);
    GBSurface surf = GBSurfaceCreateStatic(GBSurfaceTypeImage, &dim);
    GBLayer* layers[4] = {NULL};
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    for (int iLayer = 0; iLayer < 4; ++iLayer)
        layers[iLayer] = GBSurfaceAddLayer(&surf, &dim);
    VecShort2D pos = VecShortCreateStatic2D();
    VecSet(&pos, 0, -2); VecSet(&pos, 1, 5);
    GBLayerSetPos(layers[0], &pos);

```



```

VecSet(&pos, 0, 5); VecSet(&pos, 1, 5);
GBLayerSetPos(layers[1], &pos);
VecSet(&pos, 0, 10); VecSet(&pos, 1, 8);
GBLayerSetPos(layers[2], &pos);
VecSet(&pos, 0, 20); VecSet(&pos, 1, 20);
GBLayerSetPos(layers[3], &pos);
GBLayerSetModified(layers[3], false);
GSetShapoid* set = GBSurfaceGetModifiedArea(&surf);
if (GSetNbElem(set) != 5) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg,
        "GBSurfaceGetModifiedArea failed");
    PBErrCatch(ShapoidErr);
}
int iCheck = 0;
float checkp[10] = {
    0.0, 5.0, 0.0, 0.0, 9.0, 5.0, 10.0, 16.0, 16.0, 8.0};
float checku[5] = {9.0, 11.0, 7.0, 11.0, 5.0};
float checkv[5] = {11.0, 5.0, 11.0, 3.0, 8.0};
VecFloat2D p = VecFloatCreateStatic2D();
VecFloat2D u = VecFloatCreateStatic2D();
VecFloat2D v = VecFloatCreateStatic2D();
do {
    Facoid* fac = (Facoid*)GSetPop(set);
    VecSet(&p, 0, checkp[2 * iCheck]);
    VecSet(&p, 1, checkp[2 * iCheck + 1]);
    VecSet(&u, 0, checku[iCheck]); VecSet(&v, 1, checkv[iCheck]);
    if (VecIsEqual(ShapoidPos(fac), &p) == false ||
        VecIsEqual(ShapoidAxis(fac, 0), &u) == false ||
        VecIsEqual(ShapoidAxis(fac, 1), &v) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg,
            "GBSurfaceGetModifiedArea failed");
        PBErrCatch(ShapoidErr);
    }
    ShapoidFree(&fac);
    ++iCheck;
} while(GSetNbElem(set) > 0);
GSetFree(&set);
GBSurfaceFreeStatic(&surf);
printf("UnitTestGBSurfaceGetModifiedArea OK\n");
}

void UnitTestGBSurfaceUpdate() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    GBLayer* layers[4] = {NULL};
    VecSet(&dim, 0, 5); VecSet(&dim, 1, 5);
    for (int iLayer = 0; iLayer < 4; ++iLayer) {
        layers[iLayer] = GBSurfaceAddLayer((GBSurface*)surf, &dim);
        GBLayerSetBlendMode(layers[iLayer], GBLayerBlendModeOver);
    }
    GBLayerSetStackPos(layers[1], GBLayerStackPosInside);
    GBLayerSetStackPos(layers[2], GBLayerStackPosInside);
    GBLayerSetStackPos(layers[3], GBLayerStackPosFg);
    VecShort2D pos = VecShortCreateStatic2D();
    VecSet(&pos, 0, 1); VecSet(&pos, 1, 1);
    GBLayerSetPos(layers[0], &pos);
    VecSet(&pos, 0, 3); VecSet(&pos, 1, 3);
    GBLayerSetPos(layers[1], &pos);
    VecSet(&pos, 0, 4); VecSet(&pos, 1, 4);

```

```

GBLayerSetPos(layers[2], &pos);
VecSet(&pos, 0, 7); VecSet(&pos, 1, 7);
GBLayerSetPos(layers[3], &pos);
VecSetNull(&pos);
GBPixel col;
float depth;
do {
    col = GBColorGreen;
    depth = 0.0;
    GBLayerAddPixel(layers[0], &pos, &col, depth);
    col._rgba[GBPixelRed] = VecGet(&pos, 1) * 30;
    col._rgba[GBPixelGreen] = VecGet(&pos, 0) * 30;
    col._rgba[GBPixelBlue] = 0;
    col._rgba[GBPixelAlpha] = 255 - VecGet(&pos, 1) * 30;
    depth = VecGet(&pos, 0);
    GBLayerAddPixel(layers[1], &pos, &col, depth);
    col._rgba[GBPixelRed] = 0;
    col._rgba[GBPixelGreen] = VecGet(&pos, 0) * 30;
    col._rgba[GBPixelBlue] = VecGet(&pos, 1) * 30;
    col._rgba[GBPixelAlpha] = 255 - VecGet(&pos, 0) * 30;
    depth = VecGet(&pos, 1);
    GBLayerAddPixel(layers[2], &pos, &col, depth);
    col = GBColorBlue;
    depth = 0.0;
    GBLayerAddPixel(layers[3], &pos, &col, depth);
} while (VecStep(&pos, &dim));
GBSurfaceUpdate(surf);
unsigned char check[400] = {
    255,255,255,255, 255,255,255,255, 255,255,255,255, 255,255,255,
    255, 255,255,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 255,255,255,255, 0,255,0,255, 0,255,0,255, 0,255,0,255,
    0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    255,255,255,255, 0,255,0,255, 0,255,0,255, 0,255,0,255,
    0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    255,255,255,255, 0,255,0,255, 0,255,0,255, 0,0,0,255, 0,30,0,255,
    0,60,0,255, 0,90,0,255, 0,120,0,255, 0,0,0,0, 0,0,0,0,
    255,255,255,255, 0,255,0,255, 0,255,0,255, 26,30,0,255,
    0,0,0,255, 4,34,0,255, 7,67,0,255, 11,101,0,255, 120,184,120,255,
    0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255, 46,60,0,255,
    0,0,30,255, 7,34,26,255, 14,67,23,255, 21,101,19,255,
    120,184,136,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    148,90,90,255, 0,0,60,255, 11,34,53,255, 21,67,46,255,
    32,101,39,255, 120,184,152,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 184,120,120,255, 0,0,90,255, 14,34,79,255, 28,67,69,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,120,255, 30,56,136,255, 60,106,152,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255
};
for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
    if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
        check[iPix * 4] ||
        surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
        check[iPix * 4 + 1] ||
        surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
        check[iPix * 4 + 2] ||
        surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
        check[iPix * 4 + 3]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBSurfaceUpdate failed");
        //PBErrCatch(ShapoidErr);
    }
}

```

```

    }
    GBSurfaceFree(&surf);

    printf("UnitTestGBSurfaceUpdate OK\n");
}

void UnitTestGBSurfaceAddLayerFromFile() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    GBLayer* layer = GBSurfaceAddLayerFromFile(surf, "./ImageRef.tga");
    (void)layer;
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBSurfaceUpdate(surf);
    unsigned char check[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255,
        0,255,0,255, 0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255, 0,255,0,255,
        0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,255,0,255, 0,255,0,255, 0,0,0,255, 0,30,0,255,
        0,60,0,255, 0,90,0,255, 0,120,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,255,0,255, 0,255,0,255, 26,30,0,255, 0,0,0,255, 4,34,0,255,
        7,67,0,255, 11,101,0,255, 120,184,120,255, 0,0,0,0, 0,0,0,0,
        0,255,0,255, 0,255,0,255, 46,60,0,255, 0,0,30,255, 7,34,26,255,
        14,67,23,255, 21,101,19,255, 120,184,136,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 148,90,90,255, 0,0,60,255, 11,34,53,255,
        21,67,46,255, 32,101,39,255, 120,184,152,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 184,120,120,255, 0,0,90,255, 14,34,79,255,
        28,67,69,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,120,255, 30,56,136,255,
        60,106,152,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255
    };
    for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
        if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
            check[iPix * 4] ||
            surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
            check[iPix * 4 + 1] ||
            surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
            check[iPix * 4 + 2] ||
            surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
            check[iPix * 4 + 3]) {
            ShapoidErr->_type = PBErrTypeUnitTestFailed;
            sprintf(ShapoidErr->_msg, "GBSurfaceAddLayerFromFile failed");
            PBErrCatch(ShapoidErr);
        }
    }
    GBSurfaceFree(&surf);
    printf("UnitTestGBSurfaceAddLayerFromFile OK\n");
}

void UnitTestGBSurfaceFlush() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBLayerSetModified(layer, false);
    GBPixel blue = GBColorBlue;
    GBSurfaceSetBgColor(surf, &blue);

```

```

GBSurfaceFlush(surf);
if (GBLayerIsModified(layer) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBSurfaceFlush failed");
    PBErrCatch(ShapoidErr);
}
for (int iPix = GBSurfaceArea(surf); iPix--;)
    if (memcmp(surf->_finalPix + iPix, &blue, sizeof(GBPixel)) != 0) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBSurfaceFlush failed");
        PBErrCatch(ShapoidErr);
    }
GBSurfaceFree(&surf);
printf("UnitTestGBSurfaceFlush OK\n");
}

void UnitTestGBSurfaceIsSameAs() {
    char* fileName = "./ImageRef.tga";
    GBSurface* surfA = (GBSurface*)GBSurfaceImageCreateFromFile(fileName);
    GBSurface* surfB = (GBSurface*)GBSurfaceImageCreateFromFile(fileName);
    if (GBSurfaceIsSameAs(surfA, surfB) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBSurfaceIsSameAs failed");
        PBErrCatch(ShapoidErr);
    }
    VecSet(GBSurfaceDim(surfA), 0, 0);
    if (GBSurfaceIsSameAs(surfA, surfB) == true) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBSurfaceIsSameAs failed");
        PBErrCatch(ShapoidErr);
    }
    VecSet(GBSurfaceDim(surfA), 0, 10);
    GBSurfaceFinalPixels(surfA)->_rgba[GBPixelAlpha] = 255;
    if (GBSurfaceIsSameAs(surfA, surfB) == true) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBSurfaceIsSameAs failed");
        PBErrCatch(ShapoidErr);
    }
    GBSurfaceFree(&surfA);
    GBSurfaceFree(&surfB);
    printf("UnitTestGBSurfaceIsSameAs OK\n");
}

void UnitTestGBSurfaceNormalizeHue() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 3); VecSet(&dim, 1, 3);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    unsigned char in[27] = {
        20,20,20, 10,20,30, 60,50,40,
        30,30,30, 20,30,40, 50,40,30,
        40,40,40, 30,40,50, 40,30,20
    };
    VecShort2D p = VecShortCreateStatic2D();
    int iPix = 0;
    do {
        GBPixel* pix = GBSurfaceFinalPixel(surf, &p);
        pix->_rgba[GBPixelRed] = in[iPix * 3];
        pix->_rgba[GBPixelGreen] = in[iPix * 3 + 1];
        pix->_rgba[GBPixelBlue] = in[iPix * 3 + 2];
        ++iPix;
    } while (VecStep(&p, GBSurfaceDim(surf)));
    GBPostProcessing post =

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    GBPostProcessingCreateStatic(GBPPTTypeNormalizeHue);
GBSurfacePostProcess(surf, &post);
VecSetNull(&p);
iPix = 0;
unsigned char out[27] = {
    51,51,51, 0,51,102, 255,204,153,
    102,102,102, 51,102,153, 204,153,102,
    153,153,153, 102,153,204, 153,102,51
};
do {
    GBPixel* pix = GBSurfaceFinalPixel(surf, &p);
    if (pix->_rgba[GBPixelRed] != out[iPix * 3] ||
        pix->_rgba[GBPixelGreen] != out[iPix * 3 + 1] ||
        pix->_rgba[GBPixelBlue] != out[iPix * 3 + 2]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceNormalizeHue failed");
        PBErrCatch(ShapoidErr);
    }
    ++iPix;
} while (VecStep(&p, GBSurfaceDim(surf)));
GBSurfaceFree(&surf);
GBSurfaceImage* img = GBSurfaceImageCreateFromFile(
    "./GBSurfaceNormalizeHueTest.tga");
GBSurfacePostProcess((GBSurface*)img, &post);
GBSurfaceImage* ref = GBSurfaceImageCreateFromFile(
    "./GBSurfaceNormalizeHueRef.tga");
if (GBSurfaceIsSameAs((GBSurface*)img, (GBSurface*)ref) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceNormalizeHue failed");
    PBErrCatch(ShapoidErr);
}
GBSurfaceFree(&surf);
GBSurfaceImageFree(&img);
GBSurfaceImageFree(&ref);
printf("UnitTestGBSurfaceNormalizeHue OK\n");
}

void UnitTestGBSurfaceOrderedDithering() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 3); VecSet(&dim, 1, 3);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    unsigned char in[27] = {
        128,128,128, 128,128,128, 128,128,128,
        128,128,128, 128,128,128, 128,128,128,
        128,128,128, 128,128,128, 128,128,128
    };
    VecShort2D p = VecShortCreateStatic2D();
    int iPix = 0;
    do {
        GBPixel* pix = GBSurfaceFinalPixel(surf, &p);
        pix->_rgba[GBPixelRed] = in[iPix * 3];
        pix->_rgba[GBPixelGreen] = in[iPix * 3 + 1];
        pix->_rgba[GBPixelBlue] = in[iPix * 3 + 2];
        ++iPix;
    } while (VecStep(&p, GBSurfaceDim(surf)));
    GBPostProcessing post =
        GBPostProcessingCreateStatic(GBPPTTypeOrderedDithering);
    GBSurfacePostProcess(surf, &post);
    VecSetNull(&p);
    iPix = 0;
    unsigned char out[27] = {
        255,255,255, 0,0,0, 255,255,255,

```

```

    0,0,0, 255,255,255, 0,0,0,
    255,255,255, 0,0,0, 255,255,255
};
do {
    GBPixel* pix = GBSurfaceFinalPixel(surf, &p);
    if (pix->_rgba[GBPixelRed] != out[iPix * 3] ||
        pix->_rgba[GBPixelGreen] != out[iPix * 3 + 1] ||
        pix->_rgba[GBPixelBlue] != out[iPix * 3 + 2]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceOrderedDithering failed");
        PBErrCatch(ShapoidErr);
    }
    ++iPix;
} while (VecStep(&p, GBSurfaceDim(surf)));
GBSurfaceFree(&surf);
GBSurfaceImage* img = GBSurfaceImageCreateFromFile(
    "./GBSurfaceOrderedDitheringTest.tga");
GBSurfacePostProcess((GBSurface*)img, &post);
GBSurfaceImage* ref = GBSurfaceImageCreateFromFile(
    "./GBSurfaceOrderedDitheringRef.tga");
if (GBSurfaceIsSameAs((GBSurface*)img, (GBSurface*)ref) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceOrderedDithering failed");
    PBErrCatch(ShapoidErr);
}
GBSurfaceFree(&surf);
GBSurfaceImageFree(&img);
GBSurfaceImageFree(&ref);
img = GBSurfaceImageCreateFromFile(
    "./GBSurfaceOrderedDitheringTestRGB.tga");
GBSurfacePostProcess((GBSurface*)img, &post);
ref = GBSurfaceImageCreateFromFile(
    "./GBSurfaceOrderedDitheringRefRGB.tga");
if (GBSurfaceIsSameAs((GBSurface*)img, (GBSurface*)ref) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceOrderedDithering failed");
    PBErrCatch(ShapoidErr);
}
GBSurfaceFree(&surf);
GBSurfaceImageFree(&img);
GBSurfaceImageFree(&ref);
printf("UnitTestGBSurfaceOrderedDithering OK\n");
}

void UnitTestGBSurfaceFloydSteinbergDithering() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 3); VecSet(&dim, 1, 3);
    GBSurface* surf = GBSurfaceCreate(GBSurfaceTypeImage, &dim);
    unsigned char in[27] = {
        128,128,128, 128,128,128, 128,128,128,
        128,128,128, 128,128,128, 128,128,128,
        128,128,128, 128,128,128, 128,128,128
    };
    VecShort2D p = VecShortCreateStatic2D();
    int iPix = 0;
    do {
        GBPixel* pix = GBSurfaceFinalPixel(surf, &p);
        pix->_rgba[GBPixelRed] = in[iPix * 3];
        pix->_rgba[GBPixelGreen] = in[iPix * 3 + 1];
        pix->_rgba[GBPixelBlue] = in[iPix * 3 + 2];
        ++iPix;
    } while (VecStep(&p, GBSurfaceDim(surf)));
}

```

```

GBPostProcessing post =
    GBPostProcessingCreateStatic(GBPPTYPEFLOYDSTEINBERGDITHERING);
GBSurfacePostProcess(surf, &post);
VecSetNull(&p);
iPix = 0;
unsigned char out[27] = {
    255,255,255, 0,0,0, 255,255,255,
    0,0,0, 255,255,255, 0,0,0,
    255,255,255, 0,0,0, 255,255,255
};
do {
    GBPixel* pix = GBSurfaceFinalPixel(surf, &p);
    if (pix->_rgba[GBPixelRed] != out[iPix * 3] ||
        pix->_rgba[GBPixelGreen] != out[iPix * 3 + 1] ||
        pix->_rgba[GBPixelBlue] != out[iPix * 3 + 2]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceFloydSteinbergDithering failed");
        PBErrCatch(ShapoidErr);
    }
    ++iPix;
} while (VecStep(&p, GBSurfaceDim(surf)));
GBSurfaceFree(&surf);
GBSurfaceImage* img = GBSurfaceImageCreateFromFile(
    "./GBSurfaceFloydSteinbergDitheringTest.tga");
GBSurfacePostProcess((GBSurface*)img, &post);
GBSurfaceImage* ref = GBSurfaceImageCreateFromFile(
    "./GBSurfaceFloydSteinbergDitheringRef.tga");
if (GBSurfaceIsSameAs((GBSurface*)img, (GBSurface*)ref) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceFloydSteinbergDithering failed");
    PBErrCatch(ShapoidErr);
}
GBSurfaceFree(&surf);
GBSurfaceImageFree(&img);
GBSurfaceImageFree(&ref);
img = GBSurfaceImageCreateFromFile(
    "./GBSurfaceFloydSteinbergDitheringTestRGB.tga");
GBSurfacePostProcess((GBSurface*)img, &post);
ref = GBSurfaceImageCreateFromFile(
    "./GBSurfaceFloydSteinbergDitheringRefRGB.tga");
if (GBSurfaceIsSameAs((GBSurface*)img, (GBSurface*)ref) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "UnitTestGBSurfaceFloydSteinbergDithering failed");
    PBErrCatch(ShapoidErr);
}
GBSurfaceFree(&surf);
GBSurfaceImageFree(&img);
GBSurfaceImageFree(&ref);
printf("UnitTestGBSurfaceFloydSteinbergDithering OK\n");
}

void UnitTestGBSurface() {
    UnitTestGBSurfaceCreateFree();
    UnitTestGBSurfaceGetSet();
    UnitTestGBSurfaceArea();
    UnitTestGBSurfaceClone();
    UnitTestGBSurfaceAddRemoveLayer();
    UnitTestGBSurfaceGetLayerNbLayer();
    UnitTestGBSurfaceSetLayersModified();
    UnitTestGBSurfaceSetLayerStackPos();
    UnitTestGBSurfaceGetModifiedArea();
    UnitTestGBSurfaceUpdate();
}

```

```

    UnitTestGBSurfaceAddLayerFromFile();
    UnitTestGBSurfaceFlush();
    UnitTestGBSurfaceIsSameAs();
    UnitTestGBSurfaceNormalizeHue();
    UnitTestGBSurfaceOrderedDithering();
    UnitTestGBSurfaceFloydSteinbergDithering();
    printf("UnitTestGBSurface OK\n");
}

void UnitTestGBSurfaceImageCreateFree() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 800); VecSet(&dim, 1, 600);
    GBSurfaceImage* surf = GBSurfaceImageCreate(&dim);
    if (GBSurfaceGetType((GBSurface*)surf) != GBSurfaceTypeImage) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(GBSurfaceDim((GBSurface*)surf), &dim) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (surf->_fileName != NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageCreate failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceImageFree(&surf);
    printf("UnitTestGBSurfaceImageCreateFree OK\n");
}

void UnitTestGBSurfaceImageGetSet() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 800); VecSet(&dim, 1, 600);
    GBSurfaceImage* surf = GBSurfaceImageCreate(&dim);
    if (GBSurfaceImageFileName(surf) != surf->_fileName) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageFileName failed");
        PBErrCatch(GenBrushErr);
    }
    char* fileName = ".";
    GBSurfaceImageSetFileName(surf, fileName);
    if (strcmp(surf->_fileName, fileName) != 0) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageSetFileName failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceImageFree(&surf);
    printf("UnitTestGBSurfaceImageGetSet OK\n");
}

void UnitTestGBSurfaceImageClone() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 800); VecSet(&dim, 1, 600);
    GBSurfaceImage* surf = GBSurfaceImageCreate(&dim);
    char* fileName = ".";
    GBSurfaceImageSetFileName(surf, fileName);
    GBSurfaceImage* clone = GBSurfaceImageClone(surf);
    if (GBSurfaceGetType((GBSurface*)clone) != GBSurfaceTypeImage) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageCreate failed");
    }
}

```



```

        PBErriCatch(GenBrushErr);
    }
    if (VecIsEqual(GBSurfaceDim((GBSurface*)clone), &dim) == false) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageCreate failed");
        PBErriCatch(GenBrushErr);
    }
    if (strcmp(clone->_fileName, fileName) != 0) {
        GenBrushErr->_type = PBErriTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageClone failed");
        PBErriCatch(GenBrushErr);
    }
    GBSurfaceImageFree(&surf);
    GBSurfaceImageFree(&clone);
    printf("UnitTestGBSurfaceImageClone OK\n");
}

void UnitTestGBSurfaceImageSave() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurfaceImage* surfImage = GBSurfaceImageCreate(&dim);
    GBSurface* surf = (GBSurface*)surfImage;

    GBPixel t = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &t);
    GBSurfaceFlush(surf);

    GBLayer* layers[4] = {NULL};
    VecSet(&dim, 0, 5); VecSet(&dim, 1, 5);
    for (int iLayer = 0; iLayer < 4; ++iLayer) {
        layers[iLayer] = GBSurfaceAddLayer(surf, &dim);
        GBLayerSetBlendMode(layers[iLayer], GBLayerBlendModeOver);
    }
    GBLayerSetStackPos(layers[0], GBLayerStackPosBg);
    GBLayerSetStackPos(layers[1], GBLayerStackPosInside);
    GBLayerSetStackPos(layers[2], GBLayerStackPosInside);
    GBLayerSetStackPos(layers[3], GBLayerStackPosFg);
    VecShort2D pos = VecShortCreateStatic2D();
    VecSet(&pos, 0, 1); VecSet(&pos, 1, 1);
    GBLayerSetPos(layers[0], &pos);
    VecSet(&pos, 0, 3); VecSet(&pos, 1, 3);
    GBLayerSetPos(layers[1], &pos);
    VecSet(&pos, 0, 4); VecSet(&pos, 1, 4);
    GBLayerSetPos(layers[2], &pos);
    VecSet(&pos, 0, 7); VecSet(&pos, 1, 7);
    GBLayerSetPos(layers[3], &pos);
    VecSetNull(&pos);
    GBPixel col;
    float depth;
    do {
        col = GBColorGreen;
        depth = 0.0;
        GBLayerAddPixel(layers[0], &pos, &col, depth);
        col._rgba[GBPixelRed] = VecGet(&pos, 1) * 30;
        col._rgba[GBPixelGreen] = VecGet(&pos, 0) * 30;
        col._rgba[GBPixelBlue] = 0;
        col._rgba[GBPixelAlpha] = 255 - VecGet(&pos, 1) * 30;
        depth = VecGet(&pos, 0);
        GBLayerAddPixel(layers[1], &pos, &col, depth);
        col._rgba[GBPixelRed] = 0;
        col._rgba[GBPixelGreen] = VecGet(&pos, 0) * 30;
        col._rgba[GBPixelBlue] = VecGet(&pos, 1) * 30;
    } while (1);
}

```

```

        col._rgba[GBPixelAlpha] = 255 - VecGet(&pos, 0) * 30;
        depth = VecGet(&pos, 1);
        GBLayerAddPixel(layers[2], &pos, &col, depth);
        col = GBColorBlue;
        depth = 0.0;
        GBLayerAddPixel(layers[3], &pos, &col, depth);
    } while (VecStep(&pos, &dim));
    GBSurfaceUpdate(surf);
    GBSurfaceImageSetFileName(surfImage, "./GBSurfaceImageSave.tga");
    if (GBSurfaceImageSave(surfImage) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageSave failed (tga)");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceImageSetFileName(surfImage, "./GBSurfaceImageSave.gif");
    if (GBSurfaceImageSave(surfImage) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageSave failed (gif)");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceImageSetFileName(surfImage, "./GBSurfaceImageSave.jpg");
    if (GBSurfaceImageSave(surfImage) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageSave failed (jpg)");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceImageSetFileName(surfImage, "./GBSurfaceImageSave.png");
    if (GBSurfaceImageSave(surfImage) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageSave failed (png)");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceImageFree(&surfImage);
    printf("UnitTestGBSurfaceImageSave OK\n");
}

void UnitTestGBSurfaceImageCreateFromFile() {
    char* fileName = "./ImageRef.tga";
    GBSurfaceImage* surfImage = GBSurfaceImageCreateFromFile(fileName);
    if (surfImage == NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceImageCreateFromFile failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurface* surf = (GBSurface*)surfImage;
    unsigned char check[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255,
        0,255,0,255, 0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255, 0,255,0,255,
        0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,255,0,255, 0,255,0,255, 0,0,0,255, 0,30,0,255,
        0,60,0,255, 0,90,0,255, 0,120,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,255,0,255, 0,255,0,255, 26,30,0,255, 0,0,0,255, 4,34,0,255,
        7,67,0,255, 11,101,0,255, 120,184,120,255, 0,0,0,0, 0,0,0,0,
        0,255,0,255, 0,255,0,255, 46,60,0,255, 0,0,30,255, 7,34,26,255,
        14,67,23,255, 21,101,19,255, 120,184,136,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 148,90,90,255, 0,0,60,255, 11,34,53,255,
        21,67,46,255, 32,101,39,255, 120,184,152,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 184,120,120,255, 0,0,90,255, 14,34,79,255,
        28,67,69,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,120,255, 30,56,136,255,
    };
}

```

```

        60,106,152,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255
    };
    for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
        if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
            check[iPix * 4] ||
            surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
            check[iPix * 4 + 1] ||
            surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
            check[iPix * 4 + 2] ||
            surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
            check[iPix * 4 + 3]) {
            ShapoidErr->_type = PBErrTypeUnitTestFailed;
            sprintf(ShapoidErr->_msg, "GBSurfaceCreateFromFile failed");
            PBErrCatch(ShapoidErr);
        }
    }
    GBSurfaceImageFree(&surfImage);
    printf("UnitTestGBSurfaceImageCreateFromFile OK\n");
}

void UnitTestGBSurfaceImage() {
    UnitTestGBSurfaceImageCreateFree();
    UnitTestGBSurfaceImageGetSet();
    UnitTestGBSurfaceImageClone();
    UnitTestGBSurfaceImageSave();
    UnitTestGBSurfaceImageCreateFromFile();
    printf("UnitTestGBSurfaceImage OK\n");
}

void UnitTestGBEyeOrthoCreateFree() {
    GBEyeOrthoView view = GBEyeOrthoViewFront;
    GBEyeOrtho* eye = GBEyeOrthoCreate(view);
    if (eye->_view != GBEyeOrthoViewFront) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeOrthoCreate failed");
        PBErrCatch(GenBrushErr);
    }
    float check[9] = {1.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 1.0};
    VecShort2D index = VecShortCreateStatic2D();
    VecShort2D dim = MatGetDim(GBEyeProj(eye));
    int iCheck = 0;
    do {
        if (ISEQUALF(MatGet(GBEyeProj(eye), &index),
            check[iCheck]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeOrthoCreate failed");
            PBErrCatch(GenBrushErr);
        }
        ++iCheck;
    } while (VecStep(&index, &dim));
    GBEyeFree(&eye);
    if (eye != NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeOrthoFree failed");
        PBErrCatch(GenBrushErr);
    }
    printf("UnitTestGBEyeOrthoCreateFree OK\n");
}

void UnitTestGBEyeOrthoGetSet() {

```

```

GBEyeOrthoView view = GBEyeOrthoViewFront;
GBEyeOrtho* eye = GBEyeOrthoCreate(view);
VecShort2D index = VecShortCreateStatic2D();
VecFloat3D scale = VecFloatCreateStatic3D();
VecSet(&scale, 0, 2.0); VecSet(&scale, 1, 3.0);
VecSet(&scale, 2, 1.0);
GBEyeSetScale(eye, &scale);
VecFloat2D orig = VecFloatCreateStatic2D();
VecSet(&orig, 0, 4.0); VecSet(&orig, 1, 5.0);
GBEyeSetOrig(eye, &orig);
float theta = PBMATH_QUARTERPI;
GBEyeSetRot(eye, theta);
VecShort2D dim = MatGetDim(GBEyeProj(eye));
float check[6][9] = {
    {1.414214, 1.414214, 0.0, -2.121320, 2.121320, 0.0, 0.0,
     0.0, 1.0},
    {-1.414214, -1.414214, 0.0, -2.121320, 2.121320, 0.0, 0.0,
     0.0, -1.0},
    {1.414214, 1.414214, 0.0, 0.0, 0.0, -1.0, -2.121320, 2.121320,
     0.0},
    {1.414214, 1.414214, 0.0, 0.0, 0.0, 1.0, 2.121320, -2.121320,
     0.0},
    {0.0, 0.0, 1.0, -2.121320, 2.121320, 0.0, -1.414214, -1.414214,
     0.0},
    {0.0, 0.0, -1.0, -2.121320, 2.121320, 0.0, 1.414214, 1.414214,
     0.0}
};
for (int iView = 6; iView--;) {
    int iCheck = 0;
    VecSetNull(&index);
    GBEyeOrthoSetView(eye, (GBEyeOrthoView)iView);
    do {
        if (ISEQUALF(MatGet(GBEyeProj(eye), &index),
            check[iView][iCheck]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeOrthoSetView failed");
            PBErrCatch(GenBrushErr);
        }
        ++iCheck;
    } while (VecStep(&index, &dim));
}
GBEyeFree(&eye);
printf("UnitTestGBEyeOrthoGetSet OK\n");
}

void UnitTestGBEyeOrthoProcessPoint() {
    VecFloat2D v2d = VecFloatCreateStatic2D();
    VecSet(&v2d, 0, 0.0); VecSet(&v2d, 1, 1.0);
    VecFloat3D v3d = VecFloatCreateStatic3D();
    VecSet(&v3d, 0, 1.0); VecSet(&v3d, 1, 0.0); VecSet(&v3d, 2, 1.0);
    VecFloat* v4d = VecFloatCreate(4);
    VecSet(v4d, 0, 1.0); VecSet(v4d, 1, 2.0);
    VecSet(v4d, 2, 3.0); VecSet(v4d, 3, 4.0);
    float check2d[6][2] = {
        {1.0, 5.0},
        {1.0, 5.0},
        {4.0, 5.0},
        {4.0, 5.0},
        {1.0, 5.0},
        {1.0, 5.0}};
    float check3d[6][3] = {
        {4.0, 7.0, 1.0},

```

```

    {4.0,3.0,-1.0},
    {1.0,7.0,0.0},
    {7.0,7.0,0.0},
    {4.0,3.0,1.0},
    {4.0,7.0,-1.0}};
float check4d[6][4] = {
    {-2.0,7.0,3.0,4.0},
    {-2.0,3.0,-3.0,4.0},
    {-5.0,7.0,-2.0,4.0},
    {13.0,7.0,2.0,4.0},
    {-2.0,-1.0,1.0,4.0},
    {-2.0,11.0,-1.0,4.0}};
GBHandDefault* hand = GBHandDefaultCreate();
for (int iView = 6; iView--;) {
    GBEyeOrthoView view = (GBEyeOrthoView)iView;
    GBEyeOrtho* eye = GBEyeOrthoCreate(view);
    VecFloat3D scale = VecFloatCreateStatic3D();
    VecSet(&scale, 0, 2.0); VecSet(&scale, 1, 3.0);
    VecSet(&scale, 2, 1.0);
    GBEyeSetScale(eye, &scale);
    VecFloat2D orig = VecFloatCreateStatic2D();
    VecSet(&orig, 0, 4.0); VecSet(&orig, 1, 5.0);
    GBEyeSetOrig(eye, &orig);
    float theta = PBMATH_HALFPI;
    GBEyeSetRot(eye, theta);
    GBLayer layer;
    GBInk ink;
    GBTool tool;
    GBObjPod* pod = GBObjPodCreatePoint((VecFloat*)&v2d, eye,
        hand, &tool, &ink, &layer);
    VecFloat* proj = GBObjPodGetEyeObjAsPoint(pod);
    if (VecGetDim(proj) != VecGetDim(pod->_srcPoint)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeOrthoProcess failed");
        PBErrCatch(GenBrushErr);
    }
    for (int i = VecGetDim(proj); i--;) {
        if (ISEQUALF(VecGet(proj, i), check2d[iView][i]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeOrthoProcess failed");
            PBErrCatch(GenBrushErr);
        }
    }
    pod->_srcPoint = (VecFloat*)&v3d;
    GBEyeProcess((GBEye*)eye, pod);
    proj = GBObjPodGetEyeObjAsPoint(pod);
    if (VecGetDim(proj) != 3) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeOrthoProcess failed");
        PBErrCatch(GenBrushErr);
    }
    for (int i = VecGetDim(proj); i--;) {
        if (ISEQUALF(VecGet(proj, i), check3d[iView][i]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeOrthoProcess failed");
            PBErrCatch(GenBrushErr);
        }
    }
    pod->_srcPoint = v4d;
    GBEyeProcess((GBEye*)eye, pod);
    proj = GBObjPodGetEyeObjAsPoint(pod);
    if (VecGetDim(proj) != 4) {

```

```

        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeOrthoProcess failed");
        PBErrCatch(GenBrushErr);
    }
    for (int i = VecGetDim(proj); i--;) {
        if (ISEQUALF(VecGet(proj, i), check4d[iView][i]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeOrthoProcess failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBEyeFree(&eye);
    GBObjPodFree(&pod);
}
GBHandDefaultFree(&hand);
VecFree(&v4d);
printf("UnitTestGBEyeOrthoProcessPoint OK\n");
}

void UnitTestGBEyeOrthoProcessCurve() {
    SCurve* curve = SCurveCreate(1, 2, 2);
    for (int iCtrl = SCurveGetNbCtrl(curve); iCtrl--;) {
        SCurveCtrlSet(curve, iCtrl, 0, (float)iCtrl);
        SCurveCtrlSet(curve, iCtrl, 1, (float)iCtrl * 2.0);
    }
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    float theta = PBMATH_HALFPi;
    GBEyeSetRot((GBEye*)eye, theta);
    SCurve* projCurve = GBEyeGetProjectedCurve((GBEye*)eye, curve);
    if (SCurveGetDim(projCurve) != SCurveGetDim(curve)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeOrthoGetProjectedCurve failed");
        PBErrCatch(GenBrushErr);
    }
    for (int iCtrl = SCurveGetNbCtrl(curve); iCtrl--;) {
        if (ISEQUALF(SCurveCtrlGet(projCurve, iCtrl, 0),
            (float)iCtrl * -2.0) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeOrthoGetProjectedCurve failed");
            PBErrCatch(GenBrushErr);
        }
        if (ISEQUALF(SCurveCtrlGet(projCurve, iCtrl, 1),
            (float)iCtrl) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeOrthoGetProjectedCurve failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBEyeFree(&eye);
    SCurveFree(&curve);
    SCurveFree(&projCurve);
    printf("UnitTestGBEyeOrthoProcessCurve OK\n");
}

void UnitTestGBEyeOrthoProcessShapoid() {
    Facoid* facoid = FacoidCreate(2);
    VecFloat2D v = VecFloatCreateStatic2D();
    VecSet(&v, 0, 1.0); VecSet(&v, 1, 2.0);
    ShapoidTranslate(facoid, &v);
    VecSet(&v, 0, 2.0); VecSet(&v, 1, 3.0);
    ShapoidScale(facoid, (VecFloat*)&v);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);

```

```

Shapoid* shap =
    GBEyeGetProjectedShapoid((GBEye*)eye, (Shapoid*)facoid);
VecFloat2D checka = VecFloatCreateStatic2D();
VecSet(&checka, 0, 1.0); VecSet(&checka, 1, 2.0);
VecFloat2D checkb = VecFloatCreateStatic2D();
VecSet(&checkb, 0, 2.0); VecSet(&checkb, 1, 0.0);
VecFloat2D checkc = VecFloatCreateStatic2D();
VecSet(&checkc, 0, 0.0); VecSet(&checkc, 1, 3.0);
if (VecIsEqual(ShapoidPos(shap), &checka) == false ||
    VecIsEqual(ShapoidAxis(shap, 0), &checkb) == false ||
    VecIsEqual(ShapoidAxis(shap, 1), &checkc) == false) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBEyeOrthoGetProjectedShapoid failed");
    PBErrCatch(GenBrushErr);
}
ShapoidFree(&shap);
GBEyeFree(&eye);
ShapoidFree(&facoid);

Spheroid* spheroid = SpheroidCreate(3);
VecFloat3D u = VecFloatCreateStatic3D();
VecSet(&u, 0, 1.0); VecSet(&u, 1, 2.0); VecSet(&u, 2, 3.0);
ShapoidTranslate(spheroid, &u);
VecSet(&u, 0, 2.0); VecSet(&u, 1, 3.0); VecSet(&u, 2, 4.0);
ShapoidScale(spheroid, (VecFloat*)&u);
VecFloat3D checkd[6];
VecFloat3D checke[6];
VecFloat3D checkf[6];
VecFloat3D checkg[6];
for (int iView = 6; iView--;) {
    checkd[iView] = VecFloatCreateStatic3D();
    checke[iView] = VecFloatCreateStatic3D();
    checkf[iView] = VecFloatCreateStatic3D();
    checkg[iView] = VecFloatCreateStatic3D();
}
VecSet(checkd, 0, 3.0); VecSet(checkd, 1, 2.0);
VecSet(checkd, 2, -1.0);
VecSet(checke, 0, 0.0); VecSet(checke, 1, 0.0);
VecSet(checke, 2, -2.0);
VecSet(checkf, 0, 0.0); VecSet(checkf, 1, 4.0);
VecSet(checkf, 2, 0.0);
VecSet(checkg, 0, 3.0); VecSet(checkg, 1, 0.0);
VecSet(checkg, 2, 0.0);
VecSet(checkd + 1, 0, -3.0); VecSet(checkd + 1, 1, 2.0);
VecSet(checkd + 1, 2, 1.0);
VecSet(checke + 1, 0, 0.0); VecSet(checke + 1, 1, 0.0);
VecSet(checke + 1, 2, 2.0);
VecSet(checkf + 1, 0, 0.0); VecSet(checkf + 1, 1, 4.0);
VecSet(checkf + 1, 2, 0.0);
VecSet(checkg + 1, 0, -3.0); VecSet(checkg + 1, 1, 0.0);
VecSet(checkg + 1, 2, 0.0);
VecSet(checkd + 2, 0, 1.0); VecSet(checkd + 2, 1, -3.0);
VecSet(checkd + 2, 2, 2.0);
VecSet(checke + 2, 0, 2.0); VecSet(checke + 2, 1, 0.0);
VecSet(checke + 2, 2, 0.0);
VecSet(checkf + 2, 0, 0.0); VecSet(checkf + 2, 1, 0.0);
VecSet(checkf + 2, 2, 4.0);
VecSet(checkg + 2, 0, 0.0); VecSet(checkg + 2, 1, -3.0);
VecSet(checkg + 2, 2, 0.0);
VecSet(checkd + 3, 0, 1.0); VecSet(checkd + 3, 1, 3.0);
VecSet(checkd + 3, 2, -2.0);
VecSet(checke + 3, 0, 2.0); VecSet(checke + 3, 1, 0.0);

```

```

VecSet(checke + 3, 2, 0.0);
VecSet(checkf + 3, 0, 0.0); VecSet(checkf + 3, 1, 0.0);
VecSet(checkf + 3, 2, -4.0);
VecSet(checkg + 3, 0, 0.0); VecSet(checkg + 3, 1, 3.0);
VecSet(checkg + 3, 2, 0.0);
VecSet(checkd + 4, 0, -1.0); VecSet(checkd + 4, 1, 2.0);
VecSet(checkd + 4, 2, -3.0);
VecSet(checke + 4, 0, -2.0); VecSet(checke + 4, 1, 0.0);
VecSet(checke + 4, 2, 0.0);
VecSet(checkf + 4, 0, 0.0); VecSet(checkf + 4, 1, 4.0);
VecSet(checkf + 4, 2, 0.0);
VecSet(checkg + 4, 0, 0.0); VecSet(checkg + 4, 1, 0.0);
VecSet(checkg + 4, 2, -3.0);
VecSet(checkd + 5, 0, 1.0); VecSet(checkd + 5, 1, 2.0);
VecSet(checkd + 5, 2, 3.0);
VecSet(checke + 5, 0, 2.0); VecSet(checke + 5, 1, 0.0);
VecSet(checke + 5, 2, 0.0);
VecSet(checkf + 5, 0, 0.0); VecSet(checkf + 5, 1, 4.0);
VecSet(checkf + 5, 2, 0.0);
VecSet(checkg + 5, 0, 0.0); VecSet(checkg + 5, 1, 0.0);
VecSet(checkg + 5, 2, 3.0);
for (int iView = 6; iView--;) {
    GBEyeOrthoView view = (GBEyeOrthoView)iView;
    GBEyeOrtho* eye = GBEyeOrthoCreate(view);
    Shapoid* shap =
        GBEyeGetProjectedShapoid((GBEye*)eye, (Shapoid*)spheroid);
    if (VecIsEqual(ShapoidPos(shap), checkd + 5 - iView) == false ||
        VecIsEqual(ShapoidAxis(shap, 0), checke + 5 - iView) == false ||
        VecIsEqual(ShapoidAxis(shap, 1), checkf + 5 - iView) == false ||
        VecIsEqual(ShapoidAxis(shap, 2), checkg + 5 - iView) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg,
            "GBEyeOrthoGetProjectedShapoid failed");
        PBErrCatch(GenBrushErr);
    }
    ShapoidFree(&shap);
    GBEyeFree(&eye);
}
ShapoidFree(&spheroid);
printf("UnitTestGBEyeOrthoProcessShapoid OK\n");
}

void UnitTestGBEyeOrtho() {
    UnitTestGBEyeOrthoCreateFree();
    UnitTestGBEyeOrthoGetSet();
    UnitTestGBEyeOrthoProcessPoint();
    UnitTestGBEyeOrthoProcessCurve();
    UnitTestGBEyeOrthoProcessShapoid();
    printf("UnitTestGBEyeOrtho OK\n");
}

void UnitTestGBEyeIsometricCreateFree() {
    GBEyeIsometric* eye = GBEyeIsometricCreate();
    if (GBEyeGetType(eye) != GBEyeTypeIsometric ||
        ISEQUALF(eye->_thetaRight, PBMath_QUARTERPI) == false ||
        ISEQUALF(eye->_thetaY, PBMath_QUARTERPI) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricCreate failed");
        PBErrCatch(GenBrushErr);
    }
}
float check[9] = {
    0.707107, -0.00000, -0.707107,

```



```

    0.50000, 0.707107, 0.50000,
    0.50000, -0.707107, 0.50000
};
for (int iVal = 9; iVal--;) {
    if (ISEQUALF(eye->_eye._proj->_val[iVal], check[iVal]) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricCreate failed");
        PBErrCatch(GenBrushErr);
    }
}
GBEyeFree(&eye);
if (eye != NULL) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBEyeIsometricFree failed");
    PBErrCatch(GenBrushErr);
}
printf("UnitTestGBEyeIsometricCreateFree OK\n");
}

void UnitTestGBEyeIsometricGetSet() {
    GBEyeIsometric* eye = GBEyeIsometricCreate();
    if (ISEQUALF(GBEyeIsometricGetRotY(eye), eye->_thetaY) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricGetRotY failed");
        PBErrCatch(GenBrushErr);
    }
    if (ISEQUALF(GBEyeIsometricGetRotRight(eye),
        eye->_thetaRight) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricGetRotRight failed");
        PBErrCatch(GenBrushErr);
    }
    GBEyeIsometricSetRotRight(eye, 0.5 * PBMath_QUARTERPI);
    if (ISEQUALF(GBEyeIsometricGetRotRight(eye),
        0.5 * PBMath_QUARTERPI) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricSetRotRight failed");
        PBErrCatch(GenBrushErr);
    }
    float checka[9] = {
        0.707107, -0.000000, -0.707107,
        0.270598, 0.923880, 0.270598,
        0.653282, -0.382683, 0.653281
    };
    for (int iVal = 9; iVal--;) {
        if (ISEQUALF(eye->_eye._proj->_val[iVal], checka[iVal]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeIsometricSetRotRight failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBEyeIsometricSetRotY(eye, 0.5 * PBMath_QUARTERPI);
    float checkb[9] = {
        0.923880, -0.000000, -0.382683,
        0.146447, 0.923880, 0.353553,
        0.353553, -0.382683, 0.853553
    };
    if (ISEQUALF(GBEyeIsometricGetRotY(eye),
        0.5 * PBMath_QUARTERPI) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricSetRotY failed");
        PBErrCatch(GenBrushErr);
    }
}

```

```

    }
    for (int iVal = 9; iVal--;) {
        if (ISEQUALF(eye->eye._proj->_val[iVal], checkb[iVal]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeIsometricSetRotY failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBEyeFree(&eye);
    printf("UnitTestGBEyeIsometricGetSet OK\n");
}

void UnitTestGBEyeIsometricProcessPoint() {
    VecFloat2D v2d = VecFloatCreateStatic2D();
    VecSet(&v2d, 0, 0.0); VecSet(&v2d, 1, 1.0);
    VecFloat3D v3d = VecFloatCreateStatic3D();
    VecSet(&v3d, 0, 1.0); VecSet(&v3d, 1, 0.0); VecSet(&v3d, 2, 1.0);
    VecFloat* v4d = VecFloatCreate(4);
    VecSet(v4d, 0, 1.0); VecSet(v4d, 1, 2.0);
    VecSet(v4d, 2, 3.0); VecSet(v4d, 3, 4.0);
    float check2d[2] = {1.878680, 5.0};
    float check3d[3] = {1.0, 5.0, 1.0};
    float check4d[4] = {-6.242640, 2.171572, 0.585786, 4.0};
    GBHandDefault* hand = GBHandDefaultCreate();
    GBEyeIsometric* eye = GBEyeIsometricCreate();
    VecFloat3D scale = VecFloatCreateStatic3D();
    VecSet(&scale, 0, 2.0); VecSet(&scale, 1, 3.0);
    VecSet(&scale, 2, 1.0);
    GBEyeSetScale(eye, &scale);
    VecFloat2D orig = VecFloatCreateStatic2D();
    VecSet(&orig, 0, 4.0); VecSet(&orig, 1, 5.0);
    GBEyeSetOrig(eye, &orig);
    float theta = PBMATH_HALFPI;
    GBEyeSetRot(eye, theta);
    GBLayer layer;
    GBInk ink;
    GBTool tool;
    GBObjPod* pod = GBObjPodCreatePoint((VecFloat*)&v2d, eye,
        hand, &tool, &ink, &layer);
    VecFloat* proj = GBObjPodGetEyeObjAsPoint(pod);
    if (VecGetDim(proj) != VecGetDim(pod->_srcPoint)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricProcess failed");
        PBErrCatch(GenBrushErr);
    }
    for (int i = VecGetDim(proj); i--;) {
        if (ISEQUALF(VecGet(proj, i), check2d[i]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBEyeIsometricProcess failed");
            PBErrCatch(GenBrushErr);
        }
    }
    pod->_srcPoint = (VecFloat*)&v3d;
    GBEyeProcess((GBEye*)eye, pod);
    proj = GBObjPodGetEyeObjAsPoint(pod);
    if (VecGetDim(proj) != 3) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricProcess failed");
        PBErrCatch(GenBrushErr);
    }
    for (int i = VecGetDim(proj); i--;) {
        if (ISEQUALF(VecGet(proj, i), check3d[i]) == false) {

```

```

        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricProcess failed");
        PBErrCatch(GenBrushErr);
    }
}
pod->_srcPoint = v4d;
GBEyeProcess((GBEye*)eye, pod);
proj = GBObjPodGetEyeObjAsPoint(pod);
if (VecGetDim(proj) != 4) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBEyeIsometricProcess failed");
    PBErrCatch(GenBrushErr);
}
for (int i = VecGetDim(proj); i--;) {
    if (ISEQUALF(VecGet(proj, i), check4d[i]) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBEyeIsometricProcess failed");
        PBErrCatch(GenBrushErr);
    }
}
GBEyeFree(&eye);
GBObjPodFree(&pod);
GBHandDefaultFree(&hand);
VecFree(&v4d);
printf("UnitTestGBEyeIsometricProcessPoint OK\n");
}

void UnitTestGBEyeIsometricProcessCurve() {
    SCurve* curve = SCurveCreate(1, 2, 2);
    for (int iCtrl = SCurveGetNbCtrl(curve); iCtrl--;) {
        SCurveCtrlSet(curve, iCtrl, 0, (float)iCtrl);
        SCurveCtrlSet(curve, iCtrl, 1, (float)iCtrl * 2.0);
    }
    GBEyeIsometric* eye = GBEyeIsometricCreate();
    SCurve* projCurve = GBEyeGetProjectedCurve((GBEye*)eye, curve);
    if (SCurveGetDim(projCurve) != SCurveGetDim(curve)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg,
            "GBEyeIsometricGetProjectedCurve failed");
        PBErrCatch(GenBrushErr);
    }
    float check[3][2]={
        {0.0,0.0},
        {0.707107,1.914214},
        {1.414214,3.828427}
    };
    for (int iCtrl = SCurveGetNbCtrl(curve); iCtrl--;) {
        if (ISEQUALF(SCurveCtrlGet(projCurve, iCtrl, 0),
            check[iCtrl][0]) == false ||
            ISEQUALF(SCurveCtrlGet(projCurve, iCtrl, 1),
            check[iCtrl][1]) == false) {
            GenBrushErr->_type = PBErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg,
                "GBEyeIsometricGetProjectedCurve failed");
            PBErrCatch(GenBrushErr);
        }
    }
    GBEyeFree(&eye);
    SCurveFree(&curve);
    SCurveFree(&projCurve);
    printf("UnitTestGBEyeIsometricProcessCurve OK\n");
}

```

```

void UnitTestGBEyeIsometricProcessShapoid() {
    Facoid* facoid = FacoidCreate(3);
    VecFloat3D v = VecFloatCreateStatic3D();
    VecSet(&v, 0, 1.0); VecSet(&v, 1, 2.0); VecSet(&v, 2, 3.0);
    ShapoidTranslate(facoid, &v);
    VecSet(&v, 0, 3.0); VecSet(&v, 1, 2.0); VecSet(&v, 2, 1.0);
    ShapoidScale(facoid, (VecFloat*)&v);
    GBEyeIsometric* eye = GBEyeIsometricCreate();
    Shapoid* shap =
        GBEyeGetProjectedShapoid((GBEye*)eye, (Shapoid*)facoid);
    VecFloat3D checka = VecFloatCreateStatic3D();
    VecSet(&checka, 0, -1.414214); VecSet(&checka, 1, 3.414214);
    VecSet(&checka, 2, 0.585786);
    VecFloat3D checkb = VecFloatCreateStatic3D();
    VecSet(&checkb, 0, 2.121320); VecSet(&checkb, 1, 1.500000);
    VecSet(&checkb, 2, 1.500000);
    VecFloat3D checkc = VecFloatCreateStatic3D();
    VecSet(&checkc, 0, 0.000000); VecSet(&checkc, 1, 1.414214);
    VecSet(&checkc, 2, -1.414214);
    VecFloat3D checkd = VecFloatCreateStatic3D();
    VecSet(&checkd, 0, -0.707107); VecSet(&checkd, 1, 0.500000);
    VecSet(&checkd, 2, 0.500000);
    if (VecIsEqual(ShapoidPos(shap), &checka) == false ||
        VecIsEqual(ShapoidAxis(shap, 0), &checkb) == false ||
        VecIsEqual(ShapoidAxis(shap, 1), &checkc) == false ||
        VecIsEqual(ShapoidAxis(shap, 2), &checkd) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg,
            "GBEyeIsometricGetProjectedShapoid failed");
        PBErrCatch(GenBrushErr);
    }
    ShapoidFree(&shap);
    GBEyeFree(&eye);
    ShapoidFree(&facoid);
    printf("UnitTestGBEyeIsometricProcessShapoid OK\n");
}

void UnitTestGBEyeIsometric() {
    UnitTestGBEyeIsometricCreateFree();
    UnitTestGBEyeIsometricGetSet();
    UnitTestGBEyeIsometricProcessPoint();
    UnitTestGBEyeIsometricProcessCurve();
    UnitTestGBEyeIsometricProcessShapoid();
    printf("UnitTestGBEyeIsometric OK\n");
}

void UnitTestGBEyeCreateFree() {
    VecFloat3D v = VecFloatCreateStatic3D();
    VecSet(&v, 0, 1.0); VecSet(&v, 1, 1.0); VecSet(&v, 2, 1.0);
    VecFloat2D w = VecFloatCreateStatic2D();
    GBEye eye = GBEyeCreateStatic(GBEyeTypeOrtho);
    if (eye._type != GBEyeTypeOrtho ||
        VecIsEqual(&(eye._scale), &v) == false ||
        VecIsEqual(&(eye._orig), &w) == false ||
        eye._proj == NULL) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeCreateStatic failed");
        PBErrCatch(ShapoidErr);
    }
    GBEyeFreeStatic(&eye);
    if (eye._proj != NULL) {

```

```

        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeFreeStatic failed");
        PBErrCatch(ShapoidErr);
    }
    printf("UnitTestGBEyeCreateFree OK\n");
}

void UnitTestGBEyeGetSet() {
    GBEye eye = GBEyeCreateStatic(GBEyeTypeOrtho);
    if (GBEyeGetType(&eye) != GBEyeTypeOrtho) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeGetType failed");
        PBErrCatch(ShapoidErr);
    }
    if (GBEyeScale(&eye) != &(eye._scale)) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeScale failed");
        PBErrCatch(ShapoidErr);
    }
    VecFloat3D v = GBEyeGetScale(&eye);
    if (VecIsEqual(&v, &(eye._scale)) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeGetScale failed");
        PBErrCatch(ShapoidErr);
    }
    if (GBEyeOrig(&eye) != &(eye._orig)) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeOrig failed");
        PBErrCatch(ShapoidErr);
    }
    VecFloat2D w = GBEyeGetOrig(&eye);
    if (VecIsEqual(&w, &(eye._orig)) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeGetOrig failed");
        PBErrCatch(ShapoidErr);
    }
    if (GBEyeGetRot(&eye) != eye._theta) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeGetRot failed");
        PBErrCatch(ShapoidErr);
    }
    VecSet(&v, 0, 2.0); VecSet(&v, 1, 3.0); VecSet(&v, 2, 4.0);
    GBEyeSetScale(&eye, &v);
    if (VecIsEqual(&v, &(eye._scale)) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeSetScale failed");
        PBErrCatch(ShapoidErr);
    }
    VecSet(&v, 0, 3.0); VecSet(&v, 1, 3.0); VecSet(&v, 2, 3.0);
    GBEyeSetScale(&eye, (float)3.0);
    if (VecIsEqual(&v, &(eye._scale)) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeSetScale failed");
        PBErrCatch(ShapoidErr);
    }
    GBEyeSetOrig(&eye, &w);
    if (VecIsEqual(&w, &(eye._orig)) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeSetOrig failed");
        PBErrCatch(ShapoidErr);
    }
    float theta = 1.0;

```

```

    GBEyeSetRot(&eye, theta);
    if (ISEQUALF(eye._theta, theta) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeSetRot failed");
        PBErrCatch(ShapoidErr);
    }
    if (GBEyeProj(&eye) != eye._proj) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBEyeProj failed");
        PBErrCatch(ShapoidErr);
    }
    GBEyeFreeStatic(&eye);
    printf("UnitTestGBEyeGetSet OK\n");
}

void UnitTestGBEye() {
    UnitTestGBEyeCreateFree();
    UnitTestGBEyeGetSet();
    UnitTestGBEyeOrtho();
    UnitTestGBEyeIsometric();
    printf("UnitTestGBEye OK\n");
}

void UnitTestGBHandDefaultCreateFree() {
    GBHandDefault* hand = GBHandDefaultCreate();
    if (GBHandGetType(hand) != GBHandTypeDefault) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBHandDefaultCreate failed");
        PBErrCatch(ShapoidErr);
    }
    GBHandDefaultFree(&hand);
    if (hand != NULL) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBHandDefaultFree failed");
        PBErrCatch(ShapoidErr);
    }
    printf("UnitTestGBHandDefaultCreateFree OK\n");
}

void UnitTestGBHandDefaultProcess() {
    VecFloat3D point = VecFloatCreateStatic3D();
    VecSet(&point, 0, 1.0); VecSet(&point, 1, 2.0);
    VecSet(&point, 2, 3.0);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHandDefault* hand = GBHandDefaultCreate();
    GBTool tool;
    GBInk ink;
    GBLayer layer;
    GBObjPod* pod =
        GBObjPodCreatePoint(&point, &eye, hand, &tool, &ink, &layer);
    GBHandProcess(hand, pod);
    if (GSetNbElem(&(pod->_handPoints)) == 0 ||
        VecIsEqual(GSetHead(&(pod->_handPoints)),
            &point) == false) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBHandDefaultProcess failed");
        PBErrCatch(ShapoidErr);
    }
    GBEyeOrthoFree(&eye);
    GBObjPodFree(&pod);
    GBHandDefaultFree(&hand);
    printf("UnitTestGBHandDefaultProcess OK\n");
}

```

```

}

void UnitTestGBHandDefault() {
    UnitTestGBHandDefaultCreateFree();
    UnitTestGBHandDefaultProcess();
    printf("UnitTestGBHandDefault OK\n");
}

void UnitTestGBHandCreateFree() {
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    if (hand._type != GBHandTypeDefault) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBHandCreateStatic failed");
        PBErrCatch(ShapoidErr);
    }
    GBHandFreeStatic(&hand);
    printf("UnitTestGBHandCreateFree OK\n");
}

void UnitTestGBHandGetSet() {
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    if (GBHandGetType(&hand) != GBHandTypeDefault) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBHandGetType failed");
        PBErrCatch(ShapoidErr);
    }
    GBHandFreeStatic(&hand);
    printf("UnitTestGBHandCreateFree OK\n");
}

void UnitTestGBHand() {
    UnitTestGBHandCreateFree();
    UnitTestGBHandGetSet();
    UnitTestGBHandDefault();
    printf("UnitTestGBHand OK\n");
}

void UnitTestGBToolPlotterCreateFree() {
    GBToolPlotter* tool = GBToolPlotterCreate();
    if (tool->_tool._type != GBToolTypePlotter) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPlotterCreate failed");
        PBErrCatch(GenBrushErr);
    }
    GBToolPlotterFree(&tool);
    if (tool != NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPlotterFree failed");
        PBErrCatch(GenBrushErr);
    }
    printf("UnitTestGBToolPlotterCreateFree OK\n");
}

void UnitTestGBToolPlotterDrawPoint() {
    GBToolPlotter* tool = GBToolPlotterCreate();
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBPixel red = GBColorRed;

```





```

GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
GBPixel transparent = GBColorTransparent;
GBSurfaceSetBgColor(surf, &transparent);
GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
GBPixel blue = GBColorBlue;
GBInkSolid* ink = GBInkSolidCreate(&blue);
Facoid* facoid = FacoidCreate(2);
Shapoid* shap = (Shapoid*)facoid;
VecFloat2D v = VecFloatCreateStatic2D();
VecSet(&v, 0, 7.0); VecSet(&v, 1, 4.0);
ShapoidScale(shap, (VecFloat*)&v);
VecSet(&v, 0, 2.0); VecSet(&v, 1, 4.0);
ShapoidTranslate(shap, (VecFloat*)&v);
ShapoidRotStart(shap, PBMATH_QUARTERPI);
GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
GBObjPod* pod =
    GBObjPodCreateShapoid(shap, &eye, &hand, tool, ink, layer);
GBToolPlotterDraw(tool, pod);
GBSurfaceUpdate(surf);
#if BUILDMODE == 0
    unsigned char check[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
        0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
        0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    };
#else
    unsigned char check[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    };

```

```

    0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0
};
#endif
for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
    if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
        check[iPix * 4] ||
        surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
        check[iPix * 4 + 1] ||
        surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
        check[iPix * 4 + 2] ||
        surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
        check[iPix * 4 + 3]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBToolPlotterDrawFacoid failed");
        //PBErrCatch(ShapoidErr);
    }
}
GBSurfaceImageSetFileName((GBSurfaceImage*)surf,
    "/GBToolPlotterDrawFacoid.tga");
GBSurfaceImageSave((GBSurfaceImage*)surf);
GBObjPodFree(&pod);
GBToolPlotterFree(&tool);
GBSurfaceImageFree((GBSurfaceImage**)&surf);
GBInkSolidFree(&ink);
ShapoidFree(&facoid);
GBEyeOrthoFree(&eye);
printf("UnitTestGBToolPlotterDrawFacoid OK\n");
}

void UnitTestGBToolPlotterDrawPyramidoid() {
    GBToolPlotter* tool = GBToolPlotterCreate();
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBPixel blue = GBColorBlue;
    GBInkSolid* ink = GBInkSolidCreate(&blue);
    Pyramidoid* pyramidoid = PyramidoidCreate(2);
    Shapoid* shap = (Shapoid*)pyramidoid;
    VecFloat2D v = VecFloatCreateStatic2D();
    VecSet(&v, 0, 7.0); VecSet(&v, 1, 4.0);
    ShapoidScale(shap, (VecFloat*)&v);
    VecSet(&v, 0, 2.0); VecSet(&v, 1, 4.0);
    ShapoidTranslate(shap, (VecFloat*)&v);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBObjPod* pod =
        GBObjPodCreateShapoid(shap, &eye, &hand, tool, ink, layer);
    GSetAppend(&(pod->_handShapoids), shap);
    GBToolPlotterDraw(tool, pod);
    GBSurfaceUpdate(surf);
    unsigned char checka[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    };
}

```

```

0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0
};
for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
    if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
        checka[iPix * 4] ||
        surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
        checka[iPix * 4 + 1] ||
        surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
        checka[iPix * 4 + 2] ||
        surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
        checka[iPix * 4 + 3]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBToolPlotterDraw failed (2)");
        PBErrCatch(ShapoidErr);
    }
}
GBSurfaceImageSetFileName((GBSurfaceImage*)surf,
    "./GBToolPlotterDrawPyramidoid.tga");
GBSurfaceImageSave((GBSurfaceImage*)surf);
GBObjPodFree(&pod);
GBToolPlotterFree(&tool);
GBSurfaceImageFree((GBSurfaceImage**)&surf);
GBInkSolidFree(&ink);
GBEyeOrthoFree(&eye);
printf("UnitTestGBToolPlotterDrawPyramidoid OK\n");
}

void UnitTestGBToolPlotterDrawSpheroid() {
    GBToolPlotter* tool = GBToolPlotterCreate();
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBPixel blue = GBColorBlue;
    GBInkSolid* ink = GBInkSolidCreate(&blue);
    Spheroid* spheroid = SpheroidCreate(2);
    Shapoid* shap = (Shapoid*)spheroid;
    VecFloat2D v = VecFloatCreateStatic2D();
    VecSet(&v, 0, 10.0); VecSet(&v, 1, 8.0);
    ShapoidScale(shap, (VecFloat*)&v);
    VecSet(&v, 0, 5.0); VecSet(&v, 1, 5.0);
    ShapoidTranslate(shap, (VecFloat*)&v);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBObjPod* pod =
        GBObjPodCreateShapoid(shap, &eye, &hand, tool, ink, layer);
    GSetAppend(&(pod->_handShapoids), shap);
}

```

```

GBToolPlotterDraw(tool, pod);
GBSurfaceUpdate(surf);
unsigned char checka[400] = {
    0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
    0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255,
    0,0,255,255, 0,0,255,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0
};
for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
    if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
        checka[iPix * 4] ||
        surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
        checka[iPix * 4 + 1] ||
        surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
        checka[iPix * 4 + 2] ||
        surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
        checka[iPix * 4 + 3]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBToolPlotterDraw failed (3)");
        PBErrCatch(ShapoidErr);
    }
}
GBSurfaceImageSetFileName((GBSurfaceImage*)surf,
    "./GBToolPlotterDrawSpheroid.tga");
GBSurfaceImageSave((GBSurfaceImage*)surf);
GBObjPodFree(&pod);
GBToolPlotterFree(&tool);
GBSurfaceImageFree((GBSurfaceImage**)&surf);
GBInkSolidFree(&ink);
GBEyeOrthoFree(&eye);
printf("UnitTestGBToolPlotterDrawSpheroid OK\n");
}

void UnitTestGBToolPlotterDrawFacoid3D() {
    GBToolPlotter* tool = GBToolPlotterCreate();
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBLayerSetStackPos(layer, GBLayerStackPosInside);
    GBLayerSetBlendMode(layer, GBLayerBlendModeOver);
    GBPixel blue = GBColorBlue;
    blue._rgba[GBPixelAlpha] = 10;
    GBInkSolid* ink = GBInkSolidCreate(&blue);

```



```

void UnitTestGBToolPlotterDrawSCurve() {
    GBToolPlotter* tool = GBToolPlotterCreate();
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBLayerSetStackPos(layer, GBLayerStackPosInside);
    GBLayerSetBlendMode(layer, GBLayerBlendModeOver);
    GBPixel blue = GBColorBlue;
    blue._rgba[GBPixelAlpha] = 10;
    GBInkSolid* ink = GBInkSolidCreate(&blue);
    SCurve* curve = SCurveCreate(3, 3, 1);
    VecFloat3D v = VecFloatCreateStatic3D();
    SCurveSetCtrl(curve, 0, (VecFloat*)&v);
    VecSet(&v, 0, 10.0); VecSet(&v, 1, 10.0); VecSet(&v, 2, 10.0);
    SCurveSetCtrl(curve, 1, (VecFloat*)&v);
    VecSet(&v, 0, 10.0); VecSet(&v, 1, 0.0); VecSet(&v, 2, -10.0);
    SCurveSetCtrl(curve, 2, (VecFloat*)&v);
    VecSet(&v, 0, 0.0); VecSet(&v, 1, 10.0); VecSet(&v, 2, 0.0);
    SCurveSetCtrl(curve, 3, (VecFloat*)&v);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBObjPod* pod =
        GBObjPodCreateSCurve(curve, &eye, &hand, tool, ink, layer);
    GBToolPlotterDraw(tool, pod);
    GBSurfaceUpdate(surf);
    unsigned char checka[400] = {
        0,0,10,10, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,20,20,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,10,10, 0,0,10,10,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,20,20, 0,0,10,10, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,10,10, 0,0,10,10, 0,0,10,10, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,40,40, 0,0,60,60, 0,0,10,10, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,10,10, 0,0,10,10, 0,0,10,10, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,20,20,
        0,0,10,10, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,10,10, 0,0,10,10, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,20,20, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0
    };
    for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
        if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
            checka[iPix * 4] ||
            surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
            checka[iPix * 4 + 1] ||
            surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
            checka[iPix * 4 + 2] ||
            surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
            checka[iPix * 4 + 3]) {
            ShapoidErr->_type = PBErrTypeUnitTestFailed;
            sprintf(ShapoidErr->_msg, "GBToolPlotterDraw failed (5)");
            PBErrCatch(ShapoidErr);
        }
    }
    GBSurfaceImageSetFileName((GBSurfaceImage*)surf,
        ". /GBToolPlotterDrawSCurve.tga");
}

```

```

    GBSurfaceImageSave((GBSurfaceImage*)surf);
    GBObjPodFree(&pod);
    GBToolPlotterFree(&tool);
    GBSurfaceImageFree((GBSurfaceImage**) &surf);
    GBInkSolidFree(&ink);
    SCurveFree(&curve);
    GBEyeOrthoFree(&eye);
    printf("UnitTestGBToolPlotterDrawSCurve OK\n");
}

void UnitTestGBToolPlotter() {
    UnitTestGBToolPlotterCreateFree();
    UnitTestGBToolPlotterDrawPoint();
    UnitTestGBToolPlotterDrawFacoid();
    UnitTestGBToolPlotterDrawPyramidoid();
    UnitTestGBToolPlotterDrawSpheroid();
    UnitTestGBToolPlotterDrawFacoid3D();
    UnitTestGBToolPlotterDrawSCurve();

    printf("UnitTestGBToolPlotter OK\n");
}

void UnitTestGBToolCreateFree() {
    GBTool tool = GBToolCreateStatic(GBToolTypePlotter);
    if (tool._type != GBToolTypePlotter) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolCreateStatic failed");
        PBErrCatch(GenBrushErr);
    }
    GBToolFreeStatic(&tool);
    printf("UnitTestGBToolCreateFree OK\n");
}

void UnitTestGBToolGetSet() {
    GBTool tool = GBToolCreateStatic(GBToolTypePlotter);
    if (GBToolGetType(&tool) != GBToolTypePlotter) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolGetType failed");
        PBErrCatch(GenBrushErr);
    }
    GBToolFreeStatic(&tool);
    printf("UnitTestGBToolGetSet OK\n");
}

void UnitTestGBToolPenCreateFreeSetGet() {
    Spheroid* penShape = SpheroidCreate(2);
    GBToolPen* tool = GBToolPenCreate((Shapoid*)penShape);
    if (tool->_tool._type != GBToolTypePen ||
        tool->_shape == NULL ||
        !ISEQUALF(tool->_softness, 1.0)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPenCreate failed");
        PBErrCatch(GenBrushErr);
    }
    if (GBToolPenShape(tool) != tool->_shape) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPenShape failed");
        PBErrCatch(GenBrushErr);
    }
    GBToolPenSetSoftness(tool, 0.5);
    if (!ISEQUALF(tool->_softness, 0.5)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
    }
}

```

```

        sprintf(GenBrushErr->_msg, "GBToolPenSetSoftness failed");
        PBErrCatch(GenBrushErr);
    }
    if (!ISEQUALF(GBToolPenGetSoftness(tool), 0.5)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPenGetSoftness failed");
        PBErrCatch(GenBrushErr);
    }

    GBToolPenFree(&tool);
    if (tool != NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPenFree failed");
        PBErrCatch(GenBrushErr);
    }
    ShapoidFree(&penShape);
    printf("UnitTestGBToolPenCreateFreeSetGet OK\n");
}

void UnitTestGBToolPenDrawPoint() {
    Spheroid* penShape = SpheroidCreate(2);
    VecFloat2D scale = VecFloatCreateStatic2D();
    VecSet(&scale, 0, 10.0);
    VecSet(&scale, 1, 5.0);
    ShapoidScale(penShape, (VecFloat*)&scale);
    GBToolPen* tool = GBToolPenCreate((Shapoid*)penShape);
    GBToolPenSetSoftness(tool, 0.5);
    ShapoidFree(&penShape);
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 30); VecSet(&dim, 1, 30);
    GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBPixel red = GBColorRed;
    GBInkSolid* ink = GBInkSolidCreate(&red);
    VecFloat* pos = VecFloatCreate(2);
    VecSet(pos, 0, 15.0); VecSet(pos, 1, 15.0);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBObjPod* pod =
        GBObjPodCreatePoint(pos, &eye, &hand, tool, ink, layer);
    GSetAppend(&(pod->_handPoints), VecClone(pos));
    GBToolPenDraw(tool, pod);
    GBSurfaceUpdate(surf);
    GBSurfaceImageSetFileName((GBSurfaceImage*)surf,
        "./GBToolPenDrawPoint.tga");
    GBSurfaceImageSave((GBSurfaceImage*)surf);
    GenBrush* ref = GBCreateFromFile("./GBToolPenDrawPointRef.tga");
    if (!GBSurfaceIsSameAs(surf, GBSurf(ref))) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPenDrawPoint failed");
        PBErrCatch(GenBrushErr);
    }
    GBFree(&ref);
    GBObjPodFree(&pod);
    GBToolPenFree(&tool);
    GBSurfaceImageFree((GBSurfaceImage**)&surf);
    GBInkSolidFree(&ink);
    GBEyeOrthoFree(&eye);
    VecFree(&pos);
    printf("UnitTestGBToolPenDrawPoint OK\n");
}

```



```

}

void UnitTestGBToolPenDrawSCurve() {
    Spheroid* penShape = SpheroidCreate(2);
    VecFloat2D scale = VecFloatCreateStatic2D();
    VecSet(&scale, 0, 8.0);
    VecSet(&scale, 1, 3.0);
    ShapoidScale(penShape, (VecFloat*)&scale);
    GBToolPen* tool = GBToolPenCreate((Shapoid*)penShape);
    ShapoidFree(&penShape);
    GBToolPenSetSoftness(tool, 2.0);
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 30); VecSet(&dim, 1, 30);
    GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
    GBPixel white = GBColorWhite;
    GBSurfaceSetBgColor(surf, &white);
    GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
    GBLayerSetBlendMode(layer, GBLayerBlendModeOver);
    GBPixel red = GBColorRed;
    GBInkSolid* ink = GBInkSolidCreate(&red);
    SCurve* curve = SCurveCreate(3, 2, 1);
    VecFloat2D v = VecFloatCreateStatic2D();
    SCurveSetCtrl(curve, 0, (VecFloat*)&v);
    VecSet(&v, 0, 30.0); VecSet(&v, 1, 30.0);
    SCurveSetCtrl(curve, 1, (VecFloat*)&v);
    VecSet(&v, 0, 30.0); VecSet(&v, 1, 0.0);
    SCurveSetCtrl(curve, 2, (VecFloat*)&v);
    VecSet(&v, 0, 0.0); VecSet(&v, 1, 30.0);
    SCurveSetCtrl(curve, 3, (VecFloat*)&v);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBObjPod* pod =
        GBObjPodCreateSCurve(curve, &eye, &hand, tool, ink, layer);
    GBToolPenDraw(tool, pod);
    GBSurfaceUpdate(surf);
    GBSurfaceImageSetFileName((GBSurfaceImage*)surf,
        "./GBToolPenDrawSCurve.tga");
    GBSurfaceImageSave((GBSurfaceImage*)surf);
    GenBrush* ref = GBCreateFromFile("./GBToolPenDrawSCurveRef.tga");
    if (!GBSurfaceIsSameAs(surf, GBSurf(ref))) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBToolPenDrawSCurve failed");
        PBErrCatch(GenBrushErr);
    }
    GBFree(&ref);
    GBObjPodFree(&pod);
    GBToolPenFree(&tool);
    GBSurfaceImageFree((GBSurfaceImage**)&surf);
    GBInkSolidFree(&ink);
    GBEyeOrthoFree(&eye);
    SCurveFree(&curve);
    printf("UnitTestGBToolPenDrawSCurve OK\n");
}

void UnitTestGBToolPenDrawFacoid() {
    Spheroid* penShape = SpheroidCreate(2);
    VecFloat2D scale = VecFloatCreateStatic2D();
    VecSet(&scale, 0, 8.0);
    VecSet(&scale, 1, 3.0);
    ShapoidScale(penShape, (VecFloat*)&scale);
    GBToolPen* tool = GBToolPenCreate((Shapoid*)penShape);
    ShapoidFree(&penShape);

```

```

GBToolPenSetSoftness(tool, 2.0);
VecShort2D dim = VecShortCreateStatic2D();
VecSet(&dim, 0, 30); VecSet(&dim, 1, 30);
GBSurface* surf = (GBSurface*)GBSurfaceImageCreate(&dim);
GBPixel blue = GBColorWhite;
GBSurfaceSetBgColor(surf, &blue);
GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
GBLayerSetBlendMode(layer, GBLayerBlendModeOver);
GBPixel red = GBColorRed;
GBInkSolid* ink = GBInkSolidCreate(&red);
Facoid* facoid = FacoidCreate(2);
Shapoid* shap = (Shapoid*)facoid;
VecFloat2D v = VecFloatCreateStatic2D();
VecSet(&v, 0, 10.0); VecSet(&v, 1, 15.0);
ShapoidScale(shap, (VecFloat*)&v);
VecSet(&v, 0, 15.0); VecSet(&v, 1, 10.0);
ShapoidTranslate(shap, (VecFloat*)&v);
ShapoidRotStart(shap, PBMATH_QUARTERPI);
GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
GBObjPod* pod =
    GBObjPodCreateShapoid(shap, &eye, &hand, tool, ink, layer);
GBToolPenDraw(tool, pod);
GBSurfaceUpdate(surf);
GBSurfaceImageSetFileName((GBSurfaceImage*)surf,
    "/GBToolPenDrawFacoid.tga");
GBSurfaceImageSave((GBSurfaceImage*)surf);
GenBrush* ref = GBCreateFromFile("/GBToolPenDrawFacoidRef.tga");
if (!GBSurfaceIsSameAs(surf, GBSurf(ref))) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBToolPenDrawFacoid failed");
    PBErrCatch(GenBrushErr);
}
GBFree(&ref);
GBObjPodFree(&pod);
GBToolPenFree(&tool);
GBSurfaceImageFree((GBSurfaceImage**)&surf);
GBInkSolidFree(&ink);
GBEyeOrthoFree(&eye);
ShapoidFree(&facoid);
printf("UnitTestGBToolPenDrawFacoid OK\n");
}

void UnitTestGBToolPen() {
    UnitTestGBToolPenCreateFreeSetGet();
    UnitTestGBToolPenDrawPoint();
    UnitTestGBToolPenDrawFacoid();
    UnitTestGBToolPenDrawSCurve();

    printf("UnitTestGBToolPen OK\n");
}

void UnitTestGBTool() {
    UnitTestGBToolCreateFree();
    UnitTestGBToolGetSet();
    UnitTestGBToolPlotter();
    UnitTestGBToolPen();
    printf("UnitTestGBTool OK\n");
}

void UnitTestGBInkSolidCreateFree() {
    GBPixel green = GBColorGreen;

```

```

GBInkSolid* ink = GBInkSolidCreate(&green);
if (memcmp(&(ink->_color), &green, sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBInkSolidCreate failed");
    PBErrCatch(GenBrushErr);
}
if (ink->_ink._type != GBInkTypeSolid) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBInkSolidCreate failed");
    PBErrCatch(GenBrushErr);
}
GBInkSolidFree(&ink);
if (ink != NULL) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBInkSolidFree failed");
    PBErrCatch(GenBrushErr);
}
printf("UnitTestGBInkSolidCreateFree OK\n");
}

void UnitTestGBInkSolidGetSet() {
    GBPixel green = GBColorGreen;
    GBInkSolid* ink = GBInkSolidCreate(&green);
    GBPixel col = GBInkSolidGet(ink);
    if (memcmp(&col, &green, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBInkSolidGet failed");
        PBErrCatch(GenBrushErr);
    }
    GBPixel blue = GBColorBlue;
    GBInkSolidSet(ink, &blue);
    if (memcmp(&(ink->_color), &blue, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBInkSolidSet failed");
        PBErrCatch(GenBrushErr);
    }
    col = GBInkGet(ink, NULL, NULL, NULL, NULL, NULL);
    if (memcmp(&col, &blue, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBInkGet failed");
        PBErrCatch(GenBrushErr);
    }
    if (GBInkGetType(ink) != GBInkTypeSolid) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBInkGetType failed");
        PBErrCatch(GenBrushErr);
    }
    GBInkSolidFree(&ink);
    printf("UnitTestGBInkSolidGetSet OK\n");
}

void UnitTestGBInkSolid() {
    UnitTestGBInkSolidCreateFree();
    UnitTestGBInkSolidGetSet();
    printf("UnitTestGBInkSolid OK\n");
}

void UnitTestGBInk() {
    UnitTestGBInkSolid();
    printf("UnitTestGBInk OK\n");
}

```

```

void UnitTestGBObjPodCreateFree() {
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBTool tool;
    GBLayer layer;
    GBInk ink;
    VecFloat3D pos = VecFloatCreateStatic3D();
    GBObjPod* pod =
        GBObjPodCreatePoint(&pos, eye, &hand, &tool, &ink, &layer);
    if (pod->_type != GBObjTypePoint ||
        pod->_srcPoint != (VecFloat*)&pos ||
        pod->_eyePoint == NULL ||
        GSetNbElem(&(pod->_handPoints)) != 1 ||
        GSetNbElem(&(pod->_handShapoids)) != 0 ||
        GSetNbElem(&(pod->_handSCurves)) != 0 ||
        pod->_eye != (GBEye*)eye ||
        pod->_hand != &hand ||
        pod->_tool != &tool ||
        pod->_ink != &ink ||
        pod->_layer != &layer) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodCreatePoint failed");
        PBErrCatch(GenBrushErr);
    }
    GBObjPodFree(&pod);
    if (pod != NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodFree failed");
        PBErrCatch(GenBrushErr);
    }
    Facoid* facoid = FacoidCreate(2);
    pod = GBObjPodCreateShapoid(facoid, eye, &hand, &tool, &ink, &layer);
    if (pod->_type != GBObjTypeShapoid ||
        pod->_srcShapoid != (Shapoid*)facoid ||
        pod->_eyeShapoid == NULL ||
        GSetNbElem(&(pod->_handPoints)) != 0 ||
        GSetNbElem(&(pod->_handShapoids)) != 1 ||
        GSetNbElem(&(pod->_handSCurves)) != 0 ||
        pod->_eye != (GBEye*)eye ||
        pod->_hand != &hand ||
        pod->_tool != &tool ||
        pod->_ink != &ink ||
        pod->_layer != &layer) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodCreateShapoid failed");
        PBErrCatch(GenBrushErr);
    }
    GBObjPodFree(&pod);
    SCurve* curve = SCurveCreate(2, 2, 1);
    pod = GBObjPodCreateSCurve(curve, eye, &hand, &tool, &ink, &layer);
    if (pod->_type != GBObjTypeSCurve ||
        pod->_srcSCurve != curve ||
        pod->_eyeSCurve == NULL ||
        GSetNbElem(&(pod->_handPoints)) != 0 ||
        GSetNbElem(&(pod->_handShapoids)) != 0 ||
        GSetNbElem(&(pod->_handSCurves)) != 1 ||
        pod->_eye != (GBEye*)eye ||
        pod->_hand != &hand ||
        pod->_tool != &tool ||
        pod->_ink != &ink ||
        pod->_layer != &layer) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
    }
}

```

```

        sprintf(GenBrushErr->_msg, "GBObjPodCreateSCurve failed");
        PBErrCatch(GenBrushErr);
    }
    GBObjPodFree(&pod);
    SCurveFree(&curve);
    ShapoidFree(&facoid);
    GBEyeOrthoFree(&eye);
    printf("UnitTestGBObjPodCreateFree OK\n");
}

void UnitTestGBObjPodGetSet() {
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHandDefault* hand = GBHandDefaultCreate();
    GBTool* tool = PBErrMalloc(GenBrushErr, sizeof(GBTool));
    GBLayer* layer = PBErrMalloc(GenBrushErr, sizeof(GBLayer));
    GBInk* ink = PBErrMalloc(GenBrushErr, sizeof(GBInk));
    VecFloat2D pos = VecFloatCreateStatic2D();
    GBObjPod* pod =
        GBObjPodCreatePoint(&pos, eye, hand, tool, ink, layer);
    if (GBObjPodGetType(pod) != GBObjTypePoint) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodGetType failed");
        PBErrCatch(GenBrushErr);
    }
    if (GBObjPodGetObjAsPoint(pod) != (VecFloat*)&pos) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodGetObjAsPoint failed");
        PBErrCatch(GenBrushErr);
    }
    if (GBObjPodGetHandObjAsPoints(pod) != &(pod->_handPoints)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodGetHandObjAsPoints failed");
        PBErrCatch(GenBrushErr);
    }
    if (GBObjPodGetHandObjAsShapoids(pod) != &(pod->_handShapoids)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodGetHandObjAsShapoids failed");
        PBErrCatch(GenBrushErr);
    }
    if (GBObjPodGetHandObjAsSCurves(pod) != &(pod->_handSCurves)) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodGetHandObjAsSCurves failed");
        PBErrCatch(GenBrushErr);
    }
    if (GBObjPodGetEyeObjAsPoint(pod) != pod->_eyePoint) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodGetEyeObjAsPoint failed");
        PBErrCatch(GenBrushErr);
    }
    VecFloat* posEyeB = VecFloatCreate(2);
    GBObjPodSetEyePoint(pod, posEyeB);
    if (GBObjPodGetEyeObjAsPoint(pod) != posEyeB) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodSetEyePoint failed");
        PBErrCatch(GenBrushErr);
    }
    GBObjPodFree(&pod);
    Facoid* shap = FacoidCreate(2);
    pod = GBObjPodCreateShapoid(shap, eye, hand, tool, ink, layer);
    if (GBObjPodGetType(pod) != GBObjTypeShapoid) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBObjPodGetType failed");
    }
}

```

```

    PBErCatch(GenBrushErr);
}
if (GBObjPodGetObjAsShapoid(pod) != (Shapoid*)shap) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodGetObjAsShapoid failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodGetEyeObjAsShapoid(pod) != pod->_eyeShapoid) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodGetEyeObjAsShapoid failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodEye(pod) != (GBEye*)eye) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodGetEye failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodHand(pod) != (GBHand*)hand) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodGetHand failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodTool(pod) != tool) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodGetTool failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodInk(pod) != ink) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodGetInk failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodLayer(pod) != layer) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodGetLayer failed");
    PBErCatch(GenBrushErr);
}
Facoid* shapEyeB = FacoidCreate(2);
GBEyeOrtho* eyeB = GBEyeOrthoCreate(GBEyeOrthoViewFront);
GBHandDefault* handB = GBHandDefaultCreate();
GBTool* toolB = PBErMalloc(GenBrushErr, sizeof(GBTool));
GBLayer* layerB = PBErMalloc(GenBrushErr, sizeof(GBLayer));
GBInk* inkB = PBErMalloc(GenBrushErr, sizeof(GBInk));
GBObjPodSetEyeShapoid(pod, shapEyeB);
if (GBObjPodGetEyeObjAsShapoid(pod) != (Shapoid*)shapEyeB) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodSetEyeShap failed");
    PBErCatch(GenBrushErr);
}
GBObjPodSetEye(pod, eyeB);
GBObjPodSetHand(pod, handB);
GBObjPodSetTool(pod, toolB);
GBObjPodSetInk(pod, inkB);
GBObjPodSetLayer(pod, layerB);
if (GBObjPodEye(pod) != (GBEye*)eyeB) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodSetEye failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodHand(pod) != (GBHand*)handB) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodSetHand failed");
}

```

```

    PBErCatch(GenBrushErr);
}
if (GBObjPodTool(pod) != toolB) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodSetTool failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodInk(pod) != inkB) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodSetInk failed");
    PBErCatch(GenBrushErr);
}
if (GBObjPodLayer(pod) != layerB) {
    GenBrushErr->_type = PBErTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBObjPodSetLayer failed");
    PBErCatch(GenBrushErr);
}
GBEyeOrthoFree(&eye);
GBHandDefaultFree(&hand);
free(tool);
free(ink);
free(layer);
GBEyeOrthoFree(&eyeB);
GBHandDefaultFree(&handB);
free(toolB);
free(inkB);
free(layerB);
ShapoidFree(&shap);
GBObjPodFree(&pod);
printf("UnitTestGBObjPodGetSet OK\n");
}

void UnitTestGBObjPod() {
    UnitTestGBObjPodCreateFree();
    UnitTestGBObjPodGetSet();

    printf("UnitTestGBObjPod OK\n");
}

void UnitTestGenBrushCreateFree() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 800); VecSet(&dim, 1, 600);
    GenBrush* gb = GBCreateImage(&dim);
    if (VecIsEqual(GBSurfaceDim(gb->_surf), &dim) == false) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBCreateImage failed");
        PBErCatch(GenBrushErr);
    }
    if (GBSurfaceGetType(gb->_surf) != GBSurfaceTypeImage) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBCreateImage failed");
        PBErCatch(GenBrushErr);
    }
    if (GSetNbElem(&(gb->_pods)) != 0) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBCreateImage failed");
        PBErCatch(GenBrushErr);
    }
    GBFree(&gb);
    if (gb != NULL) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBFree failed");
    }
}

```

```

    PBErCatch(GenBrushErr);
}
printf("UnitTestGenBrushCreateFree OK\n");
}

void UnitTestGenBrushGetSet() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GenBrush* gb = GBCreateImage(&dim);
    if (VecIsEqual(GBDim(gb), &dim) == false) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBDim failed");
        PBErCatch(GenBrushErr);
    }
    VecShort2D d = GBGetDim(gb);
    if (VecIsEqual(&d, &dim) == false) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBGetDim failed");
        PBErCatch(GenBrushErr);
    }
    if (GBSurf(gb) != gb->_surf) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurf failed");
        PBErCatch(GenBrushErr);
    }
    if (GBFinalPixels(gb) != gb->_surf->_finalPix) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBFinalPix failed");
        PBErCatch(GenBrushErr);
    }
    if (GBGetType(gb) != GBSurfaceTypeImage) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBGetType failed");
        PBErCatch(GenBrushErr);
    }
    VecFloat2D v = VecFloatCreateStatic2D();
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBTool tool;
    GBLayer layer;
    GBInk ink;
    GSetAppend(&(gb->_pods), GBObjPodCreatePoint(&v, &eye, &hand,
        &tool, &ink, &layer));
    if (GBGetNbPod(gb) != 1) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBGetNbPod failed");
        PBErCatch(GenBrushErr);
    }
    GBPixel black = GBColorBlack;
    GBSetBgColor(gb, &black);
    if (memcmp(&(gb->_surf->_bgColor), &black, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSetBgColor failed");
        PBErCatch(GenBrushErr);
    }
    if (memcmp(GBBgColor(gb), &black, sizeof(GBPixel)) != 0) {
        GenBrushErr->_type = PBErTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBBgColor failed");
        PBErCatch(GenBrushErr);
    }
    GBPixel bgCol = GBGetBgColor(gb);
    if (memcmp(&(gb->_surf->_bgColor), &bgCol, sizeof(GBPixel)) != 0) {

```



```

    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBGetBgColor failed");
    PBErrCatch(GenBrushErr);
}
char* fileName = "./";
GBSetFileName(gb, fileName);
if (strcmp(((GBSurfaceImage*)(gb->_surf))->_fileName,
    fileName) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSetFileName failed");
    PBErrCatch(GenBrushErr);
}
if (strcmp(GBFileName(gb), fileName) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBFileName failed");
    PBErrCatch(GenBrushErr);
}
VecShort2D p = VecShortCreateStatic2D();
VecSet(&p, 0, 1); VecSet(&p, 1, 2);
if (GBFinalPixel(gb, &p) != gb->_surf->_finalPix + 9) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBFinalPixel failed");
    PBErrCatch(GenBrushErr);
}
if (GBFinalPixelSafe(gb, &p) != gb->_surf->_finalPix + 9) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBFinalPixelSafe failed");
    PBErrCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, -2);
if (GBFinalPixelSafe(gb, &p) != NULL) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBFinalPixelSafe failed");
    PBErrCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, 2);
GBPixel white = GBColorWhite;
GBSetFinalPixel(gb, &p, &white);
if (memcmp(GBFinalPixel(gb, &p), &white,
    sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSetFinalPixel failed");
    PBErrCatch(GenBrushErr);
}
GBPixel pix = GBGetFinalPixel(gb, &p);
if (memcmp(&pix, &white, sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBGetFinalPixel failed");
    PBErrCatch(GenBrushErr);
}
GBPixel blue = GBColorBlue;
GBSetFinalPixelSafe(gb, &p, &blue);
pix = GBGetFinalPixel(gb, &p);
if (memcmp(&pix, &blue, sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSetFinalPixelSafe failed");
    PBErrCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, -2);
GBSetFinalPixelSafe(gb, &p, &white);
pix = GBGetFinalPixelSafe(gb, &p);
GBPixel transparent = GBColorTransparent;

```

```

if (memcmp(&pix, &transparent, sizeof(GBPixel)) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBGetFinalPixelSafe failed");
    PBErrCatch(GenBrushErr);
}
if (GBArea(gb) != 12) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBArea failed");
    PBErrCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, 2);
if (GBIsPosInside(gb, &p) == false) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBIsPosInside failed");
    PBErrCatch(GenBrushErr);
}
VecSet(&p, 0, 10); VecSet(&p, 1, 2);
if (GBIsPosInside(gb, &p) == true) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBIsPosInside failed");
    PBErrCatch(GenBrushErr);
}
VecSet(&p, 0, 1); VecSet(&p, 1, -2);
if (GBIsPosInside(gb, &p) == true) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBIsPosInside failed");
    PBErrCatch(GenBrushErr);
}
if (GBLayers(gb) != &(gb->_surf->_layers)) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBSurfaceLayers failed");
    PBErrCatch(GenBrushErr);
}
GBEyeOrthoFree(&eye);
GBFree(&gb);
printf("UnitTestGenBrushGetSet OK\n");
}

void UnitTestGenBrushUpdate() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GenBrush* gb = GBCreateImage(&dim);
    GBSurface* surf = GBSurf(gb);
    GBLayer* layer = GBAddLayer(gb, &dim);
    GBToolPlotter* tool = GBToolPlotterCreate();
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBPixel blue = GBColorBlue;
    GBInkSolid* ink = GBInkSolidCreate(&blue);
    Facoid* facoid = FacoidCreate(2);
    Shapoid* shap = (Shapoid*)facoid;
    VecFloat2D v = VecFloatCreateStatic2D();
    VecSet(&v, 0, 7.0); VecSet(&v, 1, 4.0);
    ShapoidScale(shap, (VecFloat*)&v);
    VecSet(&v, 0, 2.0); VecSet(&v, 1, 4.0);
    ShapoidTranslate(shap, (VecFloat*)&v);
    GBEyeOrtho* eye = GBEyeOrthoCreate(GBEyeOrthoViewFront);
    GBHand hand = GBHandCreateStatic(GBHandTypeDefault);
    GBAddShapoid(gb, shap, &eye, &hand, tool, ink, layer);
    GBUpdate(gb);
    unsigned char check[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,

```

```

0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,255,255, 0,0,255,255, 0,0,255,255,
0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0
};
for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
    if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
        check[iPix * 4] ||
        surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
        check[iPix * 4 + 1] ||
        surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
        check[iPix * 4 + 2] ||
        surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
        check[iPix * 4 + 3]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBUpdate failed");
        PBErrCatch(ShapoidErr);
    }
}
}
GBToolPlotterFree(&tool);
GBInkSolidFree(&ink);
ShapoidFree(&shap);
GBEyeOrthoFree(&eye);
GBFree(&gb);
printf("UnitTestGenBrushUpdate OK\n");
}

void UnitTestGenBrushRender() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GenBrush* gb = GBCreateImage(&dim);
    GBSurface* surf = GBSurf(gb);
    GBLayer* layers[4] = {NULL};
    VecSet(&dim, 0, 5); VecSet(&dim, 1, 5);
    for (int iLayer = 0; iLayer < 4; ++iLayer) {
        layers[iLayer] = GBSurfaceAddLayer(surf, &dim);
        GBLayerSetBlendMode(layers[iLayer], GBLayerBlendModeOver);
    }
    GBLayerSetStackPos(layers[1], GBLayerStackPosInside);
    GBLayerSetStackPos(layers[2], GBLayerStackPosInside);
    GBLayerSetStackPos(layers[3], GBLayerStackPosFg);
    VecShort2D pos = VecShortCreateStatic2D();
    VecSet(&pos, 0, 1); VecSet(&pos, 1, 1);
    GBLayerSetPos(layers[0], &pos);
    VecSet(&pos, 0, 3); VecSet(&pos, 1, 3);
    GBLayerSetPos(layers[1], &pos);
    VecSet(&pos, 0, 4); VecSet(&pos, 1, 4);
}

```

```

GBLayerSetPos(layers[2], &pos);
VecSet(&pos, 0, 7); VecSet(&pos, 1, 7);
GBLayerSetPos(layers[3], &pos);
VecSetNull(&pos);
GBPixel col;
float depth;
do {
    col = GBColorGreen;
    depth = 0.0;
    GBLayerAddPixel(layers[0], &pos, &col, depth);
    col._rgba[GBPixelRed] = VecGet(&pos, 1) * 30;
    col._rgba[GBPixelGreen] = VecGet(&pos, 0) * 30;
    col._rgba[GBPixelBlue] = 0;
    col._rgba[GBPixelAlpha] = 255 - VecGet(&pos, 1) * 30;
    depth = VecGet(&pos, 0);
    GBLayerAddPixel(layers[1], &pos, &col, depth);
    col._rgba[GBPixelRed] = 0;
    col._rgba[GBPixelGreen] = VecGet(&pos, 0) * 30;
    col._rgba[GBPixelBlue] = VecGet(&pos, 1) * 30;
    col._rgba[GBPixelAlpha] = 255 - VecGet(&pos, 0) * 30;
    depth = VecGet(&pos, 1);
    GBLayerAddPixel(layers[2], &pos, &col, depth);
    col = GBColorBlue;
    depth = 0.0;
    GBLayerAddPixel(layers[3], &pos, &col, depth);
} while (VecStep(&pos, &dim));
GBUpdate(gb);
GBSetFileName(gb, "./UnitTestGenBrushRender.tga");
GBRender(gb);
GBFree(&gb);
printf("UnitTestGenBrushRender OK\n");
}

void UnitTestGenBrushAddRemoveLayer() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GenBrush* gb = GBCreateImage(&dim);
    GBLayer* layerA = GBAAddLayer(gb, &dim);
    if (layerA == NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBAddLayer failed");
        PBErrCatch(GenBrushErr);
    }
    if (GSetNbElem(GBSurfaceLayers(GBSurf(gb))) != 1) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBAddLayer failed");
        PBErrCatch(GenBrushErr);
    }
    if (VecIsEqual(GBLayerDim(layerA), &dim) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBAddLayer failed");
        PBErrCatch(GenBrushErr);
    }
    GBLayer* layerB = GBAAddLayer(gb, &dim);
    GBRemoveLayer(gb, layerA);
    if ((GBLayer*)(GBSurf(gb)->_layers._head->_data) != layerB) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBRemoveLayer failed");
        PBErrCatch(GenBrushErr);
    }
    GBFree(&gb);
    printf("UnitTestGenBrushAddRemoveLayer OK\n");
}

```

```

}

void UnitTestGenBrushGetLayerNbLayer() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GenBrush* gb = GBCreateImage(&dim);
    GBLayer* layers[3] = {NULL};
    for (int iLayer = 0; iLayer < 3; ++iLayer)
        layers[iLayer] = GBAddLayer(gb, &dim);
    if (GBGetNbLayer(gb) != 3) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBGetNbLayer failed");
        PErrCatch(GenBrushErr);
    }
    for (int iLayer = 0; iLayer < 3; ++iLayer) {
        if (GBLayer(gb, iLayer) != layers[iLayer]) {
            GenBrushErr->_type = PErrTypeUnitTestFailed;
            sprintf(GenBrushErr->_msg, "GBGetLayer failed");
            PErrCatch(GenBrushErr);
        }
    }
    GBFree(&gb);
    printf("UnitTestGenBrushGetLayer OK\n");
}

void UnitTestGenBrushSetLayerPos() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 4); VecSet(&dim, 1, 3);
    GenBrush* gb = GBCreateImage(&dim);
    GBLayer* layers[3] = {NULL};
    for (int iLayer = 0; iLayer < 3; ++iLayer)
        layers[iLayer] = GBAddLayer(gb, &dim);
    GBSetLayerStackPos(gb, layers[2], 0);
    GBSetLayerStackPos(gb, layers[0], 2);
    if (GBLayer(gb, 0) != layers[2] ||
        GBLayer(gb, 1) != layers[1] ||
        GBLayer(gb, 2) != layers[0] ||
        GBLayerIsModified(layers[0]) != true ||
        GBLayerIsModified(layers[1]) != true ||
        GBLayerIsModified(layers[2]) != true) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSetLayerPos failed");
        PErrCatch(GenBrushErr);
    }
    GBFree(&gb);
    printf("UnitTestGenBrushSetLayerPos OK\n");
}

void UnitTestGenBrushAddLayerFromFile() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GenBrush* gb = GBCreateImage(&dim);
    GBSurface* surf = GBSurf(gb);
    GBLayer* layer = GBAddLayerFromFile(gb, "../ImageRef.tga");
    (void)layer;
    GBPixel transparent = GBColorTransparent;
    GBSurfaceSetBgColor(surf, &transparent);
    GBSurfaceUpdate(surf);
    unsigned char check[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255,
        0,255,0,255, 0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
    };
}

```

```

0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255, 0,255,0,255,
0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,255,0,255, 0,255,0,255, 0,0,0,255, 0,30,0,255,
0,60,0,255, 0,90,0,255, 0,120,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,255,0,255, 0,255,0,255, 26,30,0,255, 0,0,0,255, 4,34,0,255,
7,67,0,255, 11,101,0,255, 120,184,120,255, 0,0,0,0, 0,0,0,0,
0,255,0,255, 0,255,0,255, 46,60,0,255, 0,0,30,255, 7,34,26,255,
14,67,23,255, 21,101,19,255, 120,184,136,255, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 148,90,90,255, 0,0,60,255, 11,34,53,255,
21,67,46,255, 32,101,39,255, 120,184,152,255, 0,0,0,0, 0,0,0,0,
0,0,0,0, 0,0,0,0, 184,120,120,255, 0,0,90,255, 14,34,79,255,
28,67,69,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,120,255, 30,56,136,255,
60,106,152,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
0,0,255,255, 0,0,255,255, 0,0,255,255
};
for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
    if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
        check[iPix * 4] ||
        surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
        check[iPix * 4 + 1] ||
        surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
        check[iPix * 4 + 2] ||
        surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
        check[iPix * 4 + 3]) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBAddLayerFromFile failed");
        PBErrCatch(ShapoidErr);
    }
}
GBFree(&gb);
printf("UnitTestGenBrushAddLayerFromFile OK\n");
}

void UnitTestGenBrushAddRemoveObj() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GenBrush* gb = GBCreateImage(&dim);
    VecFloat2D posA = VecFloatCreateStatic2D();
    VecFloat2D posB = VecFloatCreateStatic2D();
    GBEye eyeA = GBEyeCreateStatic(GBEyeTypeOrtho);
    GBEye eyeB = GBEyeCreateStatic(GBEyeTypeOrtho);
    GBHand handA = GBHandCreateStatic(GBHandTypeDefault);
    GBHand handB = GBHandCreateStatic(GBHandTypeDefault);
    GBTool toolA;
    GBTool toolB;
    GBLayer layerA;
    GBLayer layerB;
    GBInk inkA;
    GBInk inkB;
    GBAddPoint(gb, &posA, &eyeA, &handA, &toolA, &inkA, &layerA);
    GBAddPoint(gb, &posB, &eyeA, &handA, &toolA, &inkB, &layerA);
    if (GBGetNbPod(gb) != 2 ||
        ((GBObjPod*)(gb->_pods._head->_data))->_srcPoint !=
        (VecFloat*)&posA ||
        ((GBObjPod*)(gb->_pods._head->_next->_data))->_srcPoint !=
        (VecFloat*)&posB) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBAddPoint failed");
        PBErrCatch(GenBrushErr);
    }
}

```

```

GBRemovePod(gb, &posA, NULL, NULL, NULL, NULL, NULL);
if (GBGetNbPod(gb) != 1 ||
    ((GBObjPod*)(gb->pods._head->_data))->_srcPoint !=
    (VecFloat*)&posB) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBRemovePod failed");
    PBErrCatch(GenBrushErr);
}
GBAddPoint(gb, &posA, &eyeA, &handA, &toolA, &inkA, &layerA);
GBRemovePod(gb, NULL, &eyeA, NULL, NULL, NULL, NULL);
if (GBGetNbPod(gb) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBRemovePod failed");
    PBErrCatch(GenBrushErr);
}
GBAddPoint(gb, &posA, &eyeA, &handA, &toolA, &inkA, &layerA);
GBAddPoint(gb, &posB, &eyeB, &handA, &toolA, &inkA, &layerA);
GBRemovePod(gb, NULL, &eyeA, &handA, NULL, NULL, NULL);
if (GBGetNbPod(gb) != 1 ||
    ((GBObjPod*)(gb->pods._head->_data))->_srcPoint !=
    (VecFloat*)&posB) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBRemovePod failed");
    PBErrCatch(GenBrushErr);
}
GBAddPoint(gb, &posA, &eyeA, &handA, &toolB, &inkA, &layerA);
GBRemovePod(gb, NULL, NULL, NULL, &toolB, NULL, NULL);
if (GBGetNbPod(gb) != 1 ||
    ((GBObjPod*)(gb->pods._head->_data))->_srcPoint !=
    (VecFloat*)&posB) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBRemovePod failed");
    PBErrCatch(GenBrushErr);
}
GBAddPoint(gb, &posA, &eyeA, &handB, &toolB, &inkA, &layerB);
GBRemovePod(gb, NULL, NULL, NULL, NULL, NULL, &layerB);
if (GBGetNbPod(gb) != 1 ||
    ((GBObjPod*)(gb->pods._head->_data))->_srcPoint !=
    (VecFloat*)&posB) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBRemovePod failed");
    PBErrCatch(GenBrushErr);
}
GBRemovePod(gb, NULL, NULL, NULL, NULL, NULL, NULL);
if (GBGetNbPod(gb) != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBRemovePod failed");
    PBErrCatch(GenBrushErr);
}
GBAddPoint(gb, &posA, &eyeA, &handB, &toolB, &inkA, &layerA);
GBAddPoint(gb, &posB, &eyeB, &handB, &toolB, &inkB, &layerB);
GBRemovePod(gb, NULL, NULL, NULL, NULL, &inkB, NULL);
if (GBGetNbPod(gb) != 1 ||
    ((GBObjPod*)(gb->pods._head->_data))->_srcPoint !=
    (VecFloat*)&posA) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBRemovePod failed");
    PBErrCatch(GenBrushErr);
}
GBFree(&gb);
GBEyeFreeStatic(&eyeA);
GBEyeFreeStatic(&eyeB);

```

```

    printf("UnitTestGenBrushAddRemoveObj OK\n");
}

void UnitTestGenBrushSetPod() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GenBrush* gb = GBCreateImage(&dim);
    VecFloat2D posA = VecFloatCreateStatic2D();
    VecFloat2D posB = VecFloatCreateStatic2D();
    GBEye eyeA = GBEyeCreateStatic(GBEyeTypeOrtho);
    GBEye eyeB = GBEyeCreateStatic(GBEyeTypeOrtho);
    GBHand handA = GBHandCreateStatic(GBHandTypeDefault);
    GBHand handB = GBHandCreateStatic(GBHandTypeDefault);
    GBTool toolA;
    GBTool toolB;
    GBLayer layerA;
    GBLayer layerB;
    GBInk inkA;
    GBInk inkB;
    GBAddPoint(gb, &posA, &eyeA, &handA, &toolA, &inkA, &layerA);
    GBAddPoint(gb, &posB, &eyeA, &handB, &toolB, &inkA, &layerB);
    GBSetPodEye(gb, &eyeB, &posA, NULL, NULL, NULL, NULL, NULL);
    if (((GBObjPod*)(gb->pods._head->_data))>_eye != &eyeB) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSetPodEye failed");
        PBErrCatch(GenBrushErr);
    }
    GBSetPodHand(gb, &handA, NULL, NULL, NULL, NULL, NULL, &layerB);
    if (((GBObjPod*)(gb->pods._head->_next->_data))>_hand != &handA) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSetPodHand failed");
        PBErrCatch(GenBrushErr);
    }
    GBSetPodTool(gb, &toolA, NULL, NULL, &handA, NULL, NULL, NULL);
    if (((GBObjPod*)(gb->pods._head->_data))>_tool != &toolA ||
        ((GBObjPod*)(gb->pods._head->_next->_data))>_tool != &toolA) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSetPodTool failed");
        PBErrCatch(GenBrushErr);
    }
    GBSetPodInk(gb, &inkA, NULL, NULL, NULL, NULL, &inkB, NULL);
    if (((GBObjPod*)(gb->pods._head->_data))>_ink != &inkA ||
        ((GBObjPod*)(gb->pods._head->_next->_data))>_ink != &inkA) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSetPodTool failed");
        PBErrCatch(GenBrushErr);
    }
    GBSetPodLayer(gb, &layerA, &posB, NULL, NULL, &toolA, NULL, NULL);
    if (((GBObjPod*)(gb->pods._head->_next->_data))>_layer != &layerA) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSetPodLayer failed");
        PBErrCatch(GenBrushErr);
    }
    GBFree(&gb);
    GBEyeFreeStatic(&eyeA);
    GBEyeFreeStatic(&eyeB);
    printf("UnitTestGenBrushSetPod OK\n");
}

void UnitTestGenBrushFlush() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);

```



```

GenBrush* gb = GBCreateImage(&dim);
GBSurface* surf = GBSurf(gb);
GBLayer* layer = GBSurfaceAddLayer(surf, &dim);
GBLayerSetModified(layer, false);
GBPixel blue = GBColorBlue;
GBSurfaceSetBgColor(surf, &blue);
GBFlush(gb);
if (GBLayerIsModified(layer) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBSurfaceFlush failed");
    PBErrCatch(ShapoidErr);
}
for (int iPix = GBSurfaceArea(surf); iPix--;)
    if (memcmp(surf->_finalPix + iPix, &blue, sizeof(GBPixel)) != 0) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBSurfaceFlush failed");
        PBErrCatch(ShapoidErr);
    }
GBFree(&gb);
printf("UnitTestGenBrushFlush OK\n");
}

void UnitTestGenBrushTouchLayers() {
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 10);
    GenBrush* gb = GBCreateImage(&dim);
    VecFloat2D posA = VecFloatCreateStatic2D();
    VecFloat2D posB = VecFloatCreateStatic2D();
    GBEye eyeA = GBEyeCreateStatic(GBEyeTypeOrtho);
    GBHand handA = GBHandCreateStatic(GBHandTypeDefault);
    GBHand handB = GBHandCreateStatic(GBHandTypeDefault);
    GBTool toolA;
    GBTool toolB;
    GBLayer* layerA = GBAAddLayer(gb, &dim);
    GBLayer* layerB = GBAAddLayer(gb, &dim);
    GBInk inkA;
    GBAddPoint(gb, &posA, &eyeA, &handA, &toolA, &inkA, layerA);
    GBAddPoint(gb, &posB, &eyeA, &handB, &toolB, &inkA, layerB);
    GBSurfaceSetLayersModified(GBSurf(gb), false);
    GBNotifyChangeFromObj(gb, &posA);
    if (GBLayerIsModified(layerA) == false ||
        GBLayerIsModified(layerB) == true) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBNotifyChangeFromObj failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceSetLayersModified(GBSurf(gb), false);
    GBNotifyChangeFromEye(gb, &eyeA);
    if (GBLayerIsModified(layerA) == false ||
        GBLayerIsModified(layerB) == false) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBNotifyChangeFromEye failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurfaceSetLayersModified(GBSurf(gb), false);
    GBNotifyChangeFromHand(gb, &handA);
    if (GBLayerIsModified(layerA) == false ||
        GBLayerIsModified(layerB) == true) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBNotifyChangeFromHand failed");
        PBErrCatch(GenBrushErr);
    }
}

```

```

GBSurfaceSetLayersModified(GBSurf(gb), false);
GBNotifyChangeFromTool(gb, &toolA);
if (GBLayerIsModified(layerA) == false ||
    GBLayerIsModified(layerB) == true) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBNotifyChangeFromTool failed");
    PBErrCatch(GenBrushErr);
}
GBSurfaceSetLayersModified(GBSurf(gb), false);
GBNotifyChangeFromInk(gb, &inkA);
if (GBLayerIsModified(layerA) == false ||
    GBLayerIsModified(layerB) == false) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(GenBrushErr->_msg, "GBNotifyChangeFromInk failed");
    PBErrCatch(GenBrushErr);
}
GBFree(&gb);
GBEyeFreeStatic(&eyeA);
printf("UnitTestGenBrushTouchLayers OK\n");
}

void UnitTestGenBrushCreateFromFile() {
    char* fileName = "./ImageRef.tga";
    GenBrush* gb = GBCreateFromFile(fileName);
    if (gb == NULL) {
        GenBrushErr->_type = PBErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBCreateFromFile failed");
        PBErrCatch(GenBrushErr);
    }
    GBSurface* surf = GBSurf(gb);
    unsigned char check[400] = {
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255,
        0,255,0,255, 0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,255,0,255, 0,255,0,255, 0,255,0,255,
        0,255,0,255, 0,255,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,255,0,255, 0,255,0,255, 0,0,0,255, 0,30,0,255,
        0,60,0,255, 0,90,0,255, 0,120,0,255, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,255,0,255, 0,255,0,255, 26,30,0,255, 0,0,0,255, 4,34,0,255,
        7,67,0,255, 11,101,0,255, 120,184,120,255, 0,0,0,0, 0,0,0,0,
        0,255,0,255, 0,255,0,255, 46,60,0,255, 0,0,30,255, 7,34,26,255,
        14,67,23,255, 21,101,19,255, 120,184,136,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 148,90,90,255, 0,0,60,255, 11,34,53,255,
        21,67,46,255, 32,101,39,255, 120,184,152,255, 0,0,0,0, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 184,120,120,255, 0,0,90,255, 14,34,79,255,
        28,67,69,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,120,255, 30,56,136,255,
        60,106,152,255, 0,0,255,255, 0,0,255,255, 0,0,255,255, 0,0,0,0,
        0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0, 0,0,0,0,
        0,0,255,255, 0,0,255,255, 0,0,255,255
    };
    for (int iPix = 0; iPix < GBSurfaceArea(surf); ++iPix) {
        if (surf->_finalPix[iPix]._rgba[GBPixelRed] !=
            check[iPix * 4] ||
            surf->_finalPix[iPix]._rgba[GBPixelGreen] !=
            check[iPix * 4 + 1] ||
            surf->_finalPix[iPix]._rgba[GBPixelBlue] !=
            check[iPix * 4 + 2] ||
            surf->_finalPix[iPix]._rgba[GBPixelAlpha] !=
            check[iPix * 4 + 3]) {
            ShapoidErr->_type = PBErrTypeUnitTestFailed;
            sprintf(ShapoidErr->_msg, "GBCreateFromFile failed");
        }
    }
}

```

```

        PBErriCatch(ShapoidErr);
    }
}
GBFree(&gb);
printf("UnitTestGenBrushCreateFromFile OK\n");
}

void UnitTestGenBrushIsSameAs() {
    char* fileName = "./ImageRef.tga";
    GenBrush* gbA = GBCreateFromFile(fileName);
    GenBrush* gbB = GBCreateFromFile(fileName);
    if (GBIsSameAs(gbA, gbB) == false) {
        ShapoidErr->_type = PBErriTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBIsSameAs failed");
        PBErriCatch(ShapoidErr);
    }
    VecSet(GBSurfaceDim(GBSurf(gbA)), 0, 0);
    if (GBIsSameAs(gbA, gbB) == true) {
        ShapoidErr->_type = PBErriTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBIsSameAs failed");
        PBErriCatch(ShapoidErr);
    }
    VecSet(GBSurfaceDim(GBSurf(gbA)), 0, 10);
    GBSurfaceFinalPixels(GBSurf(gbA))->_rgba[GBPixelAlpha] = 255;
    if (GBIsSameAs(gbA, gbB) == true) {
        ShapoidErr->_type = PBErriTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBIsSameAs failed");
        PBErriCatch(ShapoidErr);
    }
    GBFree(&gbA);
    GBFree(&gbB);
    printf("UnitTestGenBrushIsSameAs OK\n");
}

void UnitTestGenBrushGetSimilarity() {
    char* fileName = "./ImageRef.tga";
    GenBrush* gbA = GBCreateFromFile(fileName);
    GenBrush* gbB = GBCreateFromFile(fileName);
    if (ISEQUALF(GBGetSimilarity(gbA, gbB), 1.0) == false) {
        ShapoidErr->_type = PBErriTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBGetSimilarity failed");
        PBErriCatch(ShapoidErr);
    }
    GBSurfaceFinalPixels(GBSurf(gbA))->_rgba[GBPixelAlpha] = 255;
    if (ISEQUALF(GBGetSimilarity(gbA, gbB), 0.9975) == false) {
        ShapoidErr->_type = PBErriTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBGetSimilarity failed");
        PBErriCatch(ShapoidErr);
    }
    GBFree(&gbA);
    GBFree(&gbB);
    printf("UnitTestGenBrushGetSimilarity OK\n");
}

void UnitTestGenBrushAddRemovePostProcessing() {
    GenBrush* gb = GBCreateFromFile("./GBSurfaceNormalizeHueTest.tga");
    if (GBPostProcs(gb) != &(gb->_postProcs)) {
        ShapoidErr->_type = PBErriTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBPostProcs failed");
        PBErriCatch(ShapoidErr);
    }
    GBPostProcessing* postA = GBAddPostProcess(gb, GBPPTTypeNormalizeHue);

```

```

if (gb->_postProcs._head->_data != (void*)postA) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBAddPostProcess failed");
    PBErrCatch(ShapoidErr);
}
if (GBPostProcess(gb, 0) != (void*)postA) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBGetPostProcess failed");
    PBErrCatch(ShapoidErr);
}
GBUpdate(gb);
GBSurfaceImage* ref = GBSurfaceImageCreateFromFile(
    "./GBSurfaceNormalizeHueRef.tga");
if (GBSurfaceIsSameAs(GBSurf(gb), (GBSurface*)ref) == false) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBUpdate failed");
    PBErrCatch(ShapoidErr);
}
GBRemovePostProcess(gb, postA);
if (GSetNbElem(GBPostProcs(gb)) != 0) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBRemovePostProcess failed");
    PBErrCatch(ShapoidErr);
}
postA = GBAddPostProcess(gb, GBPPTTypeNormalizeHue);
postA = GBAddPostProcess(gb, GBPPTTypeNormalizeHue);
if (GBGetNbPostProcs(gb) != 2) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBGetNbPostProcs failed");
    PBErrCatch(ShapoidErr);
}
GBRemoveAllPostProcess(gb);
if (GSetNbElem(GBPostProcs(gb)) != 0) {
    ShapoidErr->_type = PBErrTypeUnitTestFailed;
    sprintf(ShapoidErr->_msg, "GBRemoveAllPostProcess failed");
    PBErrCatch(ShapoidErr);
}
postA = GBAddPostProcess(gb, GBPPTTypeNormalizeHue);
GBFree(&gb);
GBSurfaceImageFree(&ref);
printf("UnitTestGenBrushAddRemovePostProcessing\n");
}

void UnitTestGenBrushScaleCropCopyFragmentFlip() {
    GenBrush* gb = GBCreateFromFile("./GBScaleCropTest.tga");
    GenBrush* gbFlipX = GBFlip(gb, 0);
    GenBrush* gbFlipY = GBFlip(gb, 1);
    GenBrush* gbFlipXRef = GBCreateFromFile("./GBFlipXRef.tga");
    GenBrush* gbFlipYRef = GBCreateFromFile("./GBFlipYRef.tga");
    if (!GBSurfaceIsSameAs(GBSurf(gbFlipX), GBSurf(gbFlipXRef)) ||
        !GBSurfaceIsSameAs(GBSurf(gbFlipY), GBSurf(gbFlipYRef))) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBFlip failed");
        PBErrCatch(ShapoidErr);
    }
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 100); VecSet(&dim, 1, 50);
    GenBrush* gbScaled = GBScale(gb, &dim, GBScaleMethod_AvgNeighbour);
    #if BUILDMODE == 0
        GenBrush* gbRef = GBCreateFromFile(
            "./GBScaleTestAvgNeighbourRef01.tga");
    #else

```

```

    GenBrush* gbRef = GBCreateFromFile(
        "../GBScaleTestAvgNeighbourRef02.tga");
#endif
    if (!GBSurfaceIsSameAs(GBSurf(gbScaled), GBSurf(gbRef))) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBScaleAvgNeighbour failed");
        PBErrCatch(ShapoidErr);
    }
    GBFree(&gbScaled);
    GBFree(&gbRef);
    VecShort2D pos = VecShortCreateStatic2D();
    VecSet(&pos, 0, -5); VecSet(&pos, 1, -5);
    VecSet(&dim, 0, 50); VecSet(&dim, 1, 50);
    GenBrush* gbCropped = GBCrop(gb, &pos, &dim, NULL);
    gbRef = GBCreateFromFile("../GBCropTestRef01.tga");
    if (!GBSurfaceIsSameAs(GBSurf(gbCropped), GBSurf(gbRef))) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBCrop failed (1)");
        PBErrCatch(ShapoidErr);
    }
    GBFree(&gbRef);
    GBFree(&gbCropped);
    VecSet(&pos, 0, 30); VecSet(&pos, 1, 30);
    VecSet(&dim, 0, 50); VecSet(&dim, 1, 50);
    GBPixel fillPix = GBColorBlue;
    gbCropped = GBCrop(gb, &pos, &dim, &fillPix);
    gbRef = GBCreateFromFile("../GBCropTestRef02.tga");
    if (!GBSurfaceIsSameAs(GBSurf(gbCropped), GBSurf(gbRef))) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBCrop failed (2)");
        PBErrCatch(ShapoidErr);
    }
    VecSet(&pos, 0, 5); VecSet(&pos, 1, 15);
    VecShort2D posDest = VecShortCreateStatic2D();
    VecSet(&posDest, 0, 40); VecSet(&posDest, 1, 30);
    VecSet(&dim, 0, 10); VecSet(&dim, 1, 20);
    GBCopyFragment(gbRef, gb, &pos, &posDest, &dim);
    GBFree(&gbRef);
    gbRef = GBCreateFromFile("../GBCopyFragmentTestRef.tga");
    if (!GBSurfaceIsSameAs(GBSurf(gb), GBSurf(gbRef))) {
        ShapoidErr->_type = PBErrTypeUnitTestFailed;
        sprintf(ShapoidErr->_msg, "GBCopyFragment failed (2)");
        PBErrCatch(ShapoidErr);
    }
    GBFree(&gbRef);
    GBFree(&gbCropped);
    GBFree(&gb);
    GBFree(&gbFlipX);
    GBFree(&gbFlipY);
    printf("UnitTestGenBrushScaleCropCopyFragmentFlip OK\n");
}

void UnitTestGenBrush() {
    UnitTestGenBrushCreateFree();
    UnitTestGenBrushGetSet();
    UnitTestGenBrushUpdate();
    UnitTestGenBrushRender();
    UnitTestGenBrushAddRemoveLayer();
    UnitTestGenBrushGetLayerNbLayer();
    UnitTestGenBrushSetLayerPos();
}

```

```

    UnitTestGenBrushUpdate();
    UnitTestGenBrushAddLayerFromFile();
    UnitTestGenBrushAddRemoveObj();
    UnitTestGenBrushSetPod();
    UnitTestGenBrushFlush();
    UnitTestGenBrushTouchLayers();
    UnitTestGenBrushCreateFromFile();
    UnitTestGenBrushIsSameAs();
    UnitTestGenBrushGetSimilarity();
    UnitTestGenBrushAddRemovePostProcessing();
    UnitTestGenBrushScaleCropCopyFragmentFlip();

    printf("UnitTestGenBrush OK\n");
}

void UnitTestAll() {
    UnitTestGBPixel();
    UnitTestGBLayer();
    UnitTestGBPostProcessing();
    UnitTestGBSurface();
    UnitTestGBSurfaceImage();
    UnitTestGBEye();
    UnitTestGBHand();
    UnitTestGBTool();
    UnitTestGBInk();
    UnitTestGBObjPod();
    UnitTestGenBrush();
    printf("UnitTestAll OK\n");
}

#if BUILDWITHGRAPHICLIB == 0

    int main() {
        UnitTestAll();
        // Return success code
        return 0;
    }

#elif BUILDWITHGRAPHICLIB == 1

    void UnitTestPaintSurface(GBSurface* const surf,
        VecShort2D* dim,
        int green) {
        // Declare a vector to memorize position in the surface
        VecShort2D pos = VecShortCreateStatic2D();
        // Set the surface to a shade of red and blue
        do {
            GBPixel pixel;
            pixel._rgba[GBPixelAlpha] = 255;
            pixel._rgba[GBPixelRed] = MIN(255, VecGet(&pos, 0));
            pixel._rgba[GBPixelGreen] = MIN(255, green);
            pixel._rgba[GBPixelBlue] = MIN(255, VecGet(&pos, 1));
            GBSurfaceSetFinalPixel(surf, &pos, &pixel);
        } while (VecStep(&pos, dim));
    }

    gint UnitTestGBSurfaceAppCB(gpointer data) {
        // Declare a variable to convert the data into the GBSurfaceApp
        GBSurfaceApp* GBApp = (GBSurfaceApp*)data;
        // Paint again the surface
        UnitTestPaintSurface((GBSurface*)GBApp,
            GBSurfaceDim((GBSurface*)GBApp), 0);
    }

```

```

    // Refresh the displayed surface
    GBSurfaceAppRefresh(GBApp);
    // Take a screenshot before closing
    bool ret = GBScreenshot(
        GBApp, "./screenshotGBSurfaceApp.tga");
    if (ret == false) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceAppScreenshot failed");
        PErrCatch(GenBrushErr);
    }
    // Kill the app
    GBSurfaceAppClose(GBApp);
    // Return false to continue the callback chain
    return FALSE;
}

void UnitTestGBSurfaceApp() {
    // Declare variable to memorize the parameters of the app
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 300); VecSet(&dim, 1, 200);
    char* title = "UnitTestGBSurfaceApp";
    // Create the app
    GenBrush* app = GBCreateApp(&dim, title);
    // Set the idle function of the surface
    GBSetIdle(app, &UnitTestGBSurfaceAppCB, 1000);
    // Paint some content on the surface
    UnitTestPaintSurface(app->_surf, &dim, 0);
    // Render the app
    bool status = GBRender(app);
    // If the render of the app failed
    if (status == false) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceAppCreate failed");
        PErrCatch(GenBrushErr);
    }
    // Free the memory used by the app
    GBFree(&app);
    printf("UnitTestGBSurfaceApp OK\n");
}

GtkWidget* UnitTestGBSurfaceWidgetWindow;
gint UnitTestGBSurfaceWidgetCB(gpointer data) {
    static int green = 0;
    // Declare a variable to convert the data into the GenBrush
    GenBrush* GBWidget = (GenBrush*)data;
    // Paint again the surface
    UnitTestPaintSurface(GBWidget->_surf,
        GBSurfaceDim(GBWidget->_surf), green);
    ++green;
    // Refresh the displayed surface
    GBRender(GBWidget);
    if (green == 255) {
        gtk_window_close(GTK_WINDOW(UnitTestGBSurfaceWidgetWindow));
    }
    // Return true to stop the callback chain
    return TRUE;
}

gboolean UnitTestGBSurfaceWidgetCloseCB(GtkWidget* widget,
    GdkEventConfigure* event, gpointer data) {
    (void)widget; (void)event;
    // Declare a variable to convert the data into the GenBrush

```

```

    GenBrush* GBWidget = (GenBrush*)data;
    // Take a screenshot before closing
    bool ret = GBScreenshot(
        (GBSurfaceWidget*)(GBWidget->_surf),
        "./screenshotGBSurfaceWidget.tga");
    if (ret == false) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "GBSurfaceWidgetScreenshot failed");
        PErrCatch(GenBrushErr);
    }
    // Free memory
    GBFree(&GBWidget);
    // Return false to continue the callback chain
    return FALSE;
}

void UnitTestGBSurfaceWidgetActivateCB(GtkApplication* app,
    gpointer user_data) {
    (void)user_data;
    // Create a GTK application
    GtkWidget* window = gtk_application_window_new(app);
    UnitTestGBSurfaceWidgetWindow = window;
    // Set the title
    gtk_window_set_title(GTK_WINDOW(window), "UnitTestGBSurfaceWidget");
    // Declare a variable to memorize the size
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 300); VecSet(&dim, 1, 200);
    // Set the size
    gtk_window_set_default_size(GTK_WINDOW(window), VecGet(&dim, 0),
        VecGet(&dim, 1));
    // Avoid window resizing
    gtk_window_set_resizable(GTK_WINDOW(window), false);
    // Create the GenBrush with a GBSurfaceWidget
    GenBrush* GBWidget = GBCreateWidget(&dim);
    // Get the widget of the drawing area
    GtkWidget* drawingArea = GBGetGtkWidget(GBWidget);
    // Add the widget to the window
    gtk_container_add(GTK_CONTAINER(window), drawingArea);
    // Connect to the delete event
    g_signal_connect(window, "delete-event",
        G_CALLBACK(UnitTestGBSurfaceWidgetCloseCB), GBWidget);
    // Connect the idle function
    g_timeout_add(40, UnitTestGBSurfaceWidgetCB, GBWidget);
    // Display the window
    gtk_widget_show_all(window);
}

void UnitTestGBSurfaceWidget(int argc, char** argv) {
    // Create a GTK application
    GtkApplication* app =
        gtk_application_new(NULL, G_APPLICATION_FLAGS_NONE);
    // Connect the activate callback
    g_signal_connect(app, "activate",
        G_CALLBACK(UnitTestGBSurfaceWidgetActivateCB), NULL);
    // Run the application
    int status = g_application_run(G_APPLICATION(app), argc, argv);
    // If the application failed
    if (status != 0) {
        GenBrushErr->_type = PErrTypeUnitTestFailed;
        sprintf(GenBrushErr->_msg, "Application failed");
        PErrCatch(GenBrushErr);
    }
}

```



```

        // Unreference the application
        g_object_unref(app);
        printf("UnitTestGBSurfaceWidget OK\n");
    }

    void UnitTestAllGTK(int argc, char** argv) {
        UnitTestGBSurfaceApp();
        UnitTestGBSurfaceWidget(argc, argv);
        printf("UnitTestAllGTK OK\n");
    }

    int main(int argc, char** argv) {
        UnitTestAll();
        UnitTestAllGTK(argc, argv);
        // Return success code
        return 0;
    }

#endif

```

## 6 Unit tests output

```

UnitTestGBPixelBlendNormal OK
UnitTestGBPixelBlendOver OK
UnitTestGBPixelIsSame OK
UnitTestGBPixelConvertRGBHSV OK
UnitTestGBPixel OK
UnitTestGBLayerCreateFree OK
UnitTestGBLayerArea OK
UnitTestGBLayerGetSet OK
UnitTestGBLayerCreateFromFile OK
UnitTestGBLayerGetBoundaryInSurface OK
UnitTestGBLayer OK
UnitTestGBPostProcessingCreateFree OK
UnitTestGBPostProcessingGetSet OK
UnitTestGBPostProcessing OK
UnitTestGBSurfaceCreateFree OK
UnitTestGBSurfaceGetSet OK
UnitTestGBSurfaceArea OK
UnitTestGBSurfaceClone OK
UnitTestGBSurfaceAddRemoveLayer OK
UnitTestGBSurfaceGetLayer OK
UnitTestGBSurfaceSetLayersModified OK
UnitTestGBSurfaceSetLayerPos OK
UnitTestGBSurfaceGetModifiedArea OK
UnitTestGBSurfaceUpdate OK
UnitTestGBSurfaceAddLayerFromFile OK
UnitTestGBSurfaceFlush OK
UnitTestGBSurfaceIsSameAs OK
UnitTestGBSurfaceNormalizeHue OK
UnitTestGBSurfaceOrderedDithering OK
UnitTestGBSurfaceFloydSteinbergDithering OK
UnitTestGBSurface OK
UnitTestGBSurfaceImageCreateFree OK
UnitTestGBSurfaceImageGetSet OK
UnitTestGBSurfaceImageClone OK
UnitTestGBSurfaceImageSave OK
UnitTestGBSurfaceImageCreateFromFile OK

```

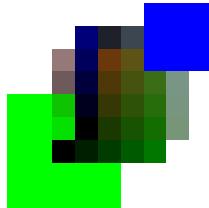
```

UnitTestGBSurfaceImage OK
UnitTestGBEyeCreateFree OK
UnitTestGBEyeGetSet OK
UnitTestGBEyeOrthoCreateFree OK
UnitTestGBEyeOrthoGetSet OK
UnitTestGBEyeOrthoProcessPoint OK
UnitTestGBEyeOrthoProcessCurve OK
UnitTestGBEyeOrthoProcessShapoid OK
UnitTestGBEyeOrtho OK
UnitTestGBEyeIsometricCreateFree OK
UnitTestGBEyeIsometricGetSet OK
UnitTestGBEyeIsometricProcessPoint OK
UnitTestGBEyeIsometricProcessCurve OK
UnitTestGBEyeIsometricProcessShapoid OK
UnitTestGBEyeIsometric OK
UnitTestGBEye OK
UnitTestGBHandCreateFree OK
UnitTestGBHandCreateFree OK
UnitTestGBHandDefaultCreateFree OK
UnitTestGBHandDefaultProcess OK
UnitTestGBHandDefault OK
UnitTestGBHand OK
UnitTestGBToolCreateFree OK
UnitTestGBToolGetSet OK
UnitTestGBToolPlotterCreateFree OK
UnitTestGBToolPlotterDrawPoint OK
UnitTestGBToolPlotterDrawFacoid OK
UnitTestGBToolPlotterDrawPyramidoid OK
UnitTestGBToolPlotterDrawSpheroid OK
UnitTestGBToolPlotterDrawFacoid3D OK
UnitTestGBToolPlotterDrawSCurve OK
UnitTestGBToolPlotter OK
UnitTestGBToolPenCreateFreeSetGet OK
UnitTestGBToolPenDrawPoint OK
UnitTestGBToolPenDrawFacoid OK
UnitTestGBToolPenDrawSCurve OK
UnitTestGBToolPen OK
UnitTestGBTool OK
UnitTestGBInkSolidCreateFree OK
UnitTestGBInkSolidGetSet OK
UnitTestGBInkSolid OK
UnitTestGBInk OK
UnitTestGBObjPodCreateFree OK
UnitTestGBObjPodGetSet OK
UnitTestGBObjPod OK
UnitTestGenBrushCreateFree OK
UnitTestGenBrushGetSet OK
UnitTestGenBrushUpdate OK
UnitTestGenBrushRender OK
UnitTestGenBrushAddRemoveLayer OK
UnitTestGenBrushGetLayer OK
UnitTestGenBrushSetLayerPos OK
UnitTestGenBrushUpdate OK
UnitTestGenBrushAddLayerFromFile OK
UnitTestGenBrushAddRemoveObj OK
UnitTestGenBrushSetPod OK
UnitTestGenBrushFlush OK
UnitTestGenBrushTouchLayers OK
UnitTestGenBrushCreateFromFile OK
UnitTestGenBrushIsSameAs OK
UnitTestGenBrushGetSimilarity OK
UnitTestGenBrushAddRemovePostProcessing

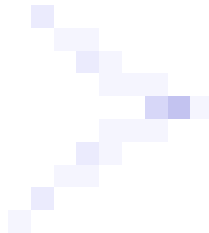
```

```
UnitTestGenBrushScaleCropCopyFragmentFlip OK  
UnitTestGenBrush OK  
UnitTestAll OK
```

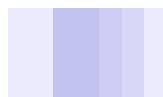
GBSurfaceImageSave.tga:



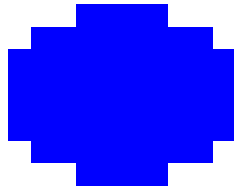
GBToolPlotterDrawSCurve.tga:



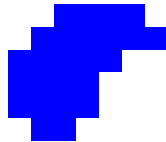
GBToolPlotterDrawFacoid3D.tga:



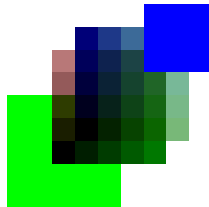
GBToolPlotterDrawSpheroid.tga:



GBToolPlotterDrawFacoid.tga:



ImageRef.tga:



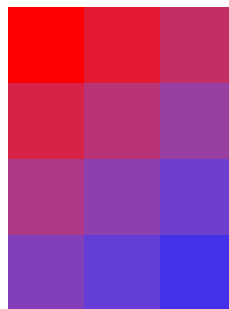
GBToolPlotterDrawPoint.tga:



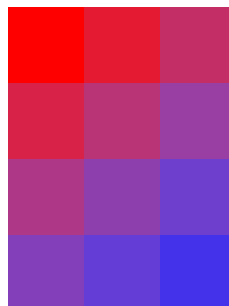
GBToolPlotterDrawPyramidoid.tga:



testBottomLeft.tga:



testTopLeft.tga:



GBSurfaceNormalizeHueTest.tga:



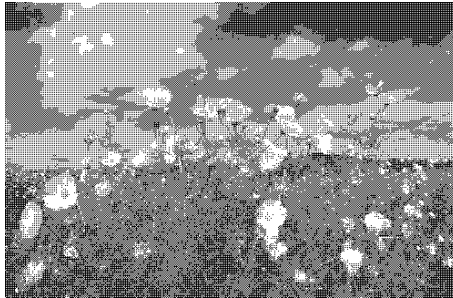
GBSurfaceNormalizeHueRef.tga:



GBSurfaceOrderedDitheringTest.tga:



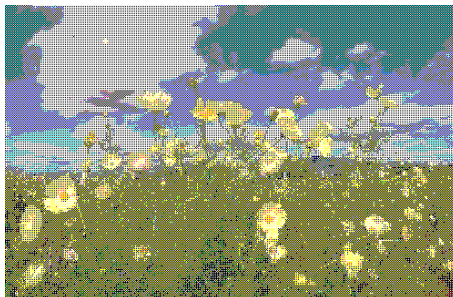
GBSurfaceOrderedDitheringRef.tga:



GBSurfaceOrderedDitheringTestRGB.tga:



GBSurfaceOrderedDitheringRefRGB.tga:



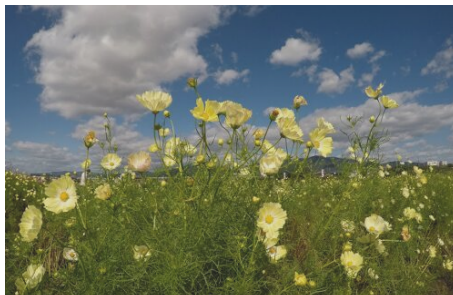
GBSurfaceFloydSteinbergDitheringTest.tga:



GBSurfaceFloydSteinbergDitheringRef.tga:



GBSurfaceFloydSteinbergDitheringTestRGB.tga:





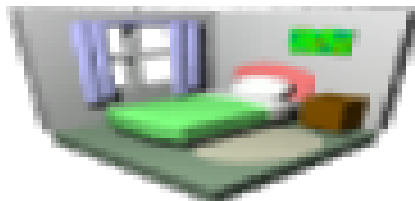
GBSurfaceFloydSteinbergDitheringRefRGB.tga:



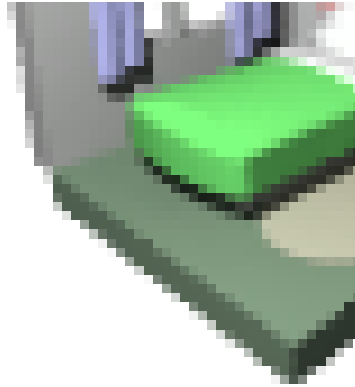
GBScaleCropTest.tga:



GBScaleTestAvgNeighbourRef.tga:



GBCropTestRef01.tga:



GBCropTestRef02.tga:



screenshotGBSurfaceApp.tga:



screenshotGBSurfaceWidget.tga:



## 7 Demo

### 7.1 ImageViewer

#### 7.1.1 main.c

```
#include <stdlib.h>
#include <stdio.h>
#include <time.h>
#include <string.h>
#include <time.h>
#include <unistd.h>
#include <sys/time.h>
#include "genbrush.h"

int main(int argc, char** argv) {
    // Check if one argument has been given
    if (argc != 2) {
        printf("No file name given in argument.\n");
        return 1;
    }
}
```

```

// Load the image as a GBSurfaceImage to get its dimensions
GBSurfaceImage* image = GBSurfaceImageCreateFromFile(argv[1]);
// If we couldn't load the image
if (image == NULL) {
    printf("Couldn't load the image %s.\n", argv[1]);
    return 1;
}
// Declare variable to memorize the title of the app
char* title = "GenBrush: Image viewer";
// Create the app with same dimensions as the image
GenBrush* app = GBCreateApp(GBSurfaceDim((GBSurface*)image), title);
// Steal the image content from the GBSurfaceImage to avoid
// reloading it
GBPixel* tmp = ((GBSurface*)image)->_finalPix;
((GBSurface*)image)->_finalPix = GBSurf(app)->_finalPix;
GBSurf(app)->_finalPix = tmp;
// Render the app
bool status = GBRender(app);
// If the render of the app failed
if (status == false) {
    printf("Couldn't create the application.\n");
    return 1;
}
// Free the memory used by the app
GBFree(&app);
// Free the memory used by the image
GBSurfaceImageFree(&image);
// Return success code
return 0;
}

```

## 7.1.2 Makefile

```

# Build mode
# 0: development (max safety, no optimisation)
# 1: release (min safety, optimisation)
# 2: fast and furious (no safety, optimisation)
BUILD_MODE?=1

all: main

# 0: monolith version, the GBSurface is rendered toward a TGA image
# 1: GTK version, the GBSurface is rendered toward a TGA image or
#    a GtkWidget
BUILDWITHGRAPHICLIB=1

# Makefile definitions
MAKEFILE_INC=../../PBMake/Makefile.inc
include $(MAKEFILE_INC)

# Rules to make the executable
repo=genbrush
$($(repo)_EXENAME): \
$($(repo)_EXENAME).o \
$($(repo)_EXE_DEP) \
$($(repo)_DEP)
$(COMPILER) 'echo "$($(repo)_EXE_DEP) $($(repo)_EXENAME).o" | tr ' ' '\n' | sort -u' $(LINK_ARG) $($(repo)_LINK_ARG)

$($(repo)_EXENAME).o: \
main.c \

```

```

$($(repo)_INC_H_EXE) \
$($(repo)_EXE_DEP)
$(COMPILER) $(BUILD_ARG) $($(repo)_BUILD_ARG) 'echo "$($(repo)_INC_DIR)" | tr ' ' '\n' | sort -u' -c main.c

```

## 7.2 Glade

This example shows how to use a GenBrush widget within a GUI designed using Glade.

### 7.2.1 main.c

```

#include <gtk/gtk.h>
#include "pbmath.h"
#include "genbrush.h"

// Main structure of the application
typedef struct {
    char* gladeFilePath;
    GtkApplication* gtkApp;
    GApplication* gApp;
    GtkWidget* mainWindow;
    GenBrush* gbWidget;
    int green;
} DemoApp;

// Declare a global instance of the application
DemoApp app;

// Callback function for the 'activate' event on the GTK application
// 'data' is the DemoApp application
void GtkAppActivate(
    GtkApplication* gtkApp,
    gpointer user_data);

// Callback function for the 'delete-event' event on the GTK application
// window
// 'user_data' is the DemoApp application
gboolean ApplicationWindowDeleteEvent(
    GtkWidget* widget,
    GdkEventConfigure* event,
    gpointer user_data);

// Callback function for the 'delete-event' event on the GTK application
// window
// 'user_data' is the DemoApp application
gboolean ButtonClicked(
    gpointer user_data);

// Paint the GenBrush surface
void PaintSurface(
    GBSurface* const surf,
    VecShort2D* dim,
    int green);

// Create an instance of the application
DemoApp DemoAppCreate(
    int argc,

```

```

char** argv) {

// Unused arguments
(void)argc;
(void)argv;

// Init the variable to paint the GenBrush widget
app.green = 0;

// Set the UI definition file path
app.gladeFilePath = strdup("./test.glade");

// Create a GTK application
app.gtkApp = gtk_application_new(
    NULL,
    G_APPLICATION_FLAGS_NONE);
app.gApp = G_APPLICATION(app.gtkApp);

// Connect the callback function on the 'activate' event of the GTK
// application
g_signal_connect(
    app.gtkApp,
    "activate",
    G_CALLBACK(GtkAppActivate),
    NULL);

// Return the instance of the application
return app;
}

// Main function of the application
int DemoAppMain(
    DemoApp* that,
    int argc,
    char** argv) {

// Run the application at the G level
int status = g_application_run(
    that->gApp,
    argc,
    argv);

// If the application failed
if (status != 0) {
    GenBrushErr->_type = PBErrTypeUnitTestFailed;
    sprintf(
        GenBrushErr->_msg,
        "g_application_run failed (%d)",
        status);
    PBErrCatch(GenBrushErr);
}

// Unreference the GTK application
g_object_unref(that->gtkApp);

// Return the status code
return status;
}

// Callback function for the 'activate' event on the GTK application
// 'user_data' is the DemoApp application
void GtkAppActivate(

```

```

GtkApplication* gtkApp,
gpointer user_data) {

    // Unused arguments
    (void)gtkApp;
    (void)user_data;

    // Create a GTK builder with the UI definition file
    GtkBuilder* gtkBuilder = gtk_builder_new_from_file(app.gladeFilePath);

    // Set the GTK application in the GTK builder
    gtk_builder_set_application(gtkBuilder, app.gtkApp);

    // Get the widget container for the GenBrush widget
    GtkWidget* container = GTK_WIDGET(
        gtk_builder_get_object(
            gtkBuilder,
            "box1"));

    // Declare a variable to memorize the size of the GenBrush widget
    VecShort2D dim = VecShortCreateStatic2D();
    VecSet(&dim, 0, 300);
    VecSet(&dim, 1, 200);

    // Create the GenBrush widget
    app.gbWidget = GBCreateWidget(&dim);

    // Get the GTK widget from the GenBrush widget
    GtkWidget* widget = GBGetGtkWidget(app.gbWidget);

    // Insert the GenBrush widget into its container
    gtk_box_pack_start(
        GTK_BOX(container),
        widget,
        TRUE,
        TRUE,
        0);

    // Get the UI's button
    GtkWidget* btn = GTK_WIDGET(
        gtk_builder_get_object(
            gtkBuilder,
            "button1"));

    // Set the callback on the 'clicked' event of the UI's button
    g_signal_connect(
        btn,
        "clicked",
        G_CALLBACK(ButtonClicked),
        NULL);

    // Get the main window
    app.mainWindow = GTK_WIDGET(
        gtk_builder_get_object(
            gtkBuilder,
            "applicationwindow1"));

    // Set the callback on the delete-event of the main window
    g_signal_connect(
        app.mainWindow,
        "delete-event",
        G_CALLBACK(ApplicationWindowDeleteEvent),

```

```

    NULL);

    // Connect the other signals defined in the UI definition file
    gtk_builder_connect_signals(
        gtkBuilder,
        NULL);

    // Free memory used by the GTK builder
    g_object_unref(G_OBJECT(gtkBuilder));

    // Display the main window and all its components
    gtk_widget_show_all(app.mainWindow);

    // Run the application at the GTK level
    gtk_main();
}

// Callback function for the 'delete-event' event on the GTK application
// window
// 'user_data' is the DemoApp application
gboolean ApplicationWindowDeleteEvent(
    GtkWidget* widget,
    GdkEventConfigure* event,
    gpointer user_data) {

    // Unused arguments
    (void)widget;
    (void)event;
    (void)user_data;

    // Free memory used by the GenBrush instance
    GBFree(&(app.gbWidget));

    // Quit the application at GTK level
    gtk_main_quit();

    // Quit the application at G level
    g_application_quit(app.gApp);

    // Return false to continue the callback chain
    return FALSE;
}

// Callback function for the 'delete-event' event on the GTK application
// window
// 'user_data' is the DemoApp application
gboolean ButtonClicked(
    gpointer user_data) {

    // Unused arguments
    (void)user_data;

    // Paint the GenBrush surface
    PaintSurface(
        app.gbWidget->_surf,
        GBSurfaceDim(app.gbWidget->_surf),
        app.green);

    // Refresh the displayed surface
    GBRender(app.gbWidget);

    // Update the value used to pain the surface

```



```

    app.green += 10;

    // If the value reached its maximum
    if (app.green >= 255) {

        // Stop the GTK window
        gtk_window_close(GTK_WINDOW(app.mainWindow));
    }

    // Return true to stop the callback chain
    return TRUE;
}

// Paint the GenBrush surface
void PaintSurface(
    GBSurface* const surf,
    VecShort2D* dim,
    int green) {

    // Loop on the pixels of the surface
    VecShort2D pos = VecShortCreateStatic2D();
    do {

        // Set the pixel value according to the argument
        GBPixel pixel;
        pixel._rgba[GBPixelAlpha] = 255;
        pixel._rgba[GBPixelRed] = MIN(255, VecGet(&pos, 0));
        pixel._rgba[GBPixelGreen] = MIN(255, green);
        pixel._rgba[GBPixelBlue] = MIN(255, VecGet(&pos, 1));
        GBSurfaceSetFinalPixel(surf, &pos, &pixel);
    } while (VecStep(&pos, dim));
}

// Main function
int main(
    int argc,
    char** argv)
{
    // Initialise the GTK library
    gtk_init(&argc, &argv);

    // Create the application
    app = DemoAppCreate(argc, argv);

    // Run the application
    int status = DemoAppMain(&app, argc, argv);

    // Return the status at the end of the application
    return status;
}

```

## 7.2.2 Makefile

```

# Build mode
# 0: development (max safety, no optimisation)
# 1: release (min safety, optimisation)
# 2: fast and furious (no safety, optimisation)
BUILD_MODE=1

all: main

```

```

# 0: monolith version, the GBSurface is rendered toward a TGA image
# 1: GTK version, the GBSurface is rendered toward a TGA image or
#    a GtkWidget
BUILDWITHGRAPHICLIB=1

# Makefile definitions
MAKEFILE_INC=../../PBMake/Makefile.inc
include $(MAKEFILE_INC)

# Dependencies of the executable (*.o)
main_DEP=

# Dependencies of the executable (*.h)
main_INC_H=\
$(ROOT_DIR)/GenBrush/genbrush.h \
$(ROOT_DIR)/PBMath/pbmath.h

# Rules to make the executable
repo=genbrush
main: \
main.o \
$(main_DEP) \
$(genbrush_EXE_DEP)
$(COMPILER) 'echo "$(main_DEP) $(genbrush_EXE_DEP) main.o" | tr ' ' '\n' | sort -u' $(LINK_ARG) $(genbrush_LINK_ARG)

main.o: \
main.c \
$(main_INC_H) \
Makefile
$(COMPILER) $(BUILD_ARG) $(genbrush_BUILD_ARG) 'echo "$(genbrush_INC_DIR)" | tr ' ' '\n' | sort -u' -c main.c

```

### 7.2.3 test.glade

```

<?xml version="1.0" encoding="UTF-8"?>
<!-- Generated with glade 3.18.3 -->
<interface>
  <requires lib="gtk+" version="3.12"/>
  <object class="GtkApplicationWindow" id="applicationwindow1">
    <property name="can_focus">False</property>
    <child>
      <object class="GtkBox" id="box1">
        <property name="visible">True</property>
        <property name="can_focus">False</property>
        <property name="orientation">vertical</property>
        <child>
          <object class="GtkButton" id="button1">
            <property name="label" translatable="yes">button</property>
            <property name="visible">True</property>
            <property name="can_focus">True</property>
            <property name="receives_default">True</property>
          </object>
          <packing>
            <property name="expand">False</property>
            <property name="fill">True</property>
            <property name="position">0</property>
          </packing>
        </child>
      </object>
    </child>
  </object>
</interface>

```

```
</object>  
</interface>
```