Studio Clean 1.5

User Guide

Acon Digital Media GmbH

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1   Introduction

Studio Clean is a DirectX and VST compatible plug-in suite for use in host applications such as audio editing or processing software. It consists of four plug-ins for noise reduction and quality enhancements:

- **StudioDenoiser** is a plug-in for broadband noise reduction. Because the algorithm takes the perceptual properties of the human hearing into account it achieves a high level of noise reduction with a minimum of audiable artifacts.
- **StudioDeclicker** contains two different algorithms. The actual declicker algorithm eliminates larger clicks and pops in the recording, while the decrackler algorithm eliminates very frequent, but short clicks.
- **StudioDeclipper** restores recordings that suffer from analog or digital clipping.
- **StudioRebirth** adds synthesized high frequency harmonics to give life to old and dull sounding recordings.

1.1   Requirements

Before you install Studio Clean, please make sure your computer fulfills the following requirements:

- A Pentium or compatible processor with a CPU clock rate of 1 GHz or more
- A minimum of 128 megabytes RAM
- A Windows-compatible sound card

In addition, you will need the following software installed on your computer:

- Windows 98 SE, Windows Me, Windows 2000 or Windows XP
- DirectX 8.0 or later (the current version at the time this is written is DirectX 9.0c)
- A DirectX or VST plug-in compatible host application.

2   The Studio Clean Plug-Ins

2.1   StudioDenoiser

StudioDenoiser is a plug-in for broadband noise reduction. Because the algorithm takes the perceptual properties of the human hearing into account it achieves a high level of noise reduction with a minimum of audiable artifacts. The noise reduction algorithm is similar to the spectral subtraction technique. This means that the frequency distribution of the noise present (the *noise profile*) in the recording is needed.
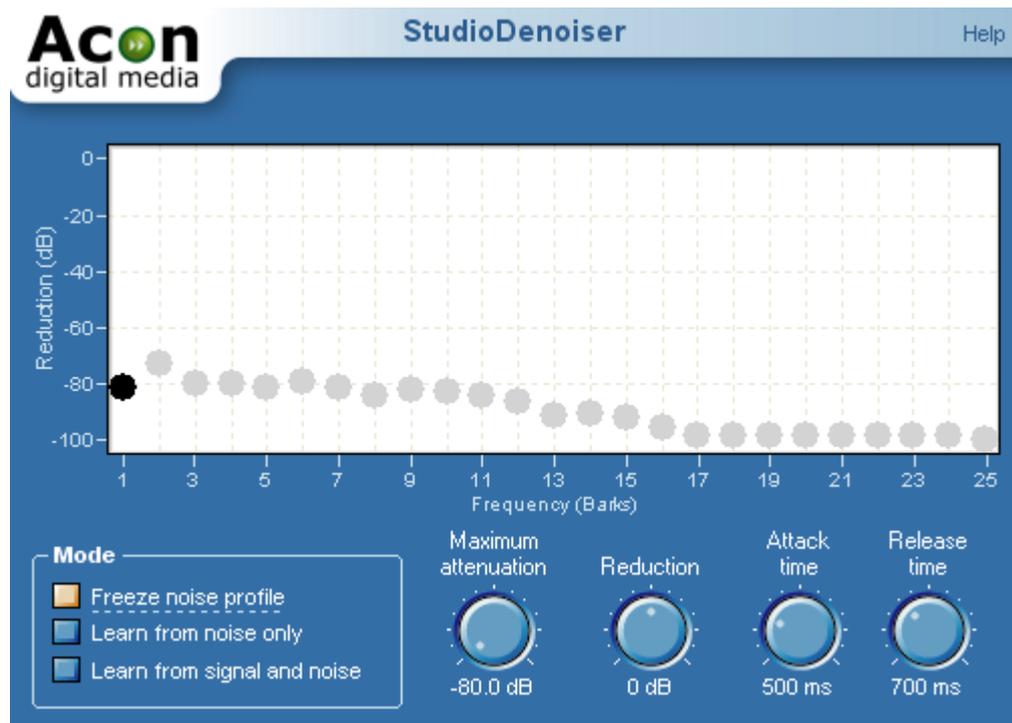
The StudioDeclicker user interface.

StudioDenoiser offers three ways of estimating the noise profile.

- **Estimation from Noise Signal**
  If you have parts of the recording containing only noise, you can automatically estimate the noise profile through analysis of a region containing noise only. Set the mode to "Learn from noise only" and play the part of the recording containing only noise. Select the "Freeze noise profile" when done.

- **Estimation from Noisy Audio Signal**
  The noise profile can also be estimated from the noisy audio signal. This method is not as accurate as the estimation from the pure noise signal, but if there are no parts available containing only noise, this is a good alternative. Furthermore, the results of the estimation can be fine tuned by the user. Set the mode to "Learn from signal and noise" and start playing. After a couple of seconds, select the "Freeze noise profile".

- **Manual entry**
  Alternativly, the noise frequency distribution can be defined manually. It is recommended to perform an estimation from the noisy audio signal before manually editing the noise profile, because the estimation serves as a good starting point. Make sure the mode is set to "Freeze noise profile" before editing the noise profile. You can manually set the noise level of each frequency band by moving the circles with the mouse or by using the arrow keys.

Settings

- **Mode**
  Selects the working mode of the denoiser. "Freeze noise profile" should be selected during denoising. "Learn from noise only" and "Learn from signal and noise" should be selected only when estimating the noise profile.

- **Maximum attenuation**
  Maximum attenuation allows you to adjust a maximum attenuation factor for each frequency band. This parameter is also referred to as noise floor. By leaving a certain noise floor, you can mask artifacts from the noise reduction algorithm.

- **Reduction factor**
  Reduction factor scales the noise profile obtained in the analysis phase and allows you to remove more (positiv values) or less (negative values) noise than the analysis algorithm detected.

- **Attack time**
  The attack time is the response time of the noise suppresion when the signal level in a frequency band increases. Longer response times gives better noise reduction, but can in some cases lead to artifacts.

- **Release time**
  The release time is the response time of the noise suppresion when the signal level in a frequency band increases. Longer response times gives better noise reduction, but can in some cases lead to artifacts.

2.2   StudioDeclicker

StudioDeclicker is a tool specialized on removing impulsive noise such as clicks and crackle. These distortions are very frequently encountered on LP and 78 RPM records. StudioDeclicker contains two different algorithms to deal with clicks and crackle. The actual declicker algorithm eliminates large clicks and pops in the recording, while the decrackler algorithms eliminates the frequent, but short clicks that the human ear percieves as crackle. StudioDeclicker removes clicks by substituting the recorded signal in the short period of time during the click with a signal estimated using the undistorted audio surrounding each click.
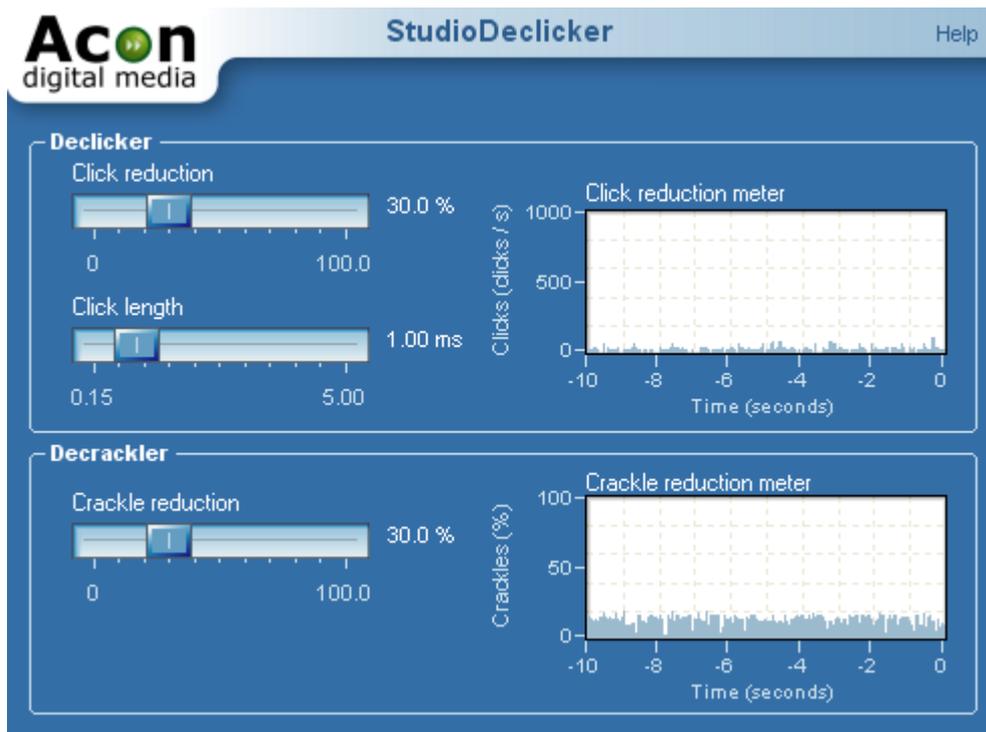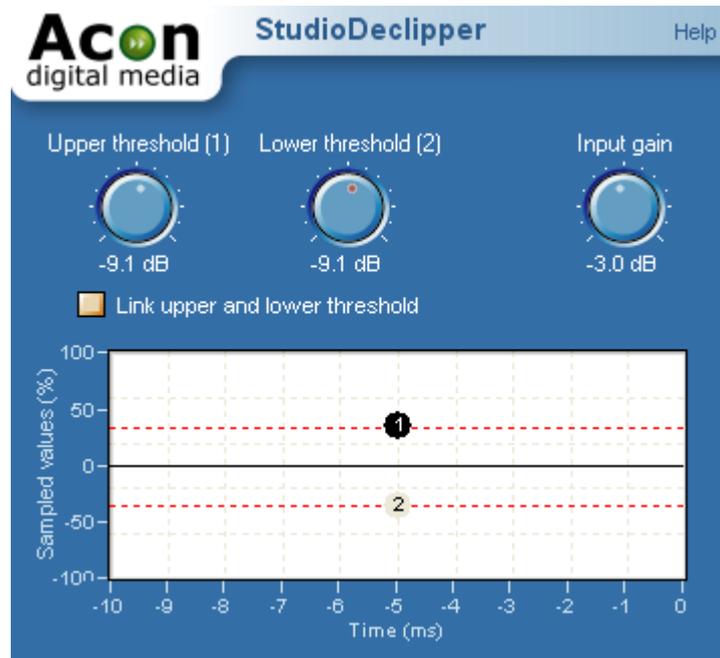
The StudioDeclicker user interface.

The StudioDeclicker user interface contains a click and a crackle reduction meter that give visual feedback of the restoration process. Both meters show a history of the reduction activity during the past ten seconds. The click reduction meter shows the number of clicks removed per second, whereas the crackle reduction meter shows the percentage of input samples regarded as crackle distorted.

Settings

- **Click reduction**
  Sets the sensitivity of the declicker algorithm. Higher reduction levels result in more click reduction.

- **Click length**
  The length of the clicks that are to be removed.

- **Crackle reduction**
  Sets the sensitivity of the decrackler algorithm. Higher crackle reduction levels result in more crackle reduction.

2.3   StudioDeclipper

StudioDeclipper restores audio recordings distorted by clipping. Clipping occurs during recording when the recording level is too high and the highest peaks cannot be correctly recorded. StudioDeclipper substitutes such distorted peaks by an estimation of the signal curve using almost the same mathematical methods as the StudioDeclicker when eliminating clicks.

The StudioDeclipper user interface.

StudioDeclipper contains an oscilloscope view to visualize restoration. The oscilloscope shows the last ten milliseconds of the recovered audio signal. The most important parameters of the declipper are the upper and lower threshold levels. The declipper will substitute all recorded peaks above the upper and below the lower threshold value. The threshold values can be adjusted using their corresponding knob controls or directly from the oscilloscope view.

Settings

- **Upper threshold**
  All samples values above the upper threshold are substituted by a signal estimation.

- **Lower threshold**
  All samples values below the lower threshold are substituted by a signal estimation.

- **Input gain**

The input gain is useful for adjusting the signal level before declipping.

- **Link upper and lower threshold**
  Usually, the clipping introduced during recording will be symmetrical, which means that the upper and lower thresholds will have the same absolute value. By activating the upper and lower threshold link, the adjustment of the declipper is simplified in the case of symmetrical clipping.

2.4 StudioRebirth

StudioRebirth gives life to dull recordings by adding synthesized high frequency content. Dull and lifeless recordings may be a result of lost high frequency content. By using the StudioRebirth plug-in, you can add artificially created harmonics based on the low frequent content to brighten up the recording.
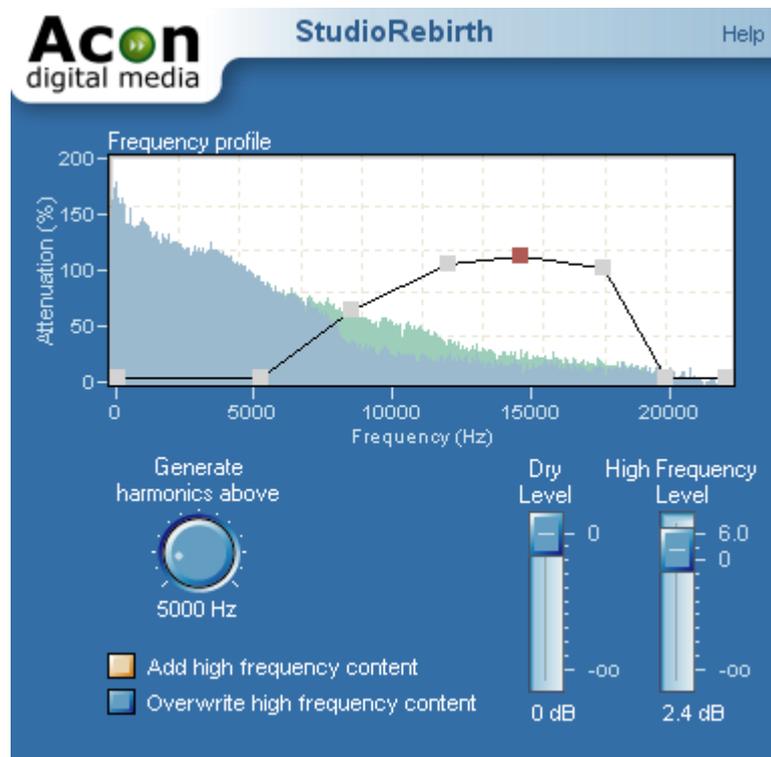
The StudioRebirth user interface.

The frequency profile allows exact control over the frequency distribution of the synthesized harmonics. In addition, the current frequency spectrum before (blue) and after (green) processing is displayed during playback for visual monitoring of the restoration process.

Settings

- **Frequency profile**
  The frequency distribution curve of the generated harmonics. Add points to the curve by clicking the left mouse button. Points are removed by clicking the right mouse button.

- **Generate harmonics above**
  Specifies the lower limit of the frequency band where harmonics should be synthesized.

- **Add high frequency content / Overwrite high frequency content**
  If add content is selected, the original content in the synthesis frequency band is mixed with the synthesized harmonics. If you choose overwrite, StudioRebirth removes the original content before adding the synthesized harmonics.

- **Dry level**
  The amount of unprocessed signal in the output mix.

- **High frequency level**
  The amount of processed signal in the output mix.

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