User Manual
for
PHOENIX4
MEDIACONVERTER

What's New

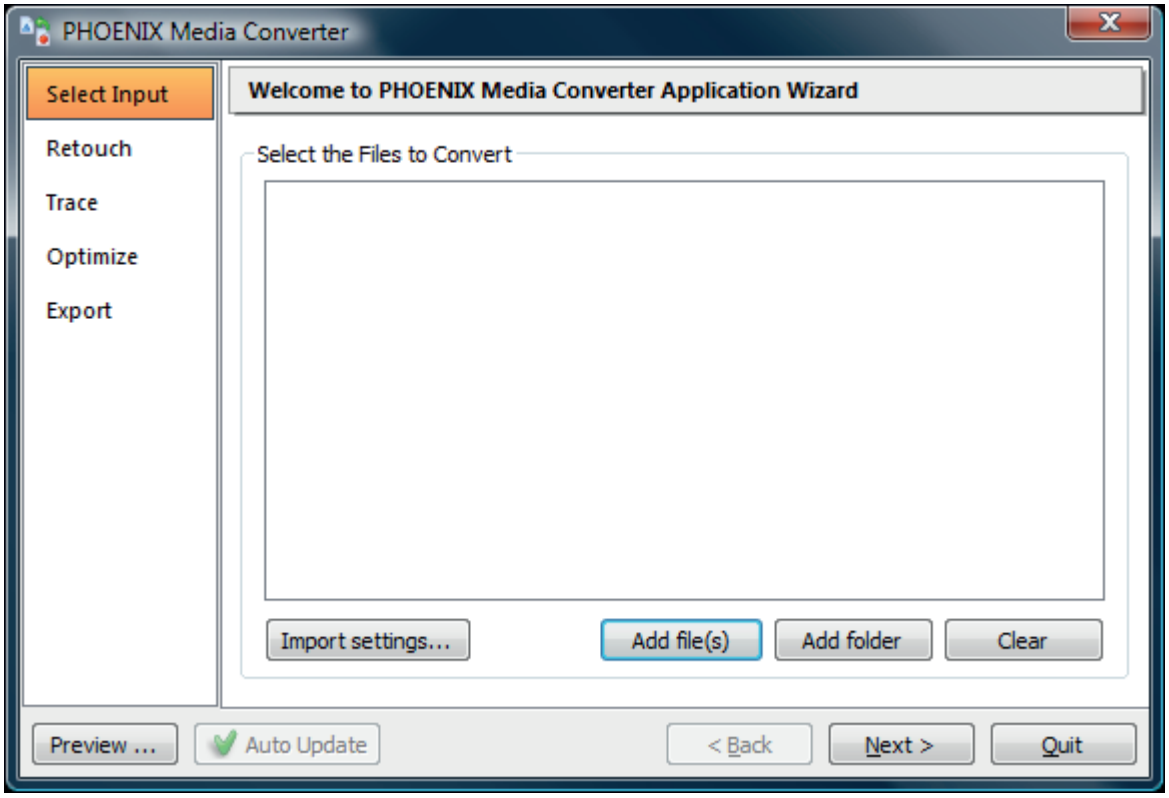
Version 2.0

This version mainly aims to improve the workflow and the output of the raster image conversion.
The changes include:

- Reworked raster image processing
    - Image pre-processing functions moved from Trace into Retouch page
    - All image preprocessing visible in the Image preview mode
    - New color reduction algorithms
        - Median Cut (improved from the previous version)
        - Octree
        - K-Means color clustering in RBG and Lab mode
    - Detail/Noise reduction control with full preview
    - Image smoothing based on Bilateral Filtering algorithm alows to smooth the image while retaining the importang features
    - Color inversion replaced by intensity inversion
    - Line fitting options in trace page combined into two simple to use sliders
        - Detail options still available in the advanced page
    - Edge detection mode added for B&W image tracing
- Application Speedup
    - Application now incorporates sofisticated caching to provide a faster feedback when parameters are changed
- Various small improvements in the optimization engine including
    - Dark lines brightening (available in the Advanced Optimization dialog)

Application Screen

Application screen is divided into three sections. At the left side there is the list of converter tabs, each presenting parameters for a specific conversion step. The current (highlighted) tab is show in the main area on the right. A tab can be directly selected from the list or using the navigation buttons in the bottom section.



Bottom section contains following buttons:

Back and Next

Select previous or the next tab in the wizard

Quit

Terminates the application

Preview

Opens the preview window.

Auto Update

Triggers automatic update in the preview window. If selected, any change in a parameter is automaticaly reflected in the preview window. Note: For complex images, this setting can have a negative impact on the responsiveness of the application.

When the application is started Select Input tab is presented to a user. This tab allows selecting input files that will be processed by the application.

Select Input Tab

First tab lets the user to select the files that will be processed in this conversion.

Add Files

Open a dialog for selecting files. It is possible to select multiple files for one conversion.

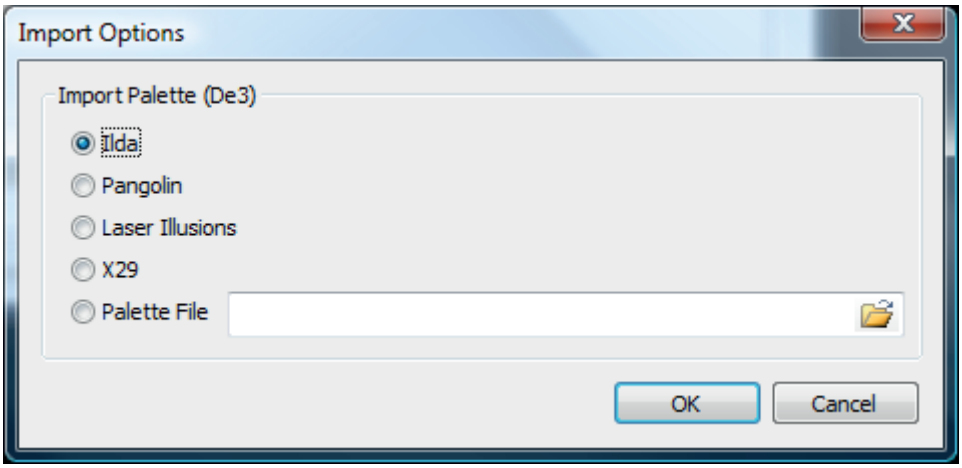
Add Folder

Open a dialog for folder selection. Adds all files supported by the converted from the selected directory.

Clear

Clears current selection

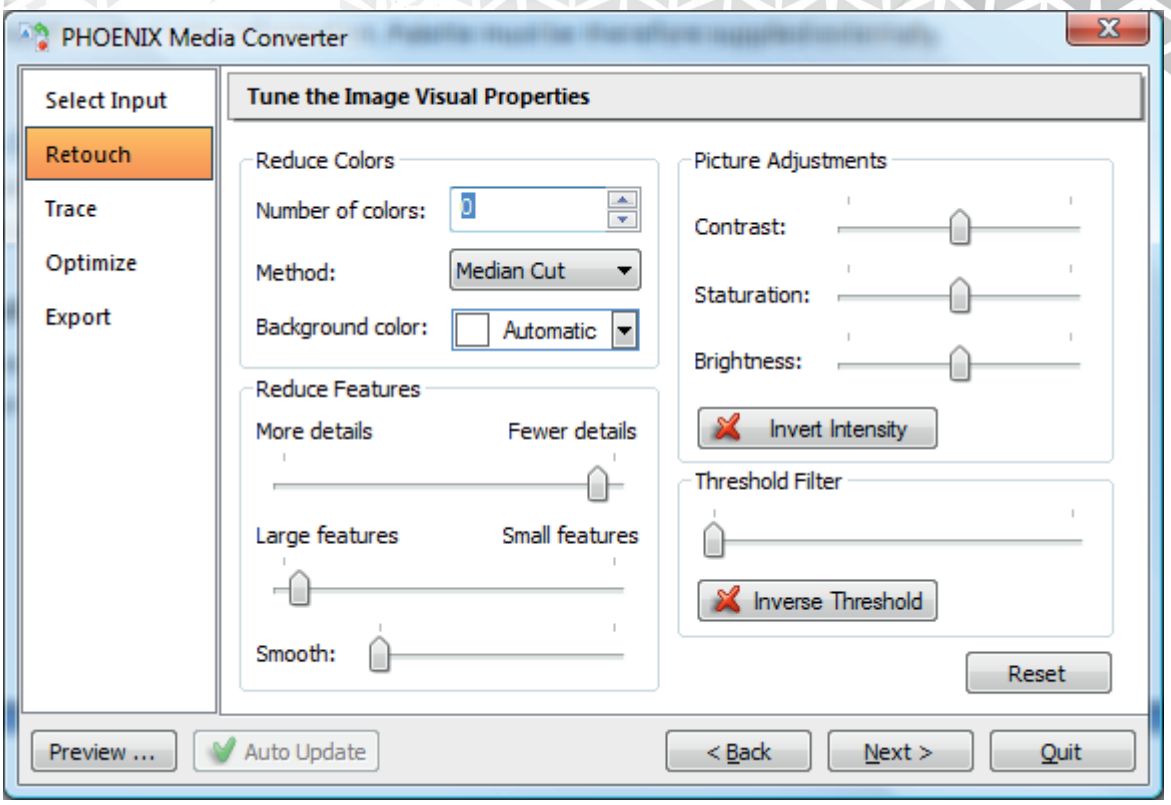
Import Settings



This dialog allows you to select color palette for De3 files. This image format does contain only the color indexes, not the actual color information. Palette must be therefore supplied externally.

Retouch Tab

This tab controls parameters for filters that can be applied to raster images before the Trace stage. Adjustments in these parameters can greatly improve the quality of the traced output.



Reduce Colors

This option enables the color reduction algorithm. Reducing the number of colors can improve the contour detection. Set to 0 to disable the color reduction or specify the desired number of colors.

The application provides different reducing algorithms:

- Median Cut
- Octree
- K-Means color clustering in RBG mode
- K-Means color clustering in Lab mode

Each algorithm might give a slightly different selection of colors for every picture.

Background Color

Background color is essential information for the image tracing. Usually the application can correctly detect it. However it is possible to specify it manually when needed.

Reduce Features

This section controls the algorithms that smoothen and clean up the raster image of noise and distortions that might result in a too complex or otherwise improperly traced image.

First two sliders control despeckling algorithm. The aim is to smoothen areas where noise it noticeable while leaving complex areas (those with significant features) intact. The first slider

controls the amount of the noise to be removed, while the other slider controls the size of features that should be kept.

Smooth slider affects the power of smoothing filter. This filter blurs out the neighboring pixels to reduce overall detail of the image. A bilateral filter is used which has stronger effect on plane areas while preserving detail along the edges.

Contrast, Saturation, Brightness

As the name suggests, these filters adjust the common image parameters. Contrast slider allows strengthening or weakening the differences between highlighted and dark areas. Saturation controls the in intensity of colors and even allows turning the image into B&W. Brightness controls the overall intensity of the picture

Threshold Filter

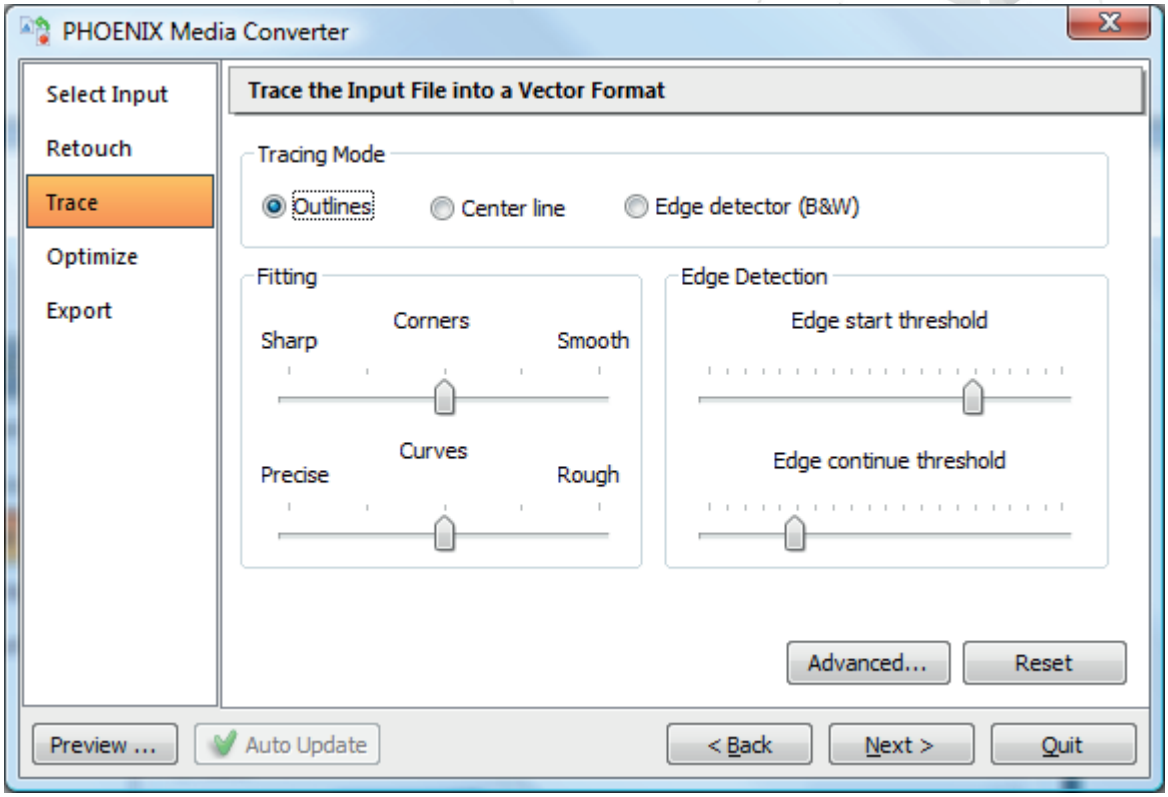
This filter effectively removes the areas of the picture that has intensity above or below the specified threshold. Inverse checkbox controls the direction.

Invert Intensity

When selected, the intensity of all pixels in the in the picture will be inverted. Dark pixel will become bright while bright pixels will be proportionally darkened.

Trace Tab

Options on this tab control the tracing process of the raster images. Algorithms that are applied in this stage attempt to extract vector base information from the raster image. To do so, the image is searched for contours, edges and similar features. When these features are found an approximation process maps standard geometric primitives like lines and splines.



Tracing Mode

This option specifies whether the vector approximation will be placed around the edges of a found contour (effectively forming two lines around every edge) or the line can be placed to go through the center of the contour.

The last option enables the *edge detection* algorithm. The detector is using Canny edge detector. In this mode the converter will produce B&W image.

Fitting

Along the tracing process the application generates a set of lines or curves along the image features.

The important part of this process is a decision when to create a corner between two curves. Too many corners result in a well fit vector representation, but it may also be too complex (in terms of point count) and highlight the imperfections in the raster image. A fever corners may bring the exact opposite situation, when the vector image is missing the important details of the original picture.

Once the set of corner points is defined, the converter needs to generate curves that will fit the detected contours between corners. Similarly to the other options there is a balance between the exact fitting and the resulting complexity.

Both sliders adjust several parameters at once in few basic steps. It is possible to fine-tune these parameters in the *Advanced* dialog.

Edge Detection

When the *Edge detector* mode is used, two basic parameters are used to control its behavior. First slider controls the threshold for accepting a newly found edge, while the other is used when deciding whether to continue tracing of an edge to the next pixel or not.

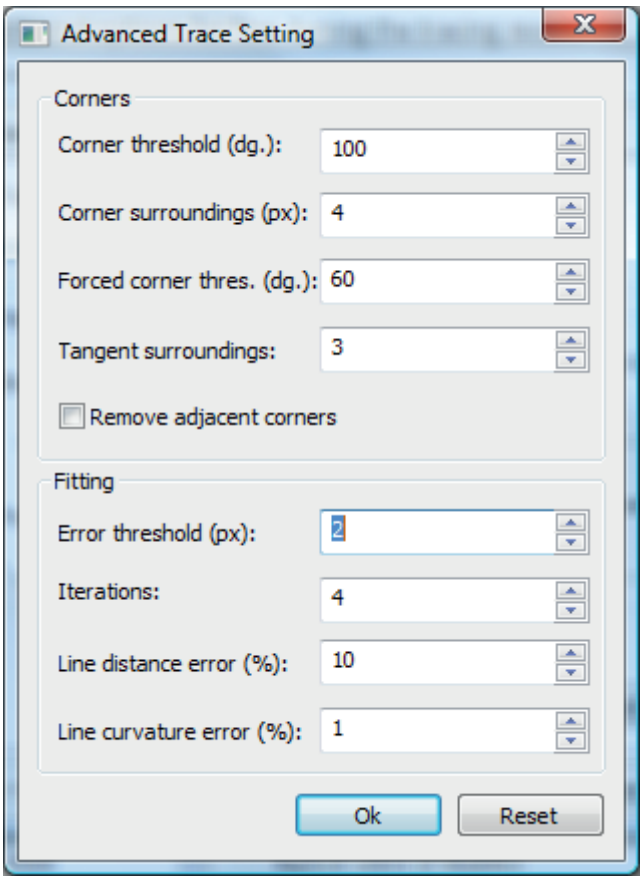
This tracing mode works better with softer preprocessing options. Therefore it is suggested to disable color reduction filter and to use only *smoothing* filter from the *retouch page.*

Reset

Pressing this button will reset all the parameters to the default values.

Advanced Options

This dialog provides some additional options for fine-tuning the tracing result.



Corners

This group of options controls the conditions for finding corners. Corner is a sharp connection point between two splines. Options here control the thresholds in degrees, number of adjacent pixels to be considered when calculating the angle. In addition it is possible to combine neighboring pixels into one corner.

Fitting

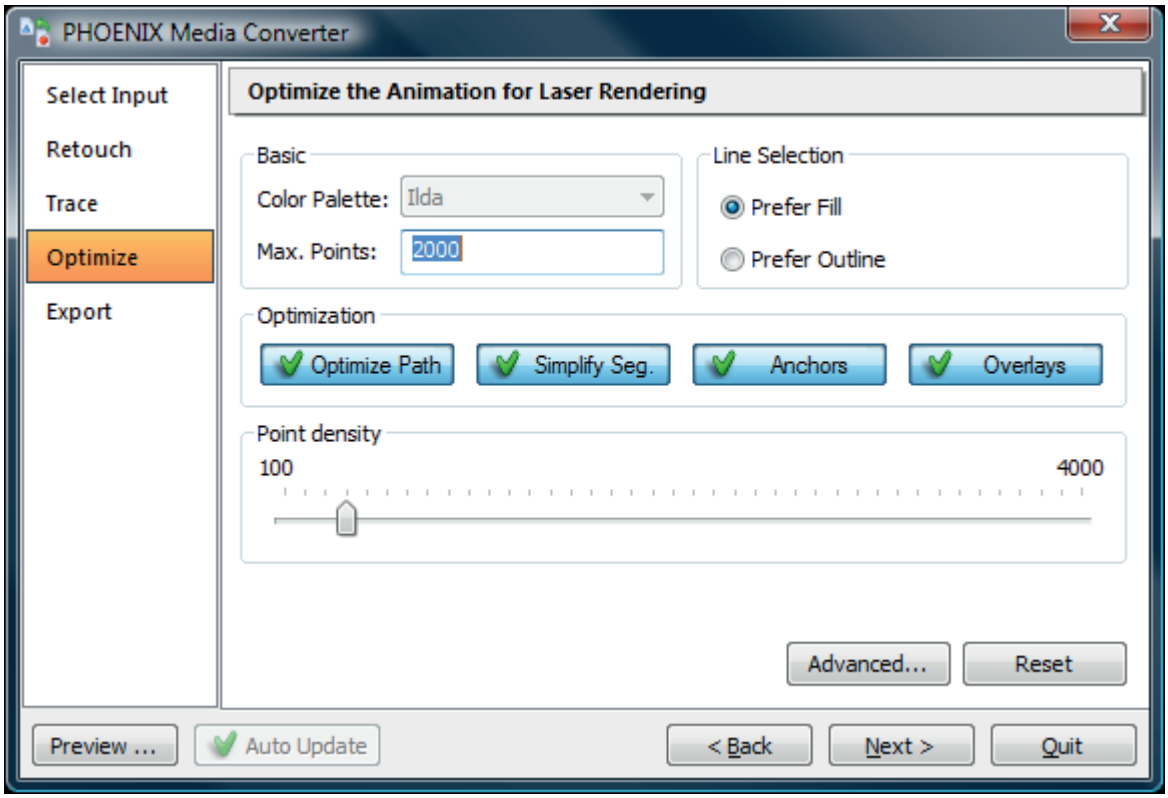
This section controls the how precise will be a contour found in the picture approximated by splines and lines. Similarly to other parameters this settings needs to be tuned for the actual picture to get the best balance between fitting and the resulting complexity.

Error threshold specifies the maximum deviation in pixels from the contour. Line distance error and Line curvature error define the minimum curvature of an arc to be considered a straight line.

Iteration parameter specifies the number of loops that the algorithm will take to find the fitting. More iteration can yield better results, but the computation time will increase accordingly.

Optimize Tab

When the vector representation of the input file is created either by tracing of a raster picture or by decoding a vector image, it is converted to a laser path. During this conversion, various optimizations are applied to improve the overall result.



Basic options are present directly on the wizard tab; more advance feature can be seen in the advance settings.

Color Palette

Only standard ILDA palette is currently supported.

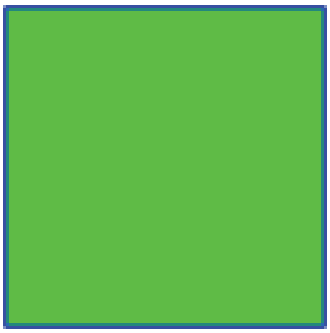
Max Points

This parameter specifies the maximum number of points on each exported frame. The application employs several strategies to achieve this count even for the larger scenes. At first it tries to remove artificially added anchor points. If not sufficient, curves are rendered with a lower precision. In case these attempts fail, the frame is simply truncated to the specified amount.

Line Selection

A laser ray cannot reasonable draw an interior of shapes. Every shape is therefore displayed only as an outline. Line selection is used to give preference to either border of fill color of the rendered shape.

Consider this square:



It has green interior and blue border. If *Prefere Fill* is selected, it will be rendered as green. On the other hand *Prefere Outline* is selected, it will be blue. The option is applicable only to shapes that have both fill and outline information. Otherwise the engine will use the data that is available.

Optimize Path

This button enables algorithms that optimize the drawing path of laser by reordering visible segments.

Simplify Segments

When this options is enabled, engine is allowed to remove some points from the input data in order to decrease the total number of points in the frame. The algorithm can identify those point that have the least contribution to the image detail and remove them first.

Anchors

Due to physical limitations of the laser scanners, it is benefitial to insert a additional points as some key places to limit the possible deformation caused by fast scanner movement. This option enables this feature.

Overlays

An input image might contain various parts/shapes that overaly each other. Without overlay processing, all these shapes are rendered independently, resulting to an quite unnatural look. If this

option is enabled, the program calculates overlaps between parts and simulates the real-life look by cutting parts that are not supposed to be visible.

In addition, this option also enables the usage of the overlay mask (which is accessible from the preview window).

Point Density

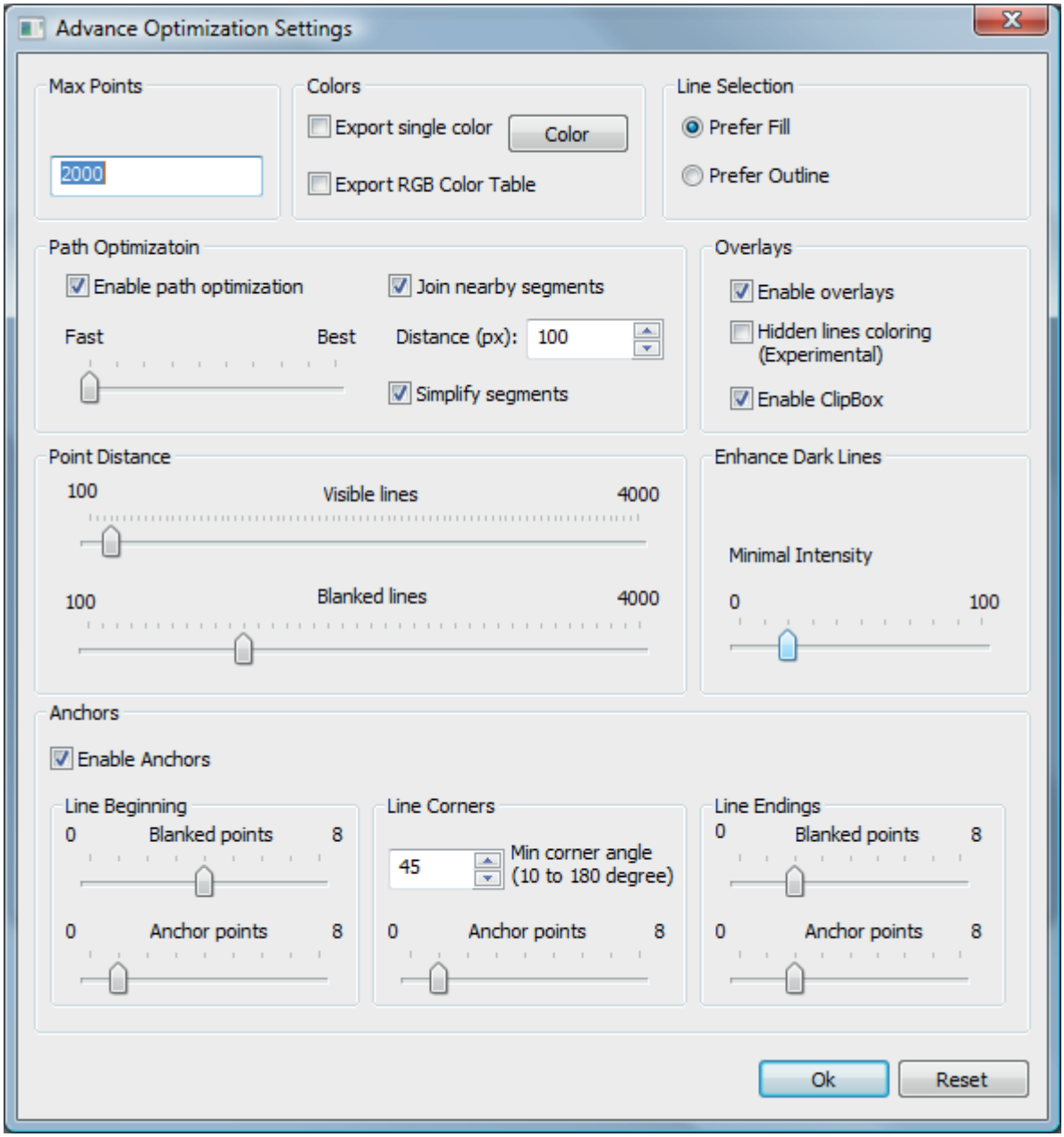
This global options controls the default distance between points in the resulting image. The actual distance can vary dependin the on image, optimizations applied and etc.

Reset

Pressing this button will set all the optimization parameters to default values.

Advanced Options

Advanced options dialog allows you to fine-tune the actual conversion process. The dialog is divided to several sections, each dealing with a different part of the processing.



Export Single Color

If set, the animation will be rendered in on predefined color

Export RGB Color Table

This option has no effect for PHO export. For ILDA export it adds the RGB section to the result file.

Path Optimization

The application includes a special algorithm to optimize the laser fly path by rearranging the visible lines so that the cumulated length of blanked lines is minimal. The algorithm is not deterministic; therefore it might yield different results each time it is used.

The quality slider can be used to adjust the ratio between quality and the length of processing. Higher quality might yield slightly better results at the cost of prolonged export times

Join Nearby Segments

This option controls whether the adjacent segments should be merged together.

Hidden Line Coloring

This option enables a processing that can handle the situation when a black/hidden line is crossing a filled shape. The algorithm is only experimental and might not always give good results. Therefore it is disabled by default.

Enable ClipBox

When enabled an artificial rectangle is drawn along the frame borders. As the effect the filled shapes that run outside of the rendering region are correctly terminated.

Point Distance

Same as the parameter in the main optimization tab. In addition it is possible to separately define the point distance for visible and blank lines

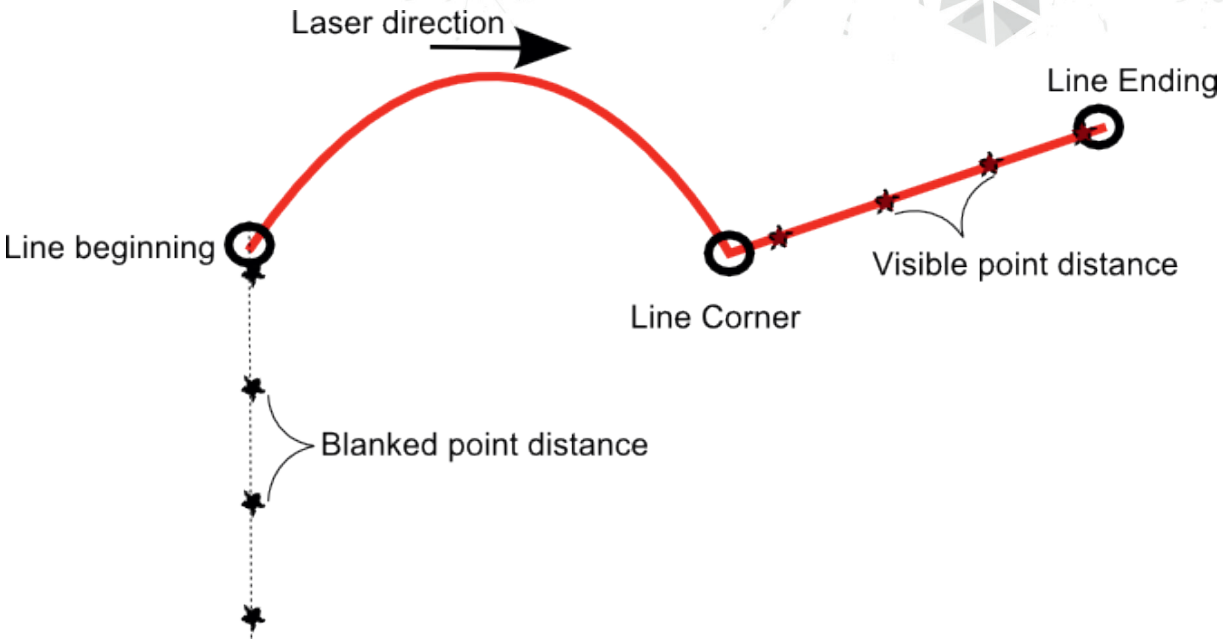
Enhance Dark Lines

It is quite common that a picture that is being converted has some black or very dark lines. While they might be perfectly visible on a bright background when presented on a screen, they will become invisible in the laser presentation. This option allows raising the intensity of these lines up to an acceptable level.

To disable this optimization, set the value to 0.

Anchor Settings

To improve the visual quality of laser drawn image artificial points are added to various parts of the laser path. These points are called anchor points.



The picture shows various parts of the laser fly path. Anchor points can be added to the beginning of a line, to the ending and at the sharp line corners.

Line beginning

Blank points slider specifies number of blanked points added to the start of a visible line. Blanked points are followed by visible anchor points. These points are added to stabilize the laser scanners before the visible line is shown.

Line ending

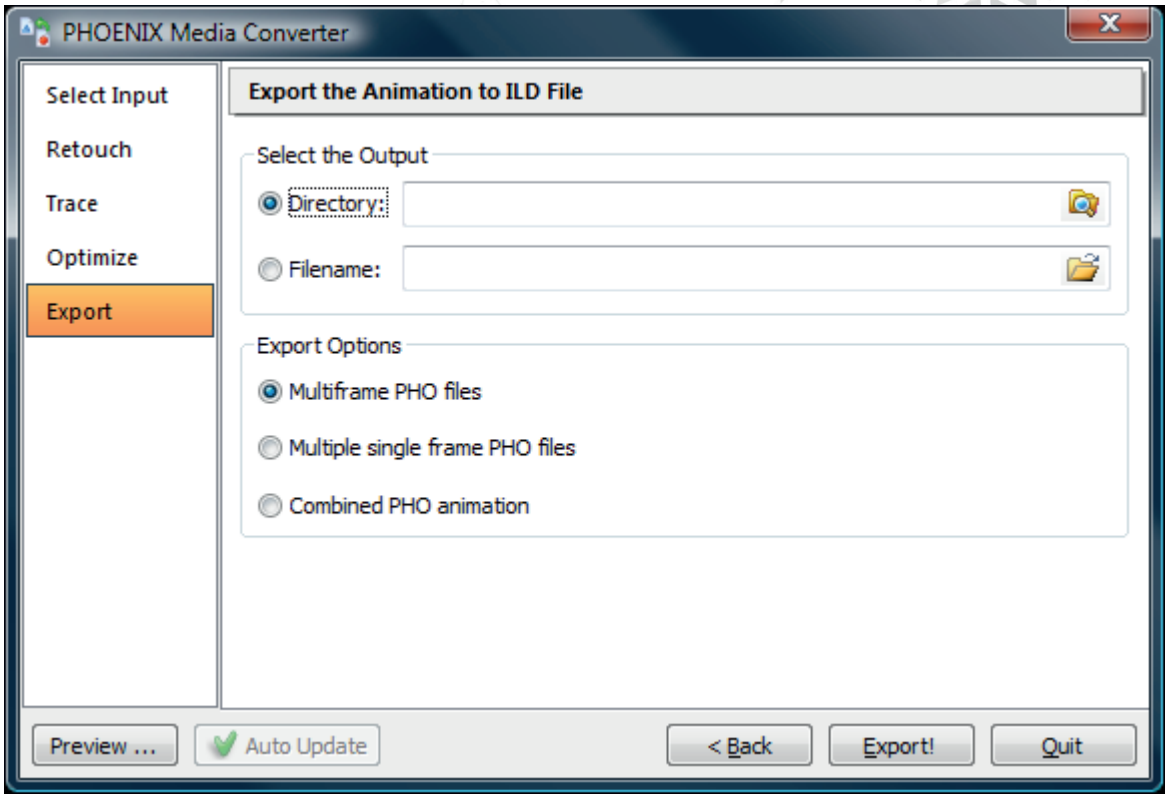
Similarly to the line beginning, anchor points can be added to the line ending. Again both visible and blanked points are added.

Line corners

Specifies the angle threshold between two connected lines which forms a corner. Anchor points can be added to this location to improve the laser rendering.

Export Tab

The options in the last tab control the format of exported animation. It is possible to specify either directory or a filename for the animation.



Multiframe PHO files

Each input file will be exported to a single multi-frame laser animation

Multiple single frame PHO files

Every frame will be exported to a separate file

Combined PHO animation

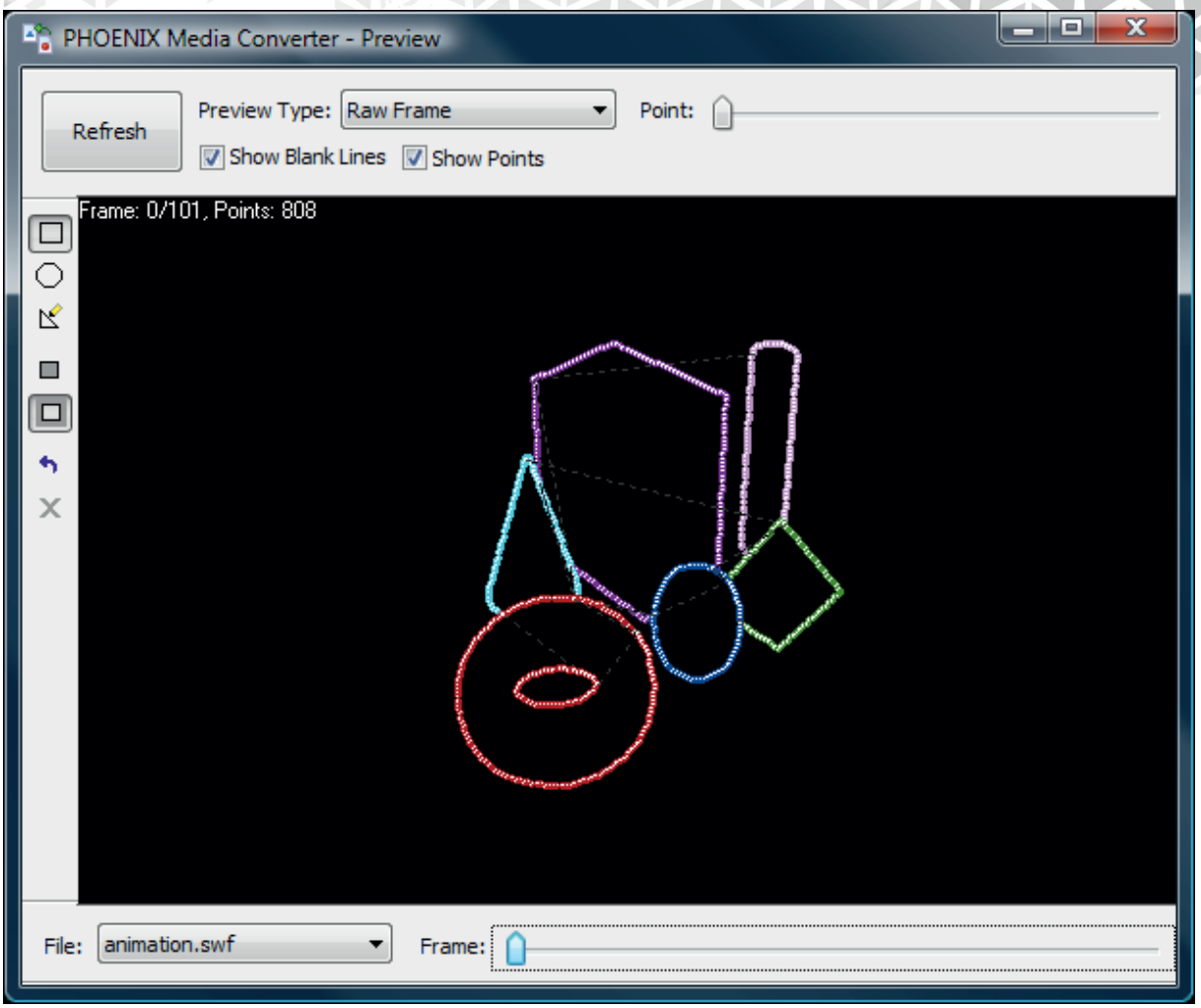
Result from all input files will be merged into a single laser animation

Export!

Press this button to start the actual conversion.

Preview Window

Live preview window allows seeing the result in various stages of processing without having to go through the whole export process.



Refresh

When *Auto Update* is not selected, *Refresh* button can be used to refresh the content of the preview window.

Preview Type

Since the conversion is performed in several step, the preview windows allows to see the intermediate results for each significant stage.

Image

Available only for raster inputs, shows the raster image with all the *Retouch* adjustments applied.

Raw Frame

Displays the vector image before any of the optimizations are applied

Processed Frame (unlimited)

Displays the image after all optimization steps, before the point reduction is applied.

Processed Frame (limited)

Displays the final image.

Point Slider

When the slider is not in the zero position, preview shows only the parts of the image up to the speficied point. It is useful for checking the laser fly path.

Show Blank Lines

When enabled, hidden lines will be displayed.

Show Points

Highlights the points on the laser path.

File

Select the input file to be shown in the preview window

Frame

Select the animation frame.

Overlay Mask Toolbox

Buttons on the left side allow to draw an overlay mask over the pictureto remove some parts from the exported animation. In freehand mode, the mask is confirmed by right mouse button.