

# Photosounder

VERSION 1.9

## User Guide

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# I. Principles

## CONCEPT

Photosounder is based on the simple concept that a sound's spectrum over time can be interpreted as an image, and that this can be reversed, an image can be interpreted as a sound spectrum over time. Photosounder is all about bridging the two domains, so that one may simply process a sound as if it was an image in order to create a transformed sound, or create a new sound from an image, an image that functions as a graphical description of the sound it creates.

When a sound is loaded, an image called a spectrogram is created. That spectrogram describes pretty extensively what composes that sound. Time goes from left to right, and frequencies from bottom for basses to the top for trebles. The brightness of the pixel define the volume at a specific place in time and frequency, the brighter the louder, the higher in position the higher in frequency, the more to the right the later it occurs in the sound.

The same principle is applied when turning an image into sound, so that if a sound is turned into an image, then that image is turned back into a sound, the sound will be somewhat similar.

## SYNTHESIS MODES

In **lossless mode** the sound will actually be exactly similar. The other mode, **noise synthesis**, gives you a somewhat different sound from the original. Let's start with noise synthesis. When an image is synthesised with this method, the image is divided into its constituent rows of pixels. Each horizontal line describes how the volume evolves through time, from left to right, depending on the brightness of the pixels, for a narrow band of noise centred around a frequency determines by the height of the row in the image. So for instance with an image that is 571 pixels high, the first row of pixels from the bottom describes the volume over time of a band of noise around 27.5 Hz (or A0), whereas the 241<sup>st</sup> row of pixels from the bottom will be centred around 440 Hz (A4). So an image simply containing a black background and a bright line going from the bottom left corner to the opposite top right corner will produce a tone that is steadily rising over time, this does so by multiplying each row of pixel with its respective narrow band of noise, then adding it all together into a sound. A white image would make each band of noise retain a constant volume, and all added together it would create a pink noise, which is a noise in which every octave has the same volume.

The lossless mode follows the same principle except for one major difference. Instead of cutting a pink noise into thin slices as a basis for the new sound, it cuts the original sound into slices in frequency, and then modifies each of such slices by comparing the new modified picture with the original. So imagine that we take the original sound's image and simply turn one pixel black, let's say the one pixel representing the sound at 2 seconds from the beginning and 660 Hz. What the lossless mode would do is that it would dip the volume at 2 seconds for the frequency slice of the original sound at 660 Hz, then add it back with the other unchanged slices. The resulting sound would be identical to the original except at that point in time and frequency where it would be silenced, without affecting the rest of the sound.

Because the lossless mode is about changing the volume of the original sound to transform it, not all features are available. Time cannot be stretched because one couldn't possibly stretch a sound properly by amplifying or silencing some parts, pitch cannot be shifted also for the same reason, and there must be no displacement of any part of the image. Typically all you should attempt to do with the lossless mode is to make some parts of the image darker or brighter, you can use this to equalise a sound, change its dynamics (like a compressor), silence or isolate some features like instruments or parasitic noises, or do something equivalent to vocoding. For everything else that breaks the relationship between the original sound and its image and the new modified image you should use the lossless mode.

There is also **Live Synthesis**, which you can enable in the Options menu, and I strongly recommend that

you use it for noise synthesis. It's just like noise synthesis but instead of being progressively rendered into a sound by blocks it is instead synthesised as the image is played back. This also gives you the freedom to control directly the playback cursor using the mouse cursor on the image, dragging it with the mouse, or the freedom to change the rate of playback without any interruption. It also directly reflects the changes in the image into sound, you will hear the latest changes to the image as the playback cursor goes over that part of the image. This is extremely useful when editing a loop as you can hear the changes as you make them. The live synthesis also has the advantage that it loops seamlessly whereas the non-live mode might not. So live synthesis is superior in everyway, except for how bad it is at normalising the volume of the sound, but typically this is only a problem for about the first second of playing a sound, then there's no problem for the rest of the session.

## PRINCIPLES OF OPERATION

Whether you load an image or a sound, Photosounder presents an image occupying the central area of the interface. Since that image is to be necessarily interpreted as a sound, the scales on the left, right and bottom show you respectively the frequency in Hertz, the pitch by note name and the time in seconds. Since any image you might load is to be turned into a sound, then the 1:1 relationship between its horizontal and vertical axes doesn't need to be respected anymore as there is no such relationship between time and pitch, so images do not keep their original aspect ratio and instead are stretched to fit the image area. An image isn't an image anymore the moment you load it, it becomes a spectrogram, the graphical description of a sound to create.

## II. Getting started

### INSTALLATION

The demo version of Photosounder is simply installed by downloading it on the Photosounder website, and extracting the ZIP file to the desired location.

The full version is obtained by buying on the website. Once the payment has been received, you should almost instantly receive by e-mail a link to download the program as well as the license file needed by the full version of the program to run. If you haven't, check inside your spam folder. The full version is installed by extracting the ZIP file and placing the license file in the same directory as the program. If it still says "Demo" that means you downloaded the demo. The demo cannot be activated and the full version has no demo mode, they're two different programs. This is a common source of confusion. The full program comes from the URL that contains your serial number, it's a permanent link and I suggest that you bookmark it. If you lose or forget the link you can have it sent back to you by email by entering the email address you used during the original purchase in the form on the download page.

### BASIC OPERATION

Photosounder can open many types of image and sound files. Whereas images are loaded largely untransformed, sounds first have to be processed and turned into a kind of image called spectrogram. That image represents features present in the sound loaded in a way that allows it to be turned back into sound in a relatively faithful way. A notable difference between images obtained in such a way and regular images in Photosounder is the former present a much higher precision in their intensity, and to represent this higher precision in a convenient fashion, their intensity is displayed in a very colourful way that helps you seize the slightest variations in the image in a glance.

Once either an image or sound is done loading (the latter which can take a few seconds depending on

the length of the sound and the processing power of the machine it is running on), Photosounder starts synthesising the image into a new sound, which progress is depicted by the blue progress bar above the image. The light blue part of the bar is the part of the sound that remains to be synthesised, the medium blue area is the part of the sound currently being processed, and the dark blue part of the bar that displays a waveform is the sound you can already listen to by click the button Play. You can save the produced sound into a sound file by pressing the Save button. You can also save the image obtained by pressing the same Save button, and by choosing the image option in the drop-down menu. You can save and entire project (including every layer, setting and lossless data) by choosing to save to a Photosounder Archive file (.pha).

By default at the start, the Cursor tool is selected. It means that when you click somewhere on the image while playing the sound, the sound playback jumps where you clicked. You can also control the sound volume by turning the Volume knob in circles using the mouse. When the cursor is over the image, it will also indicate in the lower left corner of the window the time, frequency and pitch coordinates of where in the image your cursor is pointing. It can be particularly helpful if you're trying to determine the precise pitch of a note.

The window of Photosounder can be resized by clicking and holding the group of dots in the lower right corner of the window, and dragging the cursor to the position on the screen where the lower right corner of the window is desired to be.

## CONTROLS OPERATION

In Photosounder, most settings are defined by knobs, which are controlled by the mouse. In order to change a value defined by a knob, simply click and hold anywhere on the circular area of the knob, and move the cursor in circles around the knob clockwise or counter-clockwise. For more precision in your movements, you can move the cursor further away from knob. For yet more precision, you can click and hold the right mouse button of your mouse, either simultaneously with the left button or independently, which allows you to spin the knob around 100 times slower.

## PARAMETERS

A description of what each parameter means, from left to right and top to bottom :

<b>Min. frequency</b>	Lowest frequency in the image, at the bottom of it. By default 27.5 Hz, also know as A0, one of the lowest notes we can hear.
<b>Max. frequency</b>	Highest frequency in the image, at the top of it. By default 20 kHz, a frequency at the boundary of ultrasounds.
<b>Frequency scale logarithmic base</b>	Scaling of the frequency (vertical) axis going from linear (by convention here 1) to logarithmic (here defined as 2). Any setting in between 1 and 2 is an interpolation, a form of compromise, between linear and logarithmic scaling. The logarithmic scale is used by default, as it's closer to the way we perceive frequency, but it's also the same frequency scaling as used in musical notation, which explains why notes and octaves on the right side of the image are evenly spaced.
<b>Volume</b>	Volume of the playback sound. +0.0 dB means that the sound is normalised as to make the sound as loud as possible under any circumstance while avoiding clipping, which causes distortions. Therefore a volume above 0 dB should only be used to enhance the more quiet parts of a sound.
<b>Time resolution</b>	Playback speed of the image. By default set to 100 pixels per second, which means that a picture 800 pixels long will make a sound 8 seconds long. Also the rate of images obtained from sound, which means that if you open a sound and set the time resolution to 0.5 pixels/second, the sound will play 200 times slower than its normal rate, while if you set it to 2,000 pixels/second it will make the sound 20 times faster than usual, without changing the pitch of the sound.

<b>Spray width</b>	Width of the area affected by the spray tools in pixels, in the scale of the screen.
<b>Tool intensity</b>	Intensity of the spray tools or rectangle tool in percents.
<b>Horizontal flip (FLIP)</b>	Reverses the image in time (horizontally).
<b>Invert (INV.)</b>	Inverts the colours/intensity of an image in the same way as a photographic negative.
<b>Mask Invert (M.I.)</b>	Inverts the mask. Produces the difference between the original image and the current one.
<b>Vision Mode (V.M.)</b>	Switches the Vision Mode.
<b>Gamma</b>	Gamma function, as it can be found in most image editing programs. Can be thought of as a sort of brightness function. The default (and neutral) value is defined here to be 1:1.
<b>Layer intensity</b>	Changes the intensity of a layer with respect to other layers.

## MOVE TOOL

This allows you to move a layer visually up or down, which transposes its pitch, or horizontally which changes when it occurs in time. Holding shift allows you to only move it on one axis. When you use the move tool to move a layer you can see in the lower left corner of the interface by how much in seconds and semitones the image is being shifted.

## SPRAY TOOLS

In addition to the various effects you can achieve by adjusting the aforementioned parameters, you can also finely edit the features of an image-sound by using the Spray tools. The Spray tools, activated by clicking the second, third or fourth icons to the left of the image, can be used to highlight, tone down or erase features from image-sounds, or painting up new ones. It can be used to achieve many things, such as singling out a sound, suppressing a sound, reproducing traditional sound effects by imitating their effects in the time-frequency domain (this can be learnt by loading a sound and a copy of it with the desired effect applied, and looking at the visual differences between the two), or even creating sounds from scratch.

Using these tools, a left click on the image will darken, brighten, paint up or smart erase (depending whether you've selected the black, white, flashlight or road roller spray tool) the area in the vicinity of the mouse cursor, area which will be defined by the Spray width parameter, with an intensity controlled by the Tool intensity setting and by how long the click is held. Inversely, if the right click is held, the same area will be progressively reverted to its original state. Therefore anything done with the Spray tools can be easily reverted. The reason for this reversibility is that a copy of the original image is kept in memory, and is used for reverting changes.

## RECTANGLE TOOL

The rectangle tool works similarly as spray tools. Holding the left mouse button darkens the chosen area by a ratio defined by the Tool intensity knob, holding the right mouse button inversely brightens the area.

## HARMONICS MODIFIER

If toggled, the harmonics modifier, represented by four vertically stacked dots, modifies the behavior of all spray tools by reproducing their action on the harmonics of the frequency that the mouse cursor points to. This allows for the simultaneous modification, suppression or creation of harmonic content.

## MAGNET MODIFIER

If toggled, the magnet modifier snaps the mouse cursor to the nearest feature, determined by proximity and intensity. If the harmonics modifier is also toggled, the magnet modifier also takes into account harmonic content to determine which point to snap to. The point on the image to which the magnet modifier snaps is represented by a diagonal cross on the screen.

## ZOOM

Photosounder allows you to zoom in on the image you're editing using the scroll wheel of your mouse. Scrolling up will zoom in in time, scrolling down will zoom out. You can zoom in frequency instead by holding the Shift key while scrolling, or zoom in both horizontally and vertically by holding the Control key. Once zoomed in, you can drag scroll the image by holding the middle mouse button or the End key and mouse the cursor around. Note that if you do not have a scroll wheel on your mouse you can use the Page Up and Page Down keys instead.

## LIVE SYNTHESIS

When live synthesis is enabled (in the Options menu), several aspects of Photosounder change in behaviour. The first difference is that once the live synthesis mode is ready there is no progressive processing of the whole sound, instead what is to be heard is synthesised right as you hear it. This means that you can hear changes to the image while you are making those changes, whatever they are. You can also change the playback speed instantly without having to release the Time Resolution knob to hear the change but rather while you turn it. This also enables you to synthesise sounds with a duration of several hours in a feasible way. Another difference is that by holding the mouse button while using the cursor you can make playback follow the mouse cursor and thus directly control the flow of time. The edges of the image are processed differently whether looping playback is enabled (either with the Loop Playback option or by holding the L key) or disabled. When it's enabled the live synthesis algorithm interpolates the edges of the image as if they were connected as to smoothly transition across the edges. When it's disabled the algorithm acts as if there was nothing before or after the edges, as it does in non-live synthesis.

You can save synthesised sounds to a sound file as they are synthesised using the Save Live Synthesis Output to File... option in the Options menu. Only the samples actually synthesised are saved, pauses aren't considered so the saved output doesn't necessarily need to be edited further. Saving samples to the file can be paused by turning on the Suspend Output to File option.

## III. Lossless mode

### DESCRIPTION

By default, Photosounder synthesises sounds purely from image data, discarding all original input sounds. While powerful and offering much flexibility, this approach also introduces a loss in sound quality. The lossless mode remedies to that by using the original sound as a basis for resynthesis, in the place of noise. It works by keeping an original sound and its untouched image, then comparing the differences between the image as modified by the user and that original image, and applying the differences to the original sound. Therefore, as long as a sound's image is untouched, the resulting sound will be strictly similar to the original sound, hence the term lossless.

## USAGE

In lossless mode, the last sound loaded and its associated original image are always kept in memory, and used in combination with the current image to produce the synthesised sound. This means that you can open a sound, export its image, edit this image in an image editor, then open this modified image with Photosounder in lossless mode, the resulting sound being the differences between the new image and the original image applied to the original sound.

The lossless mode is recommended for tasks such as erasing, filtering, isolating or enhancing sound features, noise reduction, subtraction and other operations between two different sounds and various time-frequency mastering operations.

## LIMITATIONS

However, there are limitations inherent to the lossless mode which are important to keep in mind. The lossless mode works by comparing the matching pixels of the original sound's image and the current image and filtering the original sound in time-frequency according to those differences. This means that it is important not to displace anything in either time or frequency in order to obtain the desired quality of sound. This is why several controls are locked in lossless mode, as using them would in the best cases produce a result of quality possibly worse than in lossy mode. It is also recommended to keep images to their original length.

## IV. Layers

### USAGE

Layers constitute a stack of individual images that combined together make up the final image that you see and hear. Using multiple layers allows you to do things you wouldn't be able to do otherwise.

By default when you open a sound, image or create a new image only one layer is present. You can add a new blank layer on top of that layer by selecting New Layer in the Layers menu, or duplicate that layer by selecting Duplicate Layer. You can see the list of layers at the bottom of the Layers menu. The currently selected layer is indicated by a check mark next to its name. You can delete the currently selected layer by clicking Delete Layer in the Layers menu. You can also move the currently selected layer up and down in the stack of layers by selecting Move Layer Up or Move Layer Down. You can switch between a view of all the layers combined or a view of only the currently selected layer by clicking View Current Layer Only. Likewise you can view only the current group of layers as separated by separators using the View Current Group Only. Unlike View Current Layer Only, View Current Group Only only lets you hear what you see. Both options can be combined to only view the current layer while only hearing the current group of layers.

Each layer has a blending mode associated with itself. The default mode is Addition, you can see in the Layers menu that it is already checked. The blending mode defines how each layer affects the combination of the layers below. Separators can be added between layers to create isolated groups of layers. Layers between separators are combined separately from other groups of layers. The combinations of each group of layers are then combined together according to the blending mode set for each separator. This can for example be used so that a layer with a blending mode set to Multiplication would only affect a precise group of layers and not every single layer below it.

Layers can also be merged into one using the Merge Down function in the Layers menu. The Merge Down function merges the currently selected layer with the layer right below it. For this reason, the



proper way to merge a group of several layers is to start by selecting the second layer from the bottom and to use Merge Down until all are merged together. Merging layers together in a different order could yield a result inconsistent with what was seen prior to the merging depending on the blending modes used. The combination of all layers can also be turned into a whole new layer at the top of the stack of layers using the Merge All to New Layer function.

## V. Menus

### FILE

#### **New**

Creates a new blank image. Its height is the default height for sounds (571 pixels by default) and its width matches the current width of the image area.

#### **Open...**

Opens a dialog to load a sound, image or saved project / script.

#### **Resume Last Session**

Loads the file 'history.pha' which was automatically generated during the previous session. Every action saves the corresponding command to 'history.pha' instantly, so you can always resume your work.

#### **Save...**

Opens a dialog so you can save your project as a sound (not in the demo) or a BMP image or a PHA (Photosounder Archive) file, which depending on what you choose can either be a history file, meaning it contains the sequence of commands used, or a status file in which case only the current state is saved. History files are generally preferable as they contain more useful information and can even allow you to change or undo some things using a text editor and are lightweight since they only contain such commands, but doesn't include the dependencies which is the image or sound files loaded (those need to either still be found in their original location or in the same folder as the PHA file), whereas a status file contains raw data with no dependencies and is typically quite large.

#### **Reload**

Reloads the last file opened.

#### **Quit**

Quits instantly. Since you can always resume the last session (see above) you can quit at anytime and resume your last session when launching the program again. You can literally Alt-F4 / ⌘-Q a fraction of a second after your last action and when you launch Photosounder again and resume the session that last action is still there.

### EDIT

#### **Undo**

Crude undo function which only saves the last version of the pixels of the current layer being edited. For more serious undoing open the file 'history.pha' found using Open Photosounder Files Folder in the Help menu with a text editor, edit out the last lines containing the actions you want to undo, save it then choose Resume Last Session in Photosounder's File menu. I realise that this method isn't as immediately convenient as conventional multiple undo, however it's also much more powerful since you can edit the actions done so far in any way you want.

#### **Copy**

Copies the current image (the final image, not the current layer) to the clipboard. Not implemented on Mac.

### **Erase Mask**

Restores the original image.

### **Default Values**

Resets all the knobs to their default values.

## **OPTIONS**

### **Loop Playback**

Loops the playback when toggled.

### **Pause After Current Loop**

Pauses the playback when the end of the loop is reached. Very useful when saving live synthesis to file to make loops end neatly. Can also be used to make edits between each iteration of a loop being exported in this way, for instance playback the loop, have it be paused after 4 iterations, then turn on a layer then resume the playback, and the recorded transition can be seamless.

### **Live Synthesis**

Turns on live synthesis, which has the characteristics outlined above in the paragraph explaining it.

### **Suspend Processing**

Stops the sound from being rendered. This is useful when doing many edits and the sound is being rendered when you don't want it to be.

### **Constant Time Resolution Analysis**

By default Photosounder varies the time resolution when analysing sounds by giving less time resolution to the basses to increase their frequency resolution. This option gives every frequency the same time resolution, which is mostly useful when processing dynamics, like doing effects to the envelope of a sound.

### **Save Live Synthesis Output to File...**

When you select it it asks you to save to a sound file, then every sample that you play from that point on will be saved to a file (and none of the pauses). The saving is completed when you select that option again to turn it off.

### **Suspend Output to File**

Pauses the live synthesis output to the sound file. This allows you to make edits and listen to them, but very importantly when you resume the output the live synthesis goes back to the position in the noise tables where it stopped, so that the saved output can be seamless.

### **Unnormalised Output**

The sounds generated are typically normalised for playback, that means the highest audio peak will be normalised to  $\pm 1.0 / 0$  dB. This is a problem when processing stereo channels separately as one might come out as having more gain than the other, throwing off original the stereo balance. When Unnormalised Output is selected the peak is brought somewhere between  $\pm 0.1$  and  $\pm 1.0$ , so the two channels should have the same gain applied, or in some rare cases one might be 10 times quieter than the other, which can easily be fixed in an audio editor.

### **Load Left Channel Only**

### **Load Right Channel Only**

When one of those two options is selected then instead of mixing down a stereo sound to mono before analysing it only one of the channels is loaded.

### **Mix Channel Files to Stereo...**

This asks you to select a left channel sound file, then a right channel sound file, then where to save the stereo mix of the two. With this you can edit the left channel first and save it, then do the right channel, and then combine the two into a single file.

### **Long Block Duration**

The default for noise synthesis is to use as a basis for synthesis a sound that loops in about 2 seconds. The looping is generally not audible, however in cases when it is or when it is visible (like turning an image into a sound for the purpose of having that image visualised in a spectrum analyser) this option increases the loop duration to over 120 seconds.

### **Linear Knob Control**

When turned on knobs are controlled by a vertical cursor movement. When turned off a circular movement is used instead.

## **HISTORY**

The History menu is a hidden menu, it can only be seen by editing 'config.txt' and setting history\_menu\_on to 1. This is only useful for people who want to script and need to control which units are used when recording actions.

### **Time in pixels**

### **Time in percents**

### **Time in seconds**

Positions in time are typically recorded in seconds, this is convenient when drawing over a sound, you can then edit the history to have different analysis time resolution which would change the position of the drawing if it was recorded in pixels, recording in seconds keeps this unchanged. However in some cases a scripter might want to use different units.

### **Frequency positions in pixels**

### **Frequency positions in percents**

### **Frequency positions in Hertz**

### **Frequency positions in notes**

Absolute positions are by default recorded in Hertz. Name of notes with cents can also be used, which is useful when drawing music.

### **Frequency dimensions in pixels**

### **Frequency dimensions in percents**

### **Frequency dimensions in semitones**

This is the unit in which things like vertical shifts are recorded, like when moving a layer up or down. Semitones are the default.

### **Relative selection index**

By default selecting a different layer records that change as an absolute count from the first layer. This can be inconvenient when creating a script that might be loaded on a project with any number of layers. This options records instead the new selection as an offset, positive or negative, from the previously selected layer.

## **VIEW**

### **Force Fast Image Display**

### **Force Smooth Image Display**

Photosounder chooses whether to use a smoother bilinear filtering for displaying images at higher zoom levels or the faster nearest neighbour algorithm when zoomed out. These options allow you to force the choice.

### **4/4 Rhythm Overlay**

Shows a 4/4 overlay over the image as if it is a loop. Useful for editing loops.

### **Semitone Overlay**

Shows horizontal dashed lines when zoomed in vertically. The lines with the longer dashes match the white notes of the keyboard. Useful when trying to draw notes.

## **TOOLS**

### **Cursor**

The default tool, it allows you to set the position of playback on the image. When live synthesis is enabled you can by holding down the mouse button and dragging the cursor around the image control directly the playback.

### **Move Tool**

### **Rectangle Tool**

### **Dark Spray**

### **White Paint Spray**

### **Brighten Spray**

### **Smart Erase**

### **Harmonics Modifier**

### **Magnet Modifier**

All these tools are explained in the Getting Started chapter.

## **OPERATIONS**

### **Invert**

Inverts the current layer. Useful when an image has a light background (this is typically undesirable, only images with dark backgrounds make interesting sounds).

### **Mask Invert**

If you load a sound and darken some of its elements for instance using a spray tool, then you can get the opposite result using Mask Invert. Let's say you remove an instrument from a sound, using Mask Invert will give you that instrument and nothing else.

### **Horizontal Flip**

### **Vertical Flip**

### **Rotate Clockwise (90°)**

### **Rotate 180°**

### **Rotate Counter-Clockwise (270°)**

Self explanatory. It should be noted however that rotations by 90° and 270° change the image a bit, since images used in Photosounder can easily be tens of thousands of pixels long but should preferably not exceed about a thousand pixels of height then those two rotations keep the original unrotated dimensions of the image.

### **Horizontal Average**

Averages every row of pixels. This is very useful when doing anything with curves, for instance you can draw a curve, fill it to the left (see below), then horizontal average it and by using it as a multiplication layer for instance you can use it as an equaliser, or using it as a subtraction layer you can use it to remove a constant noise.

### **Vertical Average**

Same as above except vertically. Useful for editing dynamics or creating envelopes.

### **Horizontal Curves**

### **Vertical Curves**

These do the same thing as the averaging operations, however instead of averaging all the rows

or columns of pixels it creates a sort of filled curve that you can visualise and edit, for instance you can erase a peak from a curve using a spray tool, then average it to use it as an effect. You can go back and forth between curves and averages for all kinds of effects, for instance you can darken slightly the peaks of a sound's vertical curve to achieve a kind of dynamic compression.

### **Fill from Maxima to Left**

### **Fill from Maxima to Bottom**

These allow you to create your own curves from scratch. Simple draw the curve you want on a blank layer using the white spray tool, then use a Fill from Maxima operation which fills up the curve, then after shifting using the Move Tool to cut out the parts that must be cut out you can use the matching Average operation. Useful when trying to create an envelope or equalisation curve.

### **Normalise to 1.0**

As a result of operations the range of values of layers can swing wildly. This operation makes the brightest pixel have a brightness of 1.0.

### **Set Pixel Sum to 1.0**

Sets the sum of pixels to 1.0. This is useful when creating a layer for convolution as you might want to keep the brightness of the result constant by having the convolution layer have a pixel sum of 1.0. For instance you can blur an image simply by convolving it with a layer that only contains a blurry dot. But if you don't set the pixel sum to 1.0 it might make the blurred image vastly brighter than the original, which might be a problem.

### **Horizontal Normalisation**

### **Vertical Normalisation**

Normalisation makes every row or column have the same sum of pixels. This makes Horizontal Normalisation give you a flat spectrum and Vertical Normalisation give you a flat envelope. A usage example would be transforming the dynamics of a sound, you would duplicate the original image's layer, in the lower of the two you'd apply Vertical Normalisation while in the upper layer you would apply Vertical Average, and you could set the upper layer to Multiplication, which would give you the original image and its sound back, however now you'd be able to edit the dynamics in the upper layer independently from the rest.

### **1 / x**

### **Square**

### **Square Root**

These operations apply those mathematical functions to every pixel of a layer.

### **Fill with White Noise**

### **Fill with Pink Noise**

### **Fill with Brown Noise**

Fill the current layer with a specific type of noise.

### **Group to Nearest Semitone**

All rows of pixels are moved to the nearest semitone. Can be somewhat useful for turning some kinds of images or drawings into musical notes.

## **LAYERS**

### **New Layer**

Adds a new blank layer above the current one.

### **Duplicate Layer**

Adds a copy of the current layer.

### **Add Separator**

Adds a separator layer, which is a layer with no image data, but that can be used to make groups. A separator layer's blending mode defines how the layers above the separator are blended with

the layers below it.

### **Merge Down**

Merges the current layer with the layer below itself according to the current layer's blending mode.

### **Delete Layer**

Removes the current layer entirely.

### **Merge All to New Layer**

Creates a new layer at the top of the stack of layers, and that layer is the same as the overall result of all the layers.

### **Move Layer Up**

### **Move Layer Down**

Moves the layer in the stack of layers.

### **View Current Layer Only**

Shows you only the current layer, but you can still hear every layer.

### **View Current Group Only**

Shows you only the result from the current group of layers, a group of layers being defined by separator layers.

### **Set Central Convolution Point**

Convolution / Propagation layers need a point of origin. Convolution works by replacing each pixel from an image with the whole of the convolution layer, so we must have a point on the convolution layer that represents the centre of that convolution. For instance if we want to blur an image by creating a convolution layer that only contains a single blurry dot, then the central convolution point must be at the centre of that blurry dot, otherwise the result of the convolution will show a shift. By default the first click with a spray tool in a layer sets the central convolution point, so most of the time you don't need to set it yourself.

### **Turn Off Layer**

Turns off a layer both visually and in the sound, kind of like deleting the layer except you can always turn it back on.

-

The following are blending modes. They define how the current layer is combined with the result of the stack of layers below.

### **Addition**

Adds the layer, it is the default mode.

### **Multiplication**

Multiplies the layer, as you would for instance if trying to apply an equalisation layer to the sound below.

### **Division**

### **Division (Reverse Order)**

Divides the layer by the stack result or vice versa with Reverse Order. Useful for trying to go the other way of multiplication, for instance dividing by a smooth frequency profile to flatten the spectrum.

### **Subtraction**

### **Subtraction (Reverse Order)**

Subtracts, useful for trying to subtract a noise profile to a noise-containing sound for instance.

### **Difference**

Gives you a subtraction going both ways. I've never had a use for it but it doesn't hurt to have it.

## **Minimum**

## **Maximum**

Compares the pixels of the layer and the stack result and picks either the darkest or the brightest. If the top layer is a flat image you can adjust its brightest to define a limit to the values of the layer below for example.

-

The following blending modes are very different and hardly ever encountered in image editing software, but very powerful. The blending modes above operate on independent pixels, for instance a pixel at a precise position on a layer is adding to the pixel at the very same position on another layer, and none of the neighbouring pixels can have any influence, that's typically how blending works. The following however are very different, they're convolution modes, that means that for full 2D convolution (here called simply "Convolution") each pixel from the layer below is replaced with a full copy of the layer above, shifted according to the position of that pixel and multiply according to its brightness.

So a bright pixel in the top right corner of the image will create a bright copy of the convolution layer in the top right corner of the resulting image, while a darker pixel in the centre of the image will create a darker copy of the convolution layer. If that's confusing the best way to get a more intuitive understanding of it is to try it. I recommend using the white spray tool at its thinnest, creating an empty lower layer, then creating an upper layer and drawing on it a shape like a tiny star, set it to Convolution then go back to the lower layer and draw a path. You'll see the shape work as if it was a brush. Instead of a star shape you can try a few separate dots, which will create copies according to the position and brightness of those dots.

If you're looking for a quick way to create rich and strange sounds it's highly recommended that you experiment with the following convolution modes. Simply applying one of the Propagation modes to a sound's image with the flipped or rotated version of itself can instantly create fascinating soundscapes or strange harmonies.

## **Vertical Propagation**

Vertical "Propagation" is a form of convolution that only happens vertically. This means that every pixel of the lower layer is replaced with the whole matching column of pixels from the upper layer, rather than the whole image. It's very useful and interesting for more musical effects. If your vertical convolution layer is a harmonic series of horizontal lines going across the image, then the result will be to add harmonics to your lower layer, so that for instance you might have a lower layer that shows notes as single lines and a vertical propagation layer that only has harmonics. The result will be the same notes but with added harmonics, and you can edit the two separately. You can also use this mode for pitch-shifting according to a curve, or even by notes. For example in [this video](#) I flattened a melody by keeping the original image in the lower layer and transformed a copy into only having lines that represent the notes of the melody, then flipped those lines upside down so that the melody would be upside down. With Vertical Propagation this had the effect of shifting every note to the same position, thus flattening the melody to the same note, except when two notes were playing at the same time in which case the vertical convolution resulted in 3 simultaneous notes, with symmetry around the middle one. One could use a different melody to create something different, or even do a Vertical Propagation with a single straight line then adding extra parallel line to create chords. The possibilities are many. I often use a single straight horizontal line made by a blurry white done average horizontally as a vertical propagation layer in order to blur a sound only vertically, I do this to fuse the sound's harmonics together, which I may use for vocoding or to separate formants and pitch-shift overtones without shift formants, which may be considered a better way to do pitch shifting.

## **Horizontal Propagation**

### **Horizontal Propagation (Looped)**

Horizontal propagation follows the same principle except of course horizontally. This can be useful for creating a reverb. In that case you would create a layer with a thin vertical line as a basis, a single straight line would give you an unchanged image, then give it a trail (using the Operations starting from a handdrawn curve depicting the desired envelope over time would do well) would create an effect similar to a reverberation. Since it operates on a per-row basis, this means that you could modify your layer so that for instance you have more trailing reverberation at the bottom in the basses than at the

top, or any creative effect you can imagine. The Looped version continues the convolution from one edge in time of the image to the other, so that if you use it for a reverb in a loop then that reverb loops seamlessly instead of stopping at the end of the loop. Horizontal Propagation, or horizontal convolution, is very much the equivalent of audio convolution, spectrally it does about the same thing, which is a good thing to remember if you enjoy using audio convolution for creative effects as you can do the same with this horizontal convolution mode.

## **Convolution**

### **Convolution (Looped)**

This is the convolution described earlier, the one in which each pixel of a layer is replaced with the entirety of the other. This is a great way to generate interesting images simply by drawing with the white spray tool. You can do this instantly by drawing a horizontal wavy line on the lower layer, then a vertical wavy line on the upper layer then setting the upper layer to Convolution. But it can also have very practical uses. A convolution by a single sharp dot doesn't do much, but convolution by two sharp dots creates a double image. You can have a note on the lower layer, maybe from a sample, then on the convolution layer by placing sharp dots apart from each other by a few semitones and the right intervals in time create a melody, by creating copies of that original image at the positions specified by the dots. Likewise you could repeat a drum by placing dots at regular intervals through a loop, then editing the drum layer would propagate the changes to all its copies instantly, and you could remove dots as you like. You could have a sharp dot and then to the right an octave below or a fifth above have a trailing dot to create a transposed reverb effect. Once again the possibilities are many.

You might notice that Convolution gets quickly very slow. That's because we're making a copy of an entire layer for every pixel in the other layer, this takes a lot of operations, it's bound to be pretty heavy. Just keep in mind that in order to make things quicker Photosounder only makes copies for the non-zero pixels in the convolution layer, so therefore the less non-zero layers the quicker it will be computed, and if your convolution layer has no zero-value pixels then you'll never see the end of it (well, it might take a couple of minutes depending on what you're working with), that's why typically a convolution layer should be something you draw.

## **HELP**

### **Open Manual...**

Opens the PDF manual.

### **Check for Updates Online...**

Takes you to the download page.

### **Open Photosounder Files Folder**

Opens the folder in Explorer / Finder where files like 'history.pha' and 'config.txt' are stored. This is where you would go to edit the configuration file or edit the history file to change or undo some things.

## **VI. History and scripting**

### **HISTORY**

While using Photosounder, all actions are recorded in real time to an history file (history.pha, located in the program's folder) in an easy to read and to edit format. This enables you to resume your work from last session (using Resume Last Session in the File menu) without losing a thing and with an identical result, even if the program didn't quit correctly or if the computer suddenly shut down. This also enables you to save a session's history to a typically small file (usually in the tens or hundreds of kilobytes).



History files are easy to read text files that can be edited with any text editor. This means you can edit the recorded actions to change the recorded history. You can undo a number of actions by deleting them, even if they're in the middle or the beginning of the file, change parameters or even add missing actions.

## SCRIPTING

Recorded history files typically record everything from the creation of a new image from scratch or from the opening of another document. By editing a recorded history file into removing the commands at its beginning which either create a new image or load a document you can make a file that when loaded will apply the subsequent actions to what is already in memory. You can for example open a sound, apply a series of actions to it to obtain a desired result, edit the history to remove the part that opens the sound, save this modified history into what can now be thought of as a script that will reproduce the recorded actions. Therefore you can load any other sound, then open that script so that the same actions will be applied to the sound currently loaded.

You can also type new commands by hand. For a reference on the scripting language please refer to the [Photosounder Archive Specification](#).

## VII. Keyboard shortcuts

<b>O</b>	Equivalent of the <b>Open</b> button
<b>S</b>	Equivalent of the <b>Save</b> button
<b>Esc</b>	Equivalent of the <b>Quit</b> button
<b>Space</b>	Equivalent of the <b>Play/Pause</b> button
<b>C</b>	<b>Copy</b> function. Copies the current image to the clipboard, allowing it to be pasted in other image editing programs.
<b>R</b>	<b>Reload</b> function. Reloads the sound or image from the file. Most practical when modifying in parallel the input file with another image or sound editing program to quickly reload a file freshly updated from another program.
<b>U</b>	<b>Undo</b> function. Cancels the last action on the image. Redoes it if pressed again.
<b>E</b>	<b>Erase changes</b> function. Cancels everything that has been done with the Spray tools or Rectangle tool from the beginning.
<b>D</b>	<b>Default values</b> function. Resets the default values for the knobs Min./Max. Frequency, Time resolution, Gamma, Logarithmic base, Spray width and intensity.
<b>N</b>	<b>New layer</b> . Adds a new layer on top of the selected one.
<b>J</b>	<b>Joins</b> the selected layer with the layer right under it.
<b>Del</b>	<b>Deletes</b> the selected layer.
<b>V</b>	<b>View</b> current layer only switch.
<b>Shift+V</b>	<b>View</b> and edit current group of layers only.
<b>T</b>	<b>Turn off</b> current layer. If a separator is selected then the entire group that it represents (the layers above itself until the next separator) is disabled.

<b>L</b>	<b>Loop</b> function. Loops back to the beginning of the sound if the key is held when the end of the sound is reached.
<b>B</b>	<b>Backwards</b> playback function. Plays the sound backwards when held.
<b>L + B</b>	<b>Ping-pong</b> playback function. Plays the sound back and forth when the two are simultaneously held. If B is pressed before L then it will start by playing the sound backwards, until it reaches the beginning of the sound and starts playing forwards again.
<b>Shift + Space</b>	<b>Pauses</b> playback after the current loop ends. Useful for when looping playback, live synthesis, saving live synthesis output to a file and suspension of that output are used together and a pause at the end of the loop is needed.
<b>H</b>	<b>High precision cursor</b> function. When held the mouse cursor goes at a fraction of its normal speed as to allow high precision editing.
<b>F</b>	<b>Force</b> function. When held, this button allows you to force the modification of locked (grayed out) controls when in lossless mode.
<b>K</b>	<b>Kill</b> processing. Suspends synthesis of sound until pressed again, until the Play button is pressed or until the project is exported to a sound.
<b>Down Arrow</b>	<b>Full rewind</b> function. Jumps back to the very beginning of the sound.
<b>Up Arrow</b>	<b>Stop</b> function. Jumps to the very end of the sound.
<b>Left Arrow</b>	<b>Jump back</b> function. Rewinds the sound by 1 second.
<b>Right Arrow</b>	<b>Jump forward</b> function. Fast forwards the sound by 1 second.
<b>Scroll Up / Page Up</b>	<b>Zoom in</b> horizontally.
<b>Scroll Dn / Page Dn</b>	<b>Zoom out</b> horizontally.
<b>Shift + Scroll</b>	<b>Zoom in/out vertically.</b>
<b>Ctrl + Scroll</b>	<b>Zoom in/out both ways.</b>
<b>Middle Click / End</b>	<b>Drag scroll</b> the image.

## VIII. Advanced options

### STEREO OPERATIONS

Photosounder operates entirely in mono. However, there are four options in the Options menu that can be used to treat each channel of a stereo sound separately and join the output into a stereo sound file.

The **Load Left Channel Only** and **Load Right Channel Only** options can be used so that when a stereo sound is loaded one of the two channels is loaded instead of an even mono mix of the two. You can therefore treat each channel separately and save the results for each into a separate sound file. However, before you save, you should make sure to toggle the **Unnormalised Output** option. Usually sounds are normalised so that their highest peak is set to 0 dB. This means that in the process of normalisation, one of the two channels might be amplify more than the other, therefore offsetting the pan in either direction. This does not occur when Unnormalised Output is enabled. However note that if one channel appears to be 100 times (+40 dB) louder than the other, just amplify the other channel accordingly by +40 dB. Unnormalised Output amplifies the output by multiples of 100 (40 dB) so that the peak amplitude of the output is always between -40 dB and 0 dB.

Once you've saved both the left and right channel to individual files, you can join them together into one stereo file by using **Mix Channel Files to Stereo...** in the Options menu. A first open dialog will appear with which you should select the left channel file. A second open dialog will appear so that you can select the right channel file. Then a save dialog will appear so that you can save the mix of the two files to a new sound file.

## MISCELLANEOUS OPTIONS

In the Options menu, **Loop Playback** can be toggled so that the sound playback always loops. **Force Fast Image Display** can be enabled so that the fastest method for displaying the image on the screen is used. Likewise, **Force Smooth Image Display** can be used for the slower but smoother method for displaying the image to be used at all times. When neither of the two are enabled Photosounder uses either of the two methods depending on the context. **Long Block Duration** can be enabled so that synthesis uses a noise that loops every 60 seconds instead of one that loops every 2 seconds. This is recommended in cases the 2 second repetition is undesirable. **Linear Knob Control** will change the way knobs are control from a circular control to a vertical linear control. **Suspend Processing** will suspend the resynthesis of sound after every time it is modified. **Constant Time Resolution Analysis** is a useful option to analyse sounds with a constant time resolution. It is equivalent to editing the configuration file's `min_bpo` value to 0, except that it doesn't require a restart of the program and it doesn't modify the configuration file.

## CONFIGURATION

Some parameters used by Photosounder can be permanently altered by modified the file 'config.txt' created by Photosounder in its folder. The numerical values can be changed by editing this file in a text editor, the changes taking effect the next time Photosounder is started. Note that the configuration file is regenerated every time Photosounder starts to reflect how the contents of the file were interpreted.

<b>audio_buffer_size</b>	Size of the audio buffer used for audio playback in samples. If you experience stutter you should try to increase it to such values as 4096, 8192 or even 16384. Otherwise you can try lowering it to other powers of two such as 512 or 1024 in order to obtain less delay in the sound playback.
<b>audio_sample_rate</b>	Internal sampling rate used playback, internal processing and audio output.
<b>waveform_display_height</b>	Height of the waveform display in pixels. An odd height is preferred.
<b>cursor_slow_rate</b>	Fraction of the normal mouse cursor speed when the H key is held down.
<b>spray_harmonics</b>	Number of harmonics (base frequency included) the harmonic modifier creates.
<b>initial_pha_size_limit</b>	Maximum allowed size in MB of the history file after loading a file in Photosounder. When below the limit, all the necessary data is written to the history file. When over the limit, all the data is replaced by a mere Open command with the path to the opened file, meaning the history file is dependent on that original file.
<b>save_to_pcm_24</b>	Saves WAV and AIFF files to 24-bit integers instead of 32-bit IEEE float.
<b>live_cursor_fps</b>	Indicates how many times per second the position of the mouse cursor should be updated when the cursor drives the live synthesis. The lower value the smoother and laggier the movement.
<b>min_frequency</b>	Minimum frequency used for analysis and by default.
<b>max_frequency</b>	Maximum frequency used for analysis and by default.
<b>pixels_per_second</b>	Time resolution in pixels/second used for analysis and by default.
<b>bands_per_octave</b>	Vertical resolution of the image after analysis defined by pixels/octave.

**min\_bpo** Minimum effective pitch resolution in pixels/octave used in the analysis.

**max\_time\_res\_for\_min\_bpo** Time resolution in pixels/second at which the time resolution will stop increasing while the pitch resolution increases from the minimum pitch resolution defined by **min\_bpo**.

**history\_menu\_on** If set to 1 it activates the History menu which gives access to several history writing options.

The last four parameters define the varying effective time and pitch resolutions in the following manner. The pitch resolution in the lowest frequencies is defined by **min\_bpo**. As we go up in pitch, the time resolution increases, while the pitch resolution remains constant, until we reach the time resolution defined by **max\_time\_res\_for\_min\_bpo**. Then the time resolution remains at that value while the pitch resolution increases. When the pitch resolution reaches **bands\_per\_octave**, the time resolution starts increasing again until it reaches **pixels\_per\_second**. The first two parameters are independent from the two others, which means that you can safely increase **pixels\_per\_second** and **bands\_per\_octave** without the appearance of the result being affected for the lower frequencies. Likewise you can change the values of **min\_bpo** and **max\_time\_res\_for\_min\_bpo** to change the effective resolutions in the lower frequencies without having any impact on the results in the higher frequencies.

There are other parameters in the configuration that are undocumented here, it is because they are modified by the program and do not need to be changed by hand.