Contents

Algorithmix® De-Noiser PlugIn

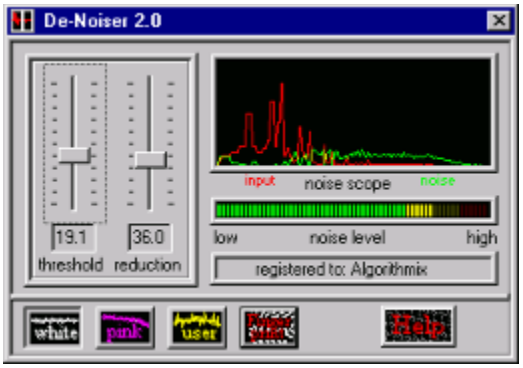

Fig.1: Screenshot of the **De-Noiser PlugIn** window.

Help file last modified: December 21, 1997.

Overview

The **De-Noiser PlugIn** belongs to the so-called *single-ended noise reduction* systems. This means it does not need any special coding procedure before recording, like in the famous tape noise reduction system from DOLBY™ Lab. It is a tool that efficiently removes any kind of broad-band noise from pre-recorded audio tracks. The **Algorithmix® De-Noiser PlugIn** is a weapon against tape hiss, noise from telephone-call cuts, background noise from live recordings, and residual noise from old records after processing with the **De-Scratcher PlugIn**. The **De-Noiser PlugIn** is very useful in forensic applications, as well.

In a single-ended noise reduction systems, the user decide which noise characteristic have to be applied for the *de-noising* process. In the **De-Noiser PlugIn,** there are two predefined noise profiles: *white* and *pink*. In addition, to receive the highest performance from the system, the user has the opportunity to record his own Noise Profile . When recording an application specific *noise profile*, we highly recommend recording it from a portion containing the background noise only.

Since the entire process runs in real time, you can simply switch between the three noise profiles while listening to the output signal. This helps you discover which noise profile is best suited to the audio material being processed.

The *noise reduction* process in the **De-Noiser PlugIn** is controlled by just two parameters, allowing an easy search for optimal results depending on the given input signal.

The frequency spectrum of the input signal as well as the spectrum of the noise taken out during the *de-noising* process can be followed in the Noise Scope. You can make an estimation of noise amount being removed based on the Noise Level indicator (see Fig.1). Although for accurate examination of the frequency spectra, we recommend using the **Analyzer PlugIn**. The **Analyzer PlugIn** can display the input and output signals of the **De-Noiser PlugIn** as well as the *noise profile* applied to processed audio material (Fig. 2).

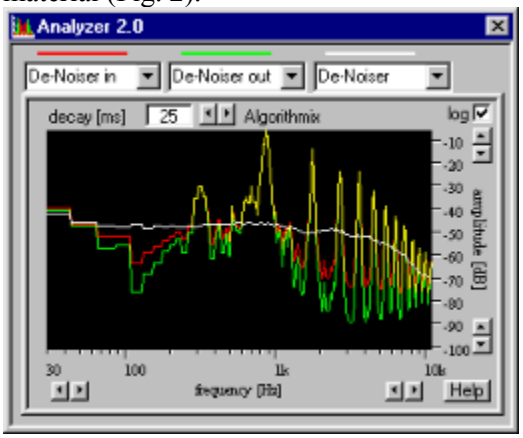

Fig.2: **Analyzer PlugIn** window with the correct set-up for **De-Noiser PlugIn**.

By setting the **Analyzer PlugIn** to *De-noiser in* (red), *De-noiser out* (green), and the white line *to De-Noiser np* (this shows the *noise profile*), you can easily follow the effect of the de-noising process on the processed material. The *noise profile* (white) marks the threshold border, above which no noise reduction is applied. The *threshold* parameter moves this *noise profile* up and down and can be used to set up the profile just above the background noise level. For a given *threshold,* the second parameter, called *reduction,* controls the amplitude of the spectral components below the chosen noise profile.

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Parameters

For the best *De-Noiser* performance, proper FFT Setting assumed, only two other parameters must be adjusted: *threshold* and *reduction*. While *threshold* controls the level below which noise reduction is applied, *reduction* decides the amount of removed noise in this region.

These two parameters can be very intuitively adjusted using the **Analyzer PlugIn,** set up as in Fig.2. (De-Noiser Input in red, De-Noiser Output in green, and selected Noise Profile in white). The *noise profile* can be adjusted up or down by changing the *threshold* parameter.

A good starting value for *threshold* is to set the *noise profile* just above the background noise level (approx. 10 dB). A subsequent increase of the *reduction* parameter should significantly reduce the background noise. If noticeable artifacts in the form of so-called singing or robot-like sounds appear (time aliasing phenomenon), decreasing the *reduction* parameter and increasing the *threshold* level (up to about 30 dB above the background noise) usually helps.

The overall performance of the **De-Noiser PlugIn** is heavily dependent on the proper adjustment of the FFT-related parameters. Especially for the final (off-line) mix, the rules recommended in the FFT Setting should be carefully followed.

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FFT Setting

To begin the spectral modifications to the audio material being processed, the signal must be transformed from time domain to frequency domain. In the current version of Sound Laundry, this is realized with a Pentium-optimized fast Fourier transform (FFT) using a modified radix-4 algorithm. For maximum flexibility, two FFT-specific parameters *Blocksize* and *Overlap* are available for the user. When working with an older PC compatible computer, the FFT process can be switched to mono mode with the *mono* button to save on computing power.

The FFT set-up in *FFT Properties* window are valid for all frequency-domain PlugIns that were switched to active mode. The appropriate window opens automatically when loading the first frequency-domain PlugIn.

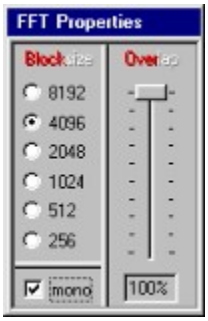

Fig.3: FFT Properties.

The *blocksize* parameter (expressed in audio samples) controls the size of the audio blocks used for the Fourier transform. As the largest possible setting of the FFT *blocksize* depends on the I/O buffer size (FFT-blocksize <= I/O buffersize), an adjustment to the I/O buffer size in the I/O settings dialog of the **PlugIn Station** may be necessary prior to setting up large FFT buffer sizes.

The larger the FFT *blocksize*, the more frequency bands are available for carrying out filter functions in frequency domain. Thus a larger FFT *blocksize* usually improves the audio quality and a smaller one increases the risk of audible artifacts. Note that the larger *blocksize* also increases the CPU load.

The time resolution of the applied filter function, however, becomes worse when increasing *blocksize*. For a static filter like in the **High-Lowpass PlugIn,** this phenomenon is not critical. For filters dynamically changing their parameters according to the input signal (like in the **De-Noiser PlugIn**), a proper balance between *blocksize* and time resolution may be quite an important issue.

Using the window overlapping process is indispensable to avoid discontinuities of audio signals at the limits of the FFT blocks used for filtering in the frequency domain. The amount of overlapping is controlled by the *overlap* parameter. An *overlap* of 100 means only half of the audio data is new in the succeeding FFT blocks, thus each audio sample is transformed twice.

One of the most important components in the audio FFT filtering process regarding sound quality is the cross-fading operation that must be performed after inverse FFT (see Fig. 4). With **Algorithmix**® technology, the typical time-domain artifacts are successfully suppressed.

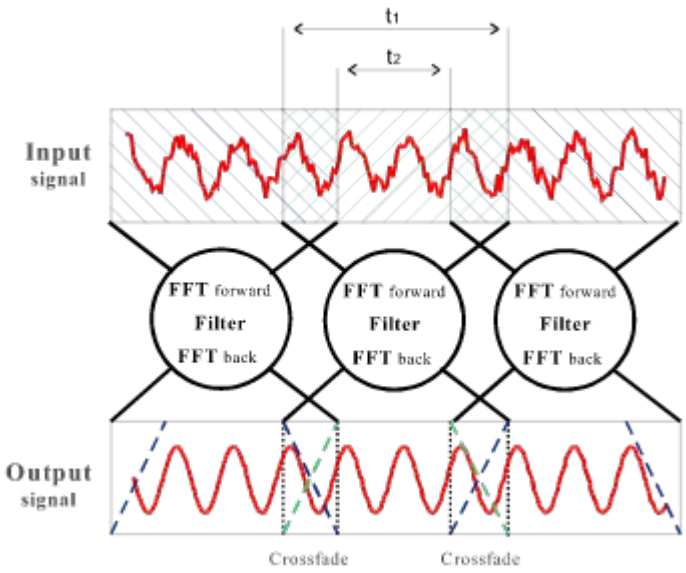

Fig. 4: Principle of the overlapping process used in the FFT in **SoundLaundry 2.0™.**

The process of overlapping used for the Fourier transform is illustrated in Fig. 4. The *overlap* parameter can be calculated from the times t1 and t2 defined in figure 4 as:

$$\text{overlap}\ [\%] = \frac{t1 - t2}{t1} * 100$$

.

Increasing the *overlap* from 10% to 100% almost doubles the CPU load. Thus reducing the *overlap* is an effective way to save CPU power. For the final mix, however, *overlap* should be set to 100% in any case. 100% overlap prevents signal distortion and so guarantees the lowest THD+N factor.

For taking advantage of the **SoundLaundry**™ real-time performance on slower systems, or if you're using mono files anyway, the FFT process can be switched to *mono* mode by selecting the appropriate checkbox in the *FFT Properties* window.

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Noise Scope

The *noise scope* displays the frequency spectrum of the input signal as well as the noise taken out during the *de-noising* process. This allows objective control of the *De-Noiser* algorithm activities.

However, especially when using a user defined Noise Profile, the **Analyzer PlugIn** is strongly recommended. It allows visual control of the *de-noising* process (placement of the *noise profile*) and precise measurement of frequency spectrum from 10 Hz to 20 kHz with a dynamic range of more than 130 dB. The display of the **Analyzer PlugIn** can simultaneously show three characteristics: *De-Noiser* input, *De-Noiser* output, and the *noise profile.*

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Noise Level

Especially if the **Analyzer PlugIn** is not available, the *noise level* meter is very useful for rough estimation of the noise amount removed from the input signal. If the background noise varies greatly, there is no general rule for the practical use of the *noise level* meter.

The more noise to be removed, the more the operator has to be aware of possible artifacts arising from the noise removal system. These artifacts are greatly influenced by the *FFT properties* and the *noise profile* used. Although the *noise level* meter can help in objective comparison among different setups, the final judgment should always be made by carefully listening to the output signal with a high-quality speaker system or headphones.

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The *noise profile* should ideally represent the frequency distribution of the noise to be removed from the noisy input signal. It is a kind of reference *spectral horizon* used by the *de-noising* algorithm. The position of the *noise profile* relative to the input signal can be controlled with the *threshold* parameter. The **Analyzer PlugIn** provides an intuitive visual control of both the input signal spectrum and the *noise profile*.

As pointed out in the Parameters section, at the beginning, the *noise profile* should be set to approx. 10 dB above the background noise level of the input signal.

At the bottom of the **De-Noiser PlugIn** window, you can find two pre-defined noise profiles: *white* and *pink*. While *white noise* has a flat frequency distribution over the linear frequency scale, the amplitude of the *pink noise* spectrum lowers proportionally to 1/f. Fig. 5 shows these two standard noise profiles and a *user noise profile*.

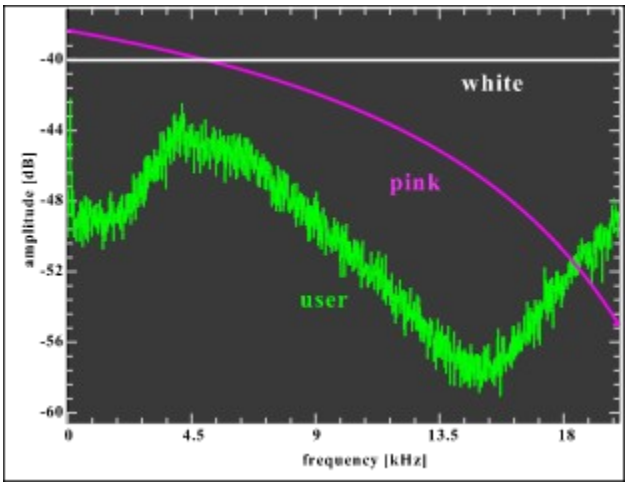

Fig. 5: Frequency spectrum of different *noise profiles*.

Applying user-defined noise profiles taken properly from the audio material to be processed, the quality of the entire *de-noising* process can be considerably enhanced. It is important that the *noise profile* should be taken from a part of audio material containing nothing but the noise signal to be removed. This can be done from the *Noiseprofile Manager* dialog, which opens after clicking on *Fingerprint*.

Fig. 6: Noiseprofile Manager.

Playback should start after pressing record in the *Noiseprofile Manager* window. If the "noise-only" part of a recording is very short (below 2 seconds), it is recommended you set up a loop for repetitive playback before recording a *noise profile* (see **PlugIn Station** help for details). The loop can be played back several times to obtain an averaged *noise profile*.

As already pointed out, the loop should contain nothing but noise (or whatever has to be removed from the input signal). If a noise profile includes spectral components of the signal to be recovered, they will also be removed or at least lowered in the *de-noising* process. Therefore, much care and sensitivity is recommended when preparing a user-specific *noise profile*.

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Application Tips

The **De-Noiser PlugIn** is an easy-to-use audio cleaning tool based on efficient signal processing algorithms. In most cases, you will automatically achieve good results. To maximize results, especially when working with heavily noise-polluted audio material, there are some practical rules:

- For the best results, record your own noise profile for every piece you de-noise. Choose a portion of the recording that does not contain any material you want to recover, only noise you intend to remove. If the audio piece to be processed contains more only-noise parts, try to record a few noise profiles and test them to determine the one that works best.

- If the part containing only the noise signal is very short (under 2 seconds), we recommend setting up a loop for repetitive playback before recording a *noise profile* (see **PlugIn Station** help for details).

- If you cannot find in your entire recording any noise-only piece, use pre-defined profiles or try to record a user noise profile from a low-level part (hopefully with pauses in the useful signal). Finally, look for the careful adjustment of the parameters *threshold* and *reduction*

- Very strong changing noise level and noise characteristic may be problematic. In such cases professional mastering engineers try to cut the original piece in parts and treat them individually with different de-noising parameters. Later the de-noised pieces are joined together.

- Do not exaggerate the parameters *threshold* and *reduction* to avoid artifacts in the form of singing or robot-like sounds (*time aliasing*). Begin with a moderate adjustment by setting the *noise profile* to just above the background noise level (approx. 10 dB) and gradually increasing the *reduction* parameter. Finally try to recursively find the best relation between these two parameters. Do not forget to correctly set up the FFT parameters as mentioned in the FFT Setting.

- If you are working on heavily disturbed material, find a good acoustical compromise between the level of remaining noise and artifacts introduced to the output signal. Be indulgent if you have hopelessly noisy material. Nobody can restore the original signal without having enough original information.

- It helps sometimes to apply the de-noising process two or more times consecutively with a moderate parameter setting rather than one pass with an extreme setup.

- A recommended tool that significantly helps to adjust the *De-Noiser* parameter is the **Analyzer PlugIn**. It allows for following the de-noising process, especially the influence of the *noise profile* and parameters

- For the best results use your own ears in connection with the *difference* feature of the **PlugIn Station**. Switch between the original input signal and the input/output difference, i.e., the portion of signal removed by the *de-noising* algorithm. This different signal normally should not contain any parts of the original signal you want to preserve.

- Multimedia-level sound cards used for A-D/D-A conversion may themselves introduce severe

artifacts and noise to an audio signal. For semi-professional applications, use high-quality audio cards and external converters (like from a DAT recorder) linked to the computer via digital connectors (coax/optical).

Important Remark:

The **De-Noiser PlugIn** is a very fast and very effective tool. You will be amazed at how dramatic the audio quality of noisy recordings can be improved. But please do not expect miracles if you process material containing so much noise that the original signal is no longer distinguishable. The information theory says that once the information is sunk in noise (bad signal-to-noise ratio) and there is not enough information about the properties of the original signal, or even worse, the original signal is non-linearly distorted, the de-noising process can deliver only limited-quality results.

For further information about our other PlugIns and new products visit us on the Internet at:

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or send e-mail to:

support@algorithmix.com

- if you need any information about installation and performance of this product.

info@algorithmix.com

- if you have general suggestions and questions concerning our product line.

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