

# Neat Video

noise reduction plug-in for VirtualDub

*To make video cleaner.*

## User guide

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# 1. Introduction

## 1.1. Overview

Neat Video is a filter designed to reduce noise and grain in digital video.

Neat Video detects, analyzes, and reduces noise. The quality of noise reduction provided by Neat Video is higher than that of other methods because Neat Video incorporates the most advanced noise reduction algorithms in the industry and takes into account specific characteristics of particular video capturing devices – video camera, camcorder, computer TV-tuner, etc., – making the filtration customized and more accurate.

In addition, Neat Video can make video look sharper without any degradation of quality. The combination of the sharpening and noise filter makes such an effect possible.

Neat Video plug-in for VirtualDub is available in three editions: Demo, Home, Pro.

- Demo plug-in is a free edition of the software with limited functionality
- Home plug-in supports up to 1280x720 frames
- Pro plug-in provides all features without frame size limitations

## 1.2. Features

### Noise Reduction and Smart Sharpening

- **Advanced noise filter** to reduce noise and grain in digital footage
- **Temporal filtration** to reduce more noise and better preserve true details
- **Complete control** over the noise filter to achieve the desired level of noise reduction
- **Smart sharpening filter** to make video look sharper without amplification of noise
- **CUDA and OpenCL acceleration** to speed up processing using computation-capable GPUs

### Device Noise Profiles

- **Custom noise profiles** to make noise reduction device-specific and more accurate
- **Auto Profile** to build noise profiles for custom video-capturing devices

Some features are only available in the Home or Pro plug-in. Detailed feature map (page 28) explains the differences between Neat Video Demo, Home and Pro plug-ins in details.

## 1.3. Requirements

Recommended system configuration is:

- Intel i7 / i5 / Xeon; single or multi-processor
- Windows 8, 7, Vista, XP; 32-bit or 64-bit

Optional CUDA acceleration requires:

- CUDA-capable NVIDIA video card;
- Recent video driver supporting CUDA v4.2 or newer.  
(you can download the latest versions of the video drivers from <http://www.nvidia.com>)

Optional OpenCL acceleration requires:

- Supported video card:
  - ATI Radeon HD 57xx/58xx/59xx;
  - AMD Radeon HD 67xx/68xx/69xx;
  - AMD Radeon HD 77xx/78xx/79xx;
  - AMD Radeon HD 87xx/88xx/89xx;
  - AMD Radeon R7 260X;
  - AMD Radeon R9 270X/280X/290X;
  - Another AMD/ATI GPU based on one of the following chip series: Juniper, Cypress, Barts, Cayman, Cape Verde, Pitcairn, Tahiti, Bonaire, Hainan, Hawaii
- Latest version of AMD Catalyst Driver

System requirements for practical use of Neat Video depend on frame size and length of video.

Processing larger frames and longer clips takes proportionally more time than smaller and shorter ones. The processing speed is determined primarily by the processor power and memory speed.

The Neat Video plug-in can process any RGB video clip supported by VirtualDub.

The 64-bit Neat Video plug-in requires a 64-bit version of VirtualDub, and 32-bit plug-in works in 32-bit VirtualDub versions.

The plug-in may be compatible with other compatible hosts that can use VirtualDub plug-in.

## 2. Key concepts

### 2.1. What it can do – functionality of Neat Video

Neat Video is a digital video filter. Its main function is to *reduce noise* in digital video.

Neat Video can work with video clips produced by any video recording devices – video cameras, camcorders, computer TV-tuners, film digitizers, etc. The software can be adjusted to a particular device by means of a *device noise profile*, which describes the noise characteristics of the device working in a certain mode.

A device noise profile is built by analyzing those areas of a video frame that contain no visible or important details. Usually, Neat Video can find such featureless areas completely automatically. In a difficult case, you can assist it and select a featureless area manually. Finding such areas is very easy for human eyes but may sometimes be a bit difficult for software.

By analyzing featureless areas in a frame, Neat Video's *noise analyzer* builds a profile which describes the noise in these areas. With this profile, Neat Video can efficiently reduce noise in the frame and in the whole video clip.

The noise filter processes video data in several *spatial frequency ranges*. This makes possible reducing noise in one frequency range even if details are present in other ranges. The filter can also selectively process any of the color channels.

Besides the intra-frame filtration, Neat Video also applies *temporal* (inter-frame) filtration to video data. Neat Video uses several consecutive frames to better reduce noise and preserve more true details in each frame. This improves the overall quality of noise reduction.

In addition to the noise filter, there is the *smart sharpening filter*, which only sharpens important details without increasing the level of noise. This filter also uses the noise profile to tell noise from details, so applying the noise and sharpening filters together saves time and produces better overall results.

### 2.2. When it works – types of noise

Neat Video is designed to reduce noise in video footage produced by video cameras, camcorders, computer TV-tuners, film digitizers and can also be used to process video from other sources. To be efficiently processed, a video clip should satisfy the following requirements:

- **Noise must be uniformly distributed throughout each frame**, i.e., there should be no strong surges of noise intensity in some areas of one frame or significant changes of noise characteristics across the frame.

Neat Video works fine, for example, with video clips produced in high sensitivity modes of a digital video camera (digital noise) or with footage captured on highly sensitive film (film grain). However, traces of dust particles on a sensor or film do not satisfy the uniformity condition and, therefore, are not efficiently removed by Neat Video.

Another possible source of noise is video compression. The compression noise is approximately uniform when high compression quality is used. Low compression quality makes noise non-uniform. Therefore, we recommend using the highest quality levels whenever possible. Try to avoid visible compression artifacts in video data beginning from the early stages of your post-processing workflow.

- **Noise should be concentrated in high and medium spatial frequencies.** This condition is usually met by most video clips produced by modern digital video capturing devices.

## 3. Installing the plug-in

When you install Neat Video, Setup asks you to specify VirtualDub *plugins* subfolder to install the plug-in there. In case the plug-in was not installed into the right folder, you still can manually install it into VirtualDub using the guidelines below.

### To manually install Neat Video plug-in into VirtualDub

- ➔ Copy the *NeatVideo.vdf* file from the Neat Video installation folder (typically, *C:\Program Files\Neat Video for VirtualDub\*) into the *\plugins\* subfolder inside the VirtualDub folder. Typically, the *NeatVideo.vdf* file should be copied to:  
*C:\Program Files\VirtualDub\plugins\*

If you install the 64-bit version of Neat Video, please make sure you specify the *\plugins\* folder (or *\plugins64\* in newer versions of VirtualDub) of the 64-bit version of VirtualDub. For the 32-bit Neat Image specify the *\plugins\* folder (or *\plugins32\* in newer versions of VirtualDub) of the 32-bit version of VirtualDub.

Then re-start VirtualDub and find Neat Video in the filter list: Video | Filters... | Add... | Neat Video

If Neat Video has **not** become available in VirtualDub after restart, please contact Neat Video support for assistance.

## 4. Running Neat Video on a sample video clip

There is a test-kit prepared to help you start using Neat Video. You can download the test-kit from the Neat Video web page: <http://www.neatvideo.com/files3/testkit.zip> (6 MB). Having downloaded, unzip it to a new folder on the hard disk.

The test-kit includes a sample video clip: the *SampleClip.mpg* file. This is a typical video clip captured by a digital video camera in high-gain mode. Technical information about the sample clip is available in the *SampleClipInfo.txt* file.

Please start VirtualDub and go through the stages below to make Neat Video clean the clip:

### 4.1. Stage I. Open the sample clip

- ➔ Use the File | Open video file... menu in VirtualDub to open the *SampleClip.mpg* file

VirtualDub will open the sample clip and you will then see that there is strong noise in it. The task of Neat Video is to reduce this noise.

### 4.2. Stage II. Add Neat Video filter

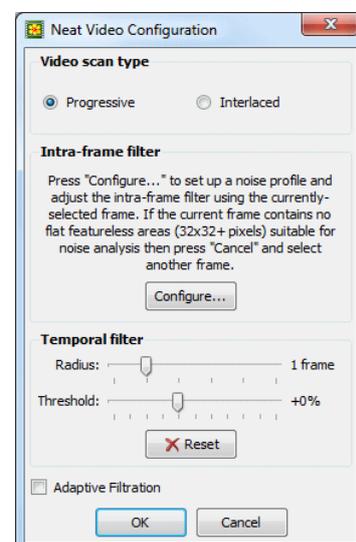
- ➔ 1. Use the Video | Filters... menu item to open the list of used filters;
- 2. Click the Add... button to open the list of available filters;
- 3. Select the Neat Video filter in the list and click the OK button.

VirtualDub will add the Neat Video filter and will open the Neat Video Configuration window with an attached window showing the video clip.

### 4.3. Stage III. Configure Neat Video

#### 1. Open Neat Video plug-in window

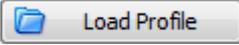
- ➔ In the Neat Video Configuration window, click the Configure... button (in the Intra-frame filter box) to open the main Neat Video plug-in window;



The Neat Video plug-in window will appear and will show the currently selected frame from the clip.

## 2. Load noise profile

To reduce noise in this frame and in the whole clip, Neat Video generally needs a noise profile describing the noise properties of the clip. We have prepared such a noise profile in advance. The profile is supplied with the test-kit in the *SampleProfile.dnp* file. Load it into plug-in:

- ➔ 1. In the Device Noise Profile tab  click  (the Load Profile button);

- 2. In the Load Device Noise Profile dialog, navigate to the folder where the sample device noise profile has been unzipped and select the *SampleProfile.dnp* file.

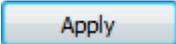
Neat Video will load the noise profile and will then be ready to filter the sample clip.

## 3. Check intra-frame preview

- ➔ Switch to the Noise Filter Settings tab 

You will notice that the intra-frame filter has already applied some filtration based on default filter settings and the preview shows a clearly visible difference. However, this is not the final result yet.

## 4. Apply the changes

- ➔ Click  in the bottom of the plug-in window.

The Neat Video plug-in window will be closed and you will again see the Neat Video Configuration window.

## 5. Adjust the temporal filter

- ➔ Adjust the Temporal filter radius setting from 1 to 2 or higher in the Effect Controls window. This will apply stronger temporal filtration to the clip.
- ➔ Click the OK button in the Neat Video Configuration window.

Both Neat Video Configuration and Filters windows will be closed and you will see the main window of VirtualDub with two – ‘before’ and ‘after’ – versions of the sample clip (you may need to move the Trackbar to select another frame to update the ‘after’ version). The ‘after’ version will show the results will show the effect of applying the noise reduction to the clip.

## 4.4. Stage IV. Render the clip

- ➔ Use the File | Save as AVI... menu item in VirtualDub and proceed to render the clip.

This will automatically apply Neat Video noise reduction to the sample clip and save the result to a new video file on the hard drive. You will then be able to open this new file, evaluate the filtration results and adjust the filter settings if necessary.

You will see that the noise in the resulting clip is significantly reduced while the true details are preserved. You can also find that the resulting noise-free clip can be compressed better (the file size is smaller) than the original noisy clip (this depends on VirtualDub’s compression settings, which can be adjusted using the Video | Compression... menu item).

The sample noise profile supplied with the test-kit is suitable only for this clip and similar clips produced by the same capturing device working in the same or similar mode. Neat Video can apply similar noise reduction to video clips captured or acquired by any other devices working in any mode. To be able to do that Neat Video needs device noise profiles that describe the noise characteristics of those devices. Using Neat Video’s Auto Profile function, you can easily build these profiles yourself. Auto Profile can automatically build a profile once you give it a suitable frame from a clip.

The next sections – Filtration process details, page 7, and Device noise profiles, page 16,– contain detailed descriptions of the filtration and profiling processes.

## 5. Filtration process details

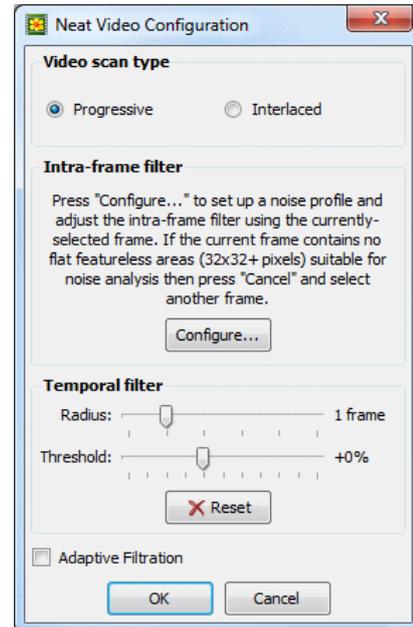
This section explains how to apply the Neat Video noise reduction to a video clip.

### 5.1. Stage I. Add Neat Video filter

To add the Neat Video noise reduction filter:

- ➔ 1. Use the Video | Filters... menu to open the list of filters;
- 2. Click the Add... button to open the list of filters;
- 3. Select the Neat Video filter in the list and click OK.

VirtualDub will add the Neat Video filter and will open the Neat Video Configuration window with an attached window showing the video clip.



### 5.2. Stage II. Specify the scan type

Neat Video filter can process clips with both progressive and interlaced scan types. Neat Video works with these two scan types in slightly different ways so it is necessary to let the filter know what kind of video is processed before configuring other filtration parameters.

- ➔ In the Neat Video Configuration window, select either Progressive or Interlaced depending on the scan type of the currently processed clip.

### 5.3. Stage III. Select a frame for noise analysis

Neat Video filter uses a frame (or two fields<sup>1</sup>) from the video clip to analyze noise and build a noise profile necessary to reduce noise in the clip. This frame should include flat featureless areas that contain no visible details, but do contain noise. To build a noise profile you have to manually find such a frame in the clip using the window (usually its caption is “Filter preview”) attached to the Neat Video Configuration window. If there are many frames that contain flat featureless areas then select one with larger and most noisy flat featureless areas without visible details.

- ➔ In the attached window, use the Trackbar to select a frame with large flat featureless areas; the selected frame will be used for noise analysis in the next stages.

### 5.4. Stage IV. Open Neat Video plug-in window

- ➔ In the Neat Video Configuration window, click the Configure... button (in the Intra-frame filter box) to open the main Neat Video plug-in window;

The Neat Video plug-in window will open and show the earlier chosen frame (for progressive video) or two fields, upper and lower, one on top of another (for interlaced video). This frame or fields will be used to build a noise profile necessary to filter the whole clip.

#### To scroll and pan the frame

- press the spacebar and drag the frame with the left mouse button.

#### To change zoom level

- use the mouse wheel when mouse is over the viewer;
- use the zoom control under the viewer;
- use the Ctrl-Plus, Ctrl-Minus, Ctrl-0, Ctrl-Alt-0 keyboard shortcuts.

<sup>1</sup> The term “frame” will be used to refer to either one frame (in progressive video) or two fields (in interlaced video).

## 5.5. Stage V. Prepare a device noise profile

To filter the noise in the clip, Neat Video needs to know the characteristics of noise produced by the input device (video camera, TV-tuner, etc.) that the video comes from. The noise characteristics of a device working in a certain mode constitute a *device noise profile*.

There are two ways to get a device noise profile for the clip:

- To build a new profile using the selected frame from the clip;
- To select a suitable profile from a pre-built set of profiles.

The first option is often the easiest one provided the selected frame contains sufficiently-large uniform featureless areas that include noise and no visible or important details. Neat Video can try to automatically find such areas in the frame and analyze noise in there to build a noise profile. When the selected frame contains featureless areas suitable for analysis, this way of preparing a noise profile is the most accurate and therefore recommended.

The second option is available once you have already built and saved several profiles for various modes of your video capturing device.

### To build a new profile using the selected frame from the clip

➔ Make sure you use the Device Noise Profile tab:  **Device Noise Profile**

➔ Click  **Auto Profile** (the Auto Profile button).

Neat Video will find and select the area selected by Auto Profile for main analysis. Neat Video will then automatically analyze the noise in that area (and then in the whole frame too) to build a new noise profile.

In difficult cases, Neat Video may be not able to find a large enough uniform featureless area in the frame. You will notice that the selected area, for example, will contain some important details, not just noise. In such cases, Neat Video also warns you that the area is not suitable for analysis. It may say that the selected area is not uniform in one or more channels, or is too small, or contains clipping in one or more channels. In such a case, move the selection (or resize, or draw a new one) to an area that does not contain any visible details and then click the same Auto Profile button again.

After the profile is built, check the Quality indicator in the Device Noise Profile box. A profile built using a uniform and featureless area will usually show a high value in this indicator. If the profile quality is high (for example, higher than 60%) then you can be sure that the noise profile is accurate. In this case, proceed to Stage VI. Adjust intra-frame filter settings, page 9.

If the quality is not high, try to select another uniform and featureless area and use Auto Profile again. That may not help still, especially if the selected frame contains only a few small featureless areas. In this case, consider building a noise profile using another frame from the same clip: close the Neat Video plug-in window and return to Stage III. Select a frame for noise analysis, page 7.

You can also try to build a profile in manual mode. However, this will anyway require some featureless areas to be available for analysis. You can find more details on automatic and manual profiling in the Device noise profiles section, page 16.

### To select a noise profile from a pre-built profile set

➔ Click  **Load Profile** (the Load Profile button). Then select a profile in the Open Device Noise Profile dialog.

or

➔ Click  (the drop-down button) in the Device Noise Profile box to open the popup menu with all available profiles and then select one of the available profiles.

Please note that you have either to build your own profiles or download some pre-built profiles and place them to the Neat Video's Profile folder to make this drop-down button and popup menu truly

work. By default, the Profile folder is located in your Documents folder<sup>1</sup>:

*Documents\Neat Video for VirtualDub\Profiles\*

If you build or download some pre-built profiles, save them to that folder and Neat Video will show those profiles in the popup menu to help you quickly load any of them.

## To additionally fine-tune the loaded profile

You may want to additionally fine-tune the profile you have just opened. Fine-tuning usually makes the profile more accurate and better matching the noise in the current clip.

- ➔ Click  (the Auto Fine-Tune button) to fine-tune the loaded profile to the current clip.

There is no need to select any area in the frame because the Auto Fine-Tune automatically analyzes the whole frame.

Please note that you do not need to fine-tune a profile if you have just built it using Auto Profile. Auto Profile automatically applies fine-tuning so you do not need to repeat it.

## 5.6. Stage VI. Adjust intra-frame filter settings

- ➔ Make sure you use the Noise Filter Settings tab: 

The Neat Video noise reduction and sharpening filters have several settings that you can adjust. Default noise filter settings usually produce good filtration results (if the noise profile is accurate). You may want to additionally vary the filter settings to achieve the filtration results that look best to your eyes.

### 5.6.1. Use intra-frame preview when adjusting filter settings

The viewer in the Noise Filter Settings tab shows a part or whole frame processed by the noise and sharpening filters. If you change any filter settings then the preview is automatically updated (provided the Preview button in the toolbar is depressed). You can zoom in and out, drag, scroll, pan the frame in the viewer to see how the filtration affects different parts of the frame. If you manually select an area in the frame then only the selected area will be processed for preview.

When the preview is ready (the preview area shows “Filtered”), click inside the preview area to temporarily switch back to the original for comparison.

### 5.6.2. Standard and Advanced modes

Neat Video has two sets of filter controls, they are available in the Standard mode and Advanced mode. You can select the mode using the Tools > Standard mode and Advanced Mode menu items. The Standard mode provides a simple control set, recommended for beginners who just start using Neat Video. The Advanced mode provides the most complete control set with maximum manual control over noise profiling and filtration processes. The Advanced mode is recommended for power users. Adjusting filter settings is described below separately for the Standard and Advanced mode. We recommend to start with the part about the Standard mode and then proceed to the part about the Advanced mode if you are going to use the most complete control set.

### 5.6.3. Adjust filter settings in Standard mode

There are two main filters in Neat Video: noise reduction filter and sharpening filter. These two filters can be used together and each of them can be used independently. You can enable, disable and adjust these filters using the guidelines in the subsections below.

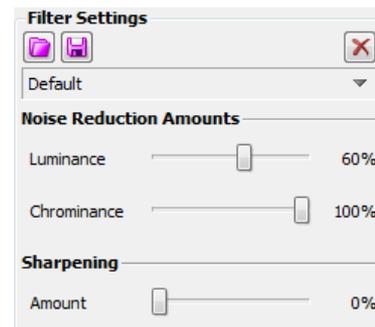
#### Adjusting noise filter settings in Standard mode

When you work with a color clip, two components of the video data can be distinguished: the luminance and chrominance component. This distinction is very useful for noise reduction because it allows

<sup>1</sup> You can check and adjust the location of that folder using the menu Tools > Preferences > Folders > Profile folder.

processing luminance and chrominance information separately by the noise filter, which improves the overall quality of filtration.

Some color clips are already represented in color spaces that enable direct separation of the luminance and chrominance components (for example, the YCrCb / YUV / YPrPb color spaces). Other clips (including RGB data that Neat Video usually takes as input) have to be converted to another representation to enable separation of the luminance and chrominance components. Neat Video applies an internal color space conversion to achieve that (Neat Video converts RGB input data to the YCrCb working color space). Once luminance and chrominance components of the video information are separated, Neat Video can treat them individually. Neat Video provides separate luminance and chrominance settings in the noise filter (as shown in the picture on the right).



In the Standard mode, the noise reduction applied to one video component (either luminance or chrominance component) is controlled by the corresponding *noise reduction amount* setting.

A noise reduction amount tells the filter how much of the detected noise should be reduced. For example, if the noise reduction amount is set to 50% then all elements that are considered (by the filter) to be noise are reduced (made less visible) in half. The noise reduction amount value of 100% tells the filter to remove the detected noise completely.

The default noise reduction amounts usually produce good filtration results provided the noise profile is accurate<sup>1</sup>. By default, the noise filter removes 60% of detected noise in the luminance channel and 100% of noise in the chrominance channels. Our experience shows that the default noise reduction amounts usually provide a good balance between noise removal and preserving natural (not over-processed) appearance of filtered footage.

## Adjust noise reduction amounts<sup>2</sup>

- ➔ Use the Noise Reduction Amounts: Luminance and Chrominance sliders.

You can vary the noise reduction amount for each frequency and channel component of the video clip. The higher a certain noise reduction amount, the more of the detected noise is removed in the corresponding component. Be careful, setting the noise reduction amounts too high, especially in the luminance channel, may lead to loss of fine details and unnaturally looking (over-smooth, plastic-like) results. Too low amounts may be not enough to sufficiently reduce the objectionable part of the noise. You have to balance the noise reduction amounts (most importantly, the amount of noise reduction in the luminance channel) to get the result that looks best to your eyes.

As human vision is not very sensitive to variations of colors, strong filtration in the chrominance component does not noticeably distort video data, but efficiently removes color noise.

## Use intra-frame preview

- ➔ Use the intra-frame preview when adjusting the noise filter settings.

After you have made changes to the noise filter parameters, do not forget to check the preview. Use the preview on different parts of the frame to get a better feeling for the results of noise reduction.

If the noise filtration looks too strong try to decrease the noise reduction amounts. If the noise filtration is not sufficient then increase the amounts.

## Adjusting sharpening settings in Standard mode (optional)

The sharpening filter in Neat Video increases sharpness of the video clip without increasing the noise

<sup>1</sup> Use the Quality indicator in the Device Noise Profile box (in the Device Noise Profile tab) to estimate the accuracy of the profile. The indicator shows how accurate and complete is the noise analysis itself. Higher values usually lead to more accurate noise reduction.

<sup>2</sup> We recommend disabling the sharpening filter when adjusting the noise filter. To disable the sharpening filter, set the Sharpening: Amount to 0%.

strength.

The sharpening filter is disabled (sharpening amount is set to 0%) by default. Increase the sharpening amount to sharpen the video. Like with any sharpening method, you have to balance the sharpening amount to avoid over-sharpening.

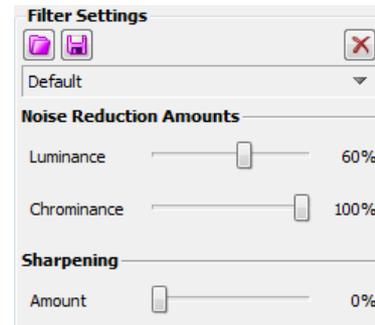
### Adjust sharpening amount

- ➔ Use the Sharpening: Amount slider.  
Specify how much sharpening should be applied to the frame.

### Use intra-frame preview

- ➔ Use the preview when adjusting the sharpening setting.  
As you make changes to the sharpening setting, do not forget to check the preview. Use the preview on different parts of the frame to get a better feeling for the results of sharpening.

As soon as you are happy with the preview results regarding both noise reduction and sharpening, proceed to save the filter settings into a preset (see page 14), or directly to Apply intra-frame filter settings, page 14.



## 5.6.4. Adjust filter settings (Advanced mode)

As said above, Neat Video has two sets of filter controls, that are available in the Standard mode and Advanced mode (you can select the mode using the Tools > Standard mode and Advanced Mode menu items). The Standard mode described above provides a simple control set, recommended for beginners who just start using Neat Video. The Advanced mode provides the most complete control set with maximum manual control over noise profiling and filtration. The Advanced mode is recommended for power users. If you want to use the Advanced mode then please read this sub-section.

As compared with the Standard mode, the Advanced mode offers a more extensive set of filter controls. There are also two filters – noise reduction filter and sharpening filter – but these have more settings now. Please follow the guidelines below to adjust both filters.

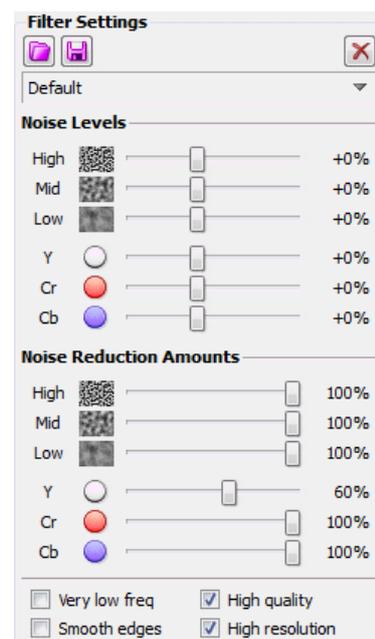
### Adjusting noise filter settings in Advanced mode

In Advanced mode, the noise filter has separate settings for all (spatial) frequency and channel components of the video data. There are also pairs of *noise level - noise reduction amount* controls for each of these video components. The meaning of each *noise level - noise reduction amount* pair is the following:

- a *noise level* control adjusts the threshold that determines which elements are considered noise in the corresponding video component and which elements are considered true details;
- a *noise reduction amount* control determines how much reduction is applied to the elements identified as noise in the corresponding video component.

In Advanced mode, you can adjust the noise levels as well as noise reduction amounts for each video component. The noise levels are adjusted relative to the noise levels of the current noise profile that have been measured on actual noise samples during profiling.

For example, the noise level of the Y (luminance) channel could be measured in the noise profile at 8.55 units.<sup>1</sup> This number tells the noise filter which elements should be considered noise and which – details: the elements that are weaker than 8.55 units are



<sup>1</sup> All measured noise levels are shown in the Profile Viewer (use the menu Profile > Profile Viewer to open it).

considered noise and reduced by the noise filter; the elements that are stronger than 8.55 units are considered details and preserved.

If you do not change the default noise filter settings (Noise Levels: Y: +0%) then noise reduction in the Y channel is completely determined by the measured number from the noise profile (8.55 units).

However, if you do adjust the filter setting for the Y noise level then this adjustment is also taken into account. For example, if you set the Noise Levels: Y control to +15% then what is considered by the noise filter as the actual noise level is:

$$8.55 * (100\% + 15\%) \Rightarrow 9.83 \text{ units}$$

With this adjustment, the elements in the Y channel that are weaker than 9.83 units are considered noise and reduced, and elements that are stronger than 9.83 units are preserved.

Thus, with a *noise level - noise reduction amount* pair of settings you can adjust what should be considered noise in a component of the video data and how much of that noise should be reduced. You have access to six such pairs – three for channel components (Y, Cr, Cb) and three for spatial frequency components (High, Mid, Low) of the video data.

Because the noise level controls are relative to the device noise profile, the default filter settings usually produce good results when the noise profile is accurate<sup>1</sup>. The noise level defaults are 0%, which means the noise levels are completely determined by the noise profile. When you adjust the level controls, the noise level estimations are raised or lowered accordingly. A noise level control can be in the range from –100%, which means no elements are considered noise, and therefore, no noise reduction is applied in the corresponding component; to +150%, which means noise reduction is applied to the elements that are weaker than 250% of the profile's noise level.

Noise reduction amounts can be in the range from 0% (none of the detected noise is removed) to 100% (all the detected noise is removed). By default, the noise filter removes 100% of detected noise in all but the luminance (Y) channel where only 60% of detected noise is removed.

Decreasing the noise reduction amounts can have a positive effect if the video clip contains some natural noise. For example, when you filter a clip including asphalt, sand, or anything else that contains fine natural noise-like features, it may be helpful to reduce amounts down to 30-50%. Our experience shows that these values generally provide a good balance between preserving the natural look of the video and noise removal.

## Adjust noise reduction amounts<sup>2</sup>

- Use the Noise Reduction Amounts: High, Mid, Low; Y, Cr, Cb sliders.

You can vary the noise reduction amount for each frequency and channel component of the video data. The higher a certain noise reduction amount, the more of the detected

noise is removed in the corresponding component. Be careful, setting the noise reduction amounts too high, especially in the luminance (Y) channel, may lead to loss of fine details and unnaturally looking (over-smooth, plastic-like) results. Too low amounts may be not enough to sufficiently reduce the objectionable part of the noise. You have to balance the noise reduction amounts (most importantly, the amount of noise reduction in the luminance channel, Y) to get the result that looks best to your eyes.

As human vision is not very sensitive to variations of colors, strong filtration in the chrominance channels (Cr, Cb) does not noticeably distort video data, but efficiently reduces color noise.

## Adjust additional filter settings (optional)

- If the clip contains strong low frequency<sup>3</sup> noise (like large color blobs sometimes produced by compression) then you may want to enable the Very low freq option in the Noise Filter Settings box.
- Check the Smooth edges option to make edges and lines in the clip look smoother.

<sup>1</sup> Use the Quality indicator in the Device Noise Profile box to estimate the accuracy of the profile. The indicator shows how accurate and complete is the noise profile itself. Higher values usually lead to more accurate noise reduction.

<sup>2</sup> We recommend disabling the sharpening filter when adjusting the noise filter. To disable the sharpening filter, uncheck all channels in the Sharpening Settings box.

<sup>3</sup> See “what is frequency” question in page 25.

- ➔ Check the **High quality** option to enable higher-quality noise reduction filter. This will slightly slow down processing but will deliver the most accurate results in return.
- ➔ Check the **High resolution** option to enable the higher-resolution noise filter. This may be useful when processing clips with very fine details that should be better preserved by the filter.

### Use intra-frame preview

- ➔ Use the intra-frame preview when adjusting the noise filter settings.

After you have made changes to the noise filter parameters, do not forget to check the preview. Use the preview on different parts of the frame to get a better feeling for the results of noise reduction.

If the noise filtration looks too strong try to decrease the noise reduction amounts for appropriate channel or frequency components. If the noise filtration is not sufficient then increase the amounts.

### Adjust noise levels (only when necessary)

Usually it is not necessary to change the noise levels if the noise profile is accurate. You only have to adjust the noise levels if you see that some noise elements are not reduced even if you set the noise reduction amounts to 100%. Such residual noise elements are usually caused by an inaccurate noise profile providing inaccurate noise level estimations to the noise filter. This may be compensated by adjusting (increasing) the noise levels in the filter settings.

- ➔ Use the Noise Levels: High, Mid, Low; Y, Cr, Cb sliders.

The noise filter has access to three frequency components and three channel components of the video data. Corresponding sliders adjust the estimated noise levels for each of these components.

The higher a certain noise level, the more elements in the corresponding component are considered noise. Be careful, setting a noise level setting too high can lead to removal of important details. Setting a noise level setting too low can lead to incomplete filtration: residual noise and compression artifacts can stay in the filtered clip.

As a rule, if the device noise profile has been built properly, it is not necessary to increase the noise levels by more than 50%. If the clip contains strong surges of noise in the high frequency range, it is recommended to increase the high frequency noise level up to +20 to 40%.

If the clip contains strong color noise, it is recommended to increase the Cr and Cb noise levels to +30%. In some cases, it may be useful to increase these noise levels up to +100%.

If adjusting noise levels still does not help and some noise elements remain in the filtered clip, probably the device noise profile is not good at all. Return to Stage V, page 8, and additionally fine-tune the device noise profile or simply rebuild the profile from scratch.

## Adjusting sharpening settings in Advanced mode (optional)

The sharpening filter is designed to increase sharpness of the clip without increasing the noise strength.

The default values of the sharpening settings should produce satisfactory results (when sharpening is enabled for any of the channel components) but you are encouraged to vary the settings to find values that produce the desired level of sharpness. Zero sharpening amounts will not sharpen the clip at all. The non-zero sharpening amounts will apply sharpening of the specified strength. Use sharpening controls for different frequency components to sharpen fine, medium or large details. As with any other sharpening method, you have to balance the amounts to avoid over-sharpening.

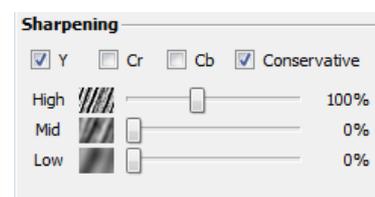
### Select color channels where sharpening should be applied

- ➔ Use checkboxes in the Sharpening section.

Usually you only want to sharpen the luminance channel – Y.

### Select sharpening mode

- ➔ Check the **Conservative** checkbox to enable more accurate sharpening, which produces much less halo effect around sharpened details.



## Adjust sharpening amounts

- ➔ Use the High, Mid and Low sliders in the Sharpening section.  
Specify how much sharpening should be applied to each frequency component of the clip.

## Use intra-frame preview

- ➔ Use the preview when adjusting the sharpening settings.  
After you have made changes to the sharpening settings, do not forget to check the preview. Use the preview on different parts of the frame to get a better feeling for the results of sharpening.

As soon as you are happy with the preview results regarding both noise reduction and sharpening, proceed to save the filter settings into a preset (below), or directly to Apply intra-frame filter settings, page 14.

## 5.6.5. Save intra-frame filter settings into a preset (optional)

### To save the filter settings into a preset

- ➔ Click  (the Save filter settings as preset... button) in the Filter Settings box.  
In the Save Filter Preset dialog box, specify the name of the file to save the preset. The filter presets are stored in \*.nfp files.

Saved filter preset includes the noise filter and sharpening settings. By re-opening a preset, you can reproduce exactly the same intra-frame filter settings later on. Together, a device noise profile and a filter preset can be used to accurately reproduce the filtration results.

### To load a previously saved filter preset

- ➔ Click  (the Load filter preset... button) in the Filter Settings box. In the Load Filter Preset dialog box, specify the name of the filter preset to be opened.
- or

- ➔ Click  (the drop-down button) in the Filter Settings box to open the popup menu with all available presets and then select one of them.

There are several pre-written filter presets in your Documents folder<sup>1</sup>:

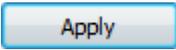
*Documents\Neat Video for VirtualDub\Presets\*

Please explore these presets to see what combinations and values of the noise and sharpening filter's settings can be used to solve typical tasks (names of the presets explain these tasks).

## 5.6.6. Apply intra-frame filter settings

After you have prepared a noise profile and adjusted the intra-frame filter settings, you have to apply these changes.

### To apply intra-frame filter settings

- ➔ Click  (the Apply button in the bottom of the plug-in window).

The Neat Video plug-in window will be closed and the plug-in will automatically save the device noise profile and filter preset in the project you work with. If you later re-open the Neat Video plug-in window, the plug-in will automatically pick up saved noise profile and noise filter settings.

<sup>1</sup> To check and adjust the location of that folder use the menu Tools > Preferences > Folders > Preset folder.

## 5.7. Stage VII. Adjust temporal filter settings

Besides the intra-frame filtration (that you configured in the previous section) Neat Video also applies temporal (inter-frame) filtration to the video clip. Temporal filtration allows Neat Video to improve the overall quality of noise reduction. Neat Video uses several consecutive frames to better reduce noise and preserve more true details in each frame.

You can adjust the temporal filter settings using the controls available in the Temporal filter box in the Neat Video Configuration window.

### To adjust temporal filter settings

#### Adjust Temporal filter radius

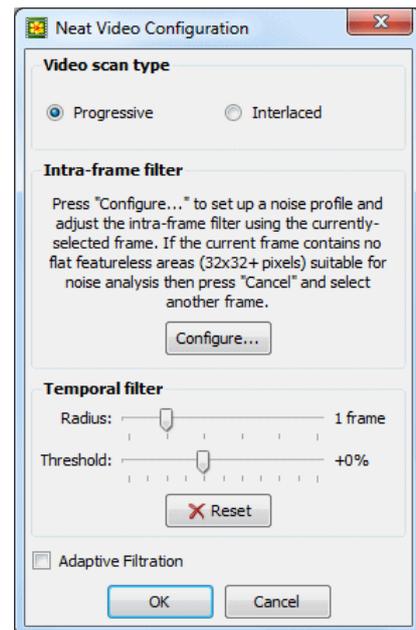
The Temporal filter radius setting determines the number of consecutive frames used for temporal filtration. Higher values of this setting lead to more aggressive (and slower) temporal filtration. Lower values lead to less aggressive (and faster) filtration based on a smaller number of consecutive frames. Zero value disables temporal filtration completely. The default value is 1, which means three consecutive frames (the current one, one before and one after the current one) are used for temporal filtration.

- ➔ Use the Radius control in the Temporal filter box in the Neat Video Configuration window.

#### Adjust Temporal filter threshold

The Temporal filter threshold setting determines how sensitive the temporal filter is to changes (for example, motion of objects) in consecutive frames. Higher values of this setting lead to more aggressive filtration with less attention to temporal changes (lower motion sensitivity). Lower values lead to less aggressive filtration with more attention to temporal changes and better preservation of moving details (higher motion sensitivity).

- ➔ Use the Threshold control in the Temporal filter box in the Neat Video Configuration window.



## 5.8. Stage VIII. Adjust adaptive filtration

### Enable or disable adaptive filtration

The noise properties of the video data may vary in different parts of the clip. Neat Video can automatically adjust its filters to the changing noise when this option is enabled. If the noise is the same in different parts of the clip then this option can be left disabled.

- ➔ Enable the Adaptive Filtration option to let Neat Video automatically adapt its filters to the changing noise in the clip.

## 5.9. Stage IX. Render the clip

### To apply Neat Video noise reduction

- ➔ Use the File | Save as AVI... menu item in VirtualDub.

This will automatically apply Neat Video noise reduction to the video sequence and save the result to a new video file on the hard drive (you may want to adjust VirtualDub's compression settings before starting filtration; these settings can be adjusted using the Video | Compression... menu item in VirtualDub).

Neat Video is a processor-intensive filter, and the processor's speed is the most critical. On Intel i7 3.4 GHz, Neat Video v3 processes a 720x576 clip at the speed of 20-30 fps, depending on filter settings. Larger frame sizes are processed proportionally slower.

## 6. Device noise profiles

A *device noise profile* (or *noise profile*, or simply *profile*) describes the properties of visible noise produced by a video capturing device (e.g., a video camera, camcorder, computer TV-tuner, film digitizer, etc.) working in a certain mode. Several noise profiles corresponding to different modes of a device constitute a *profile set* for this device. Neat Video can use a profile from a profile set to process a video clip produced by a device working in the corresponding device mode.

You can easily build noise profiles for your video capturing device. Learn how to build and use device noise profiles in Neat Video in the subsections 6.1-6.3 below.

### 6.1. Building a profile for a device mode (standard profiling procedure)

This subsection explains how to build a single profile for a video clip produced in a certain mode.

Building a new noise profile generally includes three stages:

- Stage I. Building a profile;
- Stage II. Documenting the profile;
- Stage III. Saving the profile.

#### 6.1.1. Stage I. Building a profile

To build a noise profile for a video clip you have to take these steps:

- Step 1. Selecting a frame suitable for noise analysis;
- Step 2. Analyzing the noise.

#### Step 1. Selecting a frame suitable for noise analysis

To build an accurate noise profile, Neat Video has to analyze a specific frame from the video clip. This frame should include uniform featureless areas containing only noise without real details.

A uniform area (with minor variation in all color channels) may be overcast sky, clear sky (without clouds and birds), or any other part of a suitable frame, where there are no visually perceptible details (except the noise). Neat Video needs to analyze a uniform featureless area of around 128x128 pixels (the minimum size is 32x32 pixels).

In the video clip you want to build a profile for, find a frame that contains flat featureless areas. Then use this frame to build a noise profile:

- 1. Use the `Video | Filters...` menu item to open the list of used filters;
  2. If Neat Video is not in the list, then click the `Add...` button to open the list of available filters, and then double-click on the Neat Video filter in the list. If Neat Video is already in the list, then simply double-click it.  
This will open the Neat Video Configuration window with an attached window showing the video sequence.
  3. In the attached window, use the `Trackbar` to find a frame with large flat featureless areas; the selected frame will be used for noise analysis in the next steps.
  4. In the Neat Video Configuration window, click the `Configure...` button in the `Intra-frame filter box`.

The Neat Video plug-in window will open and show the currently selected frame.

#### Step 2. Analyzing the noise (profiling)

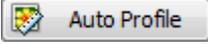
Analyzing noise (profiling) is the main part of building a noise profile. This version of Neat Video offers three ways of conducting the noise analysis (profiling): automatic, semi-automatic and manual one. Using automatic profiling is easier and therefore recommended for beginners. In difficult cases (for example if Neat Video is unable to automatically find a uniform featureless area in the analyzed frame), automatic profiling may not work or produce less than perfect results. You can always override automatics and use semi-automatic or manual profiling.

Make sure you use the Device Noise Profile tab:



### Case of automatic profiling

To analyze the noise properties of the video clip, Neat Video uses uniform areas of the frame. Such areas should contain noise but no visible or important details. With automatic profiling, Neat Video tries to find one such area automatically and then uses this area to analyze noise.

- ➔ Click  (the Auto Profile button).

Neat Video will automatically find and show the frame area selected for analysis and will analyze it automatically. If the selected area shown in viewer indeed contains no visible details then the resulting noise profile will be accurate.

In difficult cases, Neat Video may be unable to find a sufficiently-large uniform featureless area in the frame. You will notice that the selected area, for example, will contain some important details. In such a case, use the semi-automatic profiling instead (see below).

If you see that the area automatically selected for analysis is indeed uniform and featureless, then the resulting noise analysis is accurate. To be sure, check the Quality indicator in the Device Noise Profile box. A profile built using a uniform and featureless area will usually show a high value in this indicator.

If the profile quality is high (for example, higher than 75%) then you can be sure that the noise profile is accurate. In this case, proceed to Stage II. Documenting the noise profile, page 18.

If the quality is not high, try to use the semi-automatic profiling instead (see below).

### Case of semi-automatic profiling

#### 1) Find a uniform featureless area

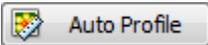
- ➔ Manually find and select an area that contains no visible details.<sup>1</sup>

The area should be at least 32x32 pixels large. That is the minimum size; the recommended size is 128x128 pixels or more (you can resize the selection frame).

Scroll, pan, zoom the frame to find a uniform area. Set the selection to the found uniform area.

If you cannot find a uniform area in the frame, try to use another frame from the same video clip.

#### 2) Analyze selected area

- ➔ Click  (the Auto Profile button).

Neat Video will automatically analyze the selected area and build a noise profile.

At this point the profile is ready. Proceed to Stage II. Documenting the noise profile.

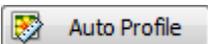
### Case of manual profiling (Advanced mode only)

#### 1) Find a uniform featureless area

- ➔ Manually find and select an area that contains no visible details.

The area should be at least 32x32 pixels large. This is the minimum size; the recommended size is 128x128 pixels or more (you can resize the selection frame).

#### 2) Analyze selected area

- ➔ Click  (the Auto Profile button).

Neat Video will automatically analyze the selected area and build a noise profile.

<sup>1</sup> You can see some examples of uniform featureless areas in the Examples section, page 23.

### 3) Additionally manually fine-tune the profile

Fine-tuning uses additional flat featureless frame areas to make the noise profile more accurate. You have to manually select and analyze several such areas one after another.

#### 1) Find and select a uniform featureless area

- ➔ Scroll, pan, zoom the frame in the viewer in the Device Noise Profile tab to find a new uniform area.

The size of an area may be from 16x16 to 256x256 pixels. Using larger areas makes fine-tuning more accurate. The selection edges will change their thickness according to the selection size.

#### 2) Analyze selected area with Manual Fine-Tune

- ➔ Click  (the Manual Fine-Tune button) or select the Profile | Fine-Tune Using Selected Area menu item.

The analysis results will be shown in the noise profile equalizer: the graphs of the equalizer will change some of the values (see the picture on the right) as you do fine-tuning. You can switch from one channel to another in the equalizer to better see a specific channel's graph, or select to show them all together.

The goal of manual fine-tuning is to fill the equalizer with measured values (shown as graph-color knots) in all points of the graphs. The previous steps (specifically, the Auto Profile function) may have already filled some of the values. Manual fine-tuning can further improve the analysis by filling out the still missing or interpolated values (shown as yellow knots) and/or making some of already measured values more precise.



#### 3) Repeat 1-2 above with other uniform areas of different brightness

To make a device noise profile more accurate, fine-tune it using several uniform areas of the frame. Select areas of different brightness for best results. Try to choose and analyze uniform areas to cover all or most elements of the equalizer in all its color channels. The more elements of profile are analyzed, the higher is the quality of the profile.

#### 4) Complete fine-tuning using Auto Complete

- ➔ Click  (the Auto Complete button) or select the Profile | Auto Complete menu item to automatically complete the fine-tuning by adjusting the unmeasured values using interpolation based on the measured data. At this point the profile is ready.

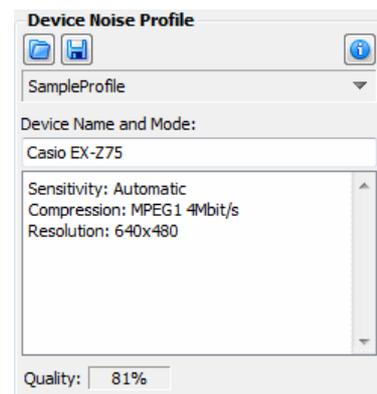
## 6.1.2. Stage II. Documenting the noise profile

At this point the noise analysis is done and all important noise characteristics are gathered in the profile. However, you may still want to manually document the profile by describing the video capturing device and its mode.

- ➔ Use the Device Name and Mode fields in the Device Noise Profile box to specify the model of the video capturing device and describe the device mode used to capture the profiled clip.

It is highly recommended to specify these details to keep record of devices, device modes, and corresponding device noise profiles that you use.

The noise characteristics of any two devices can be extremely different. Even a single device in different modes can produce significantly different noise. Therefore, it is always better to use separate noise profiles for different devices and device modes to avoid inaccurate filtration and artifacts. Commenting on the device name and mode parameters will



help you re-use a noise profile later when you will look for a suitable profile to process a video clip.

There may be many device parameters but not all of them influence noise and those that do differ by the strength of their influence. It makes sense to document only those parameters that appreciably affect noise. In the tables below, those parameters are described that usually appreciably affect noise characteristics (from the most to the less important ones) for video capturing devices:

<b>Video capturing device parameters in the order of decreasing importance</b>		
<b>Sensitivity of light-capturing device</b>	Film type and sensitivity (for digitized analog video), effective sensor sensitivity (for digital video), etc.	More sensitive light-capturing devices / media usually produce stronger noise.
<b>Compression of video clip</b>	Video compression method / mode used	Stronger compression typically produces more artifacts and destroys details; weaker compression preserves more details. It is preferable to use the lowest amount of compression possible for the best results.
<b>Resolution/ frame size</b>	1920x1080, 1366x768, 1280x720, 720x576, 512x384, 352x288, etc.	Video clips of different resolutions usually have very different noise characteristics.

If two video clips were produced by the same device in the same or similar conditions (most of the above device mode parameters are the same) then the noise of these two clips should be very similar. If you have built a device noise profile using one of these clips, you can use this profile to filter both clips with good results. If however, the conditions were different then the noise in two clips could be significantly different. In this case, cross-use of the noise profile is not recommended. Instead, two different profiles should be built and used to filter these two clips.

### 6.1.3. Stage III. Saving the noise profile

- ➔ Use  (the Save Device Noise Profile As... button) in the Device Noise Profile box.

In the Save Device Noise Profile As... dialog box, specify a meaningful file name and save the profile to the hard drive. Device noise profile are saved in *\*.dnp* files.

#### **File naming considerations**

If you are going to re-use the device noise profile, select a good file name explaining the device name and mode so that you could easily recognize this profile by its file name later on. Alternatively, you can use special folder structuring to keep many device noise profiles arranged according to their device modes.

Saved noise profile includes a complete noise analysis. Therefore, by re-opening the noise profile with another clip, you can reproduce exactly the same conditions for noise reduction later on.

## 6.2. Using noise profiles

When you have a set of profiles for your video capturing device, you can directly use these profiles to process clips with Neat Video. Usually the set contains only one profile that is most suitable to process a given clip. Therefore it is very important to select the right profile, which would provide good match between profile and clip. Profiles in a profile set usually have been built for different device modes and to make a perfect match between a profile and a clip the device mode of this profile should be the same or very close to the device mode used to capture this clip. In the current version of Neat Video, you have to manually select a device noise profile that matches the video clip based on profile descriptions and file names.

Obviously it is preferable to build a new noise profile for each clip, because such a profile would perfectly match the noise of that clip. Nevertheless, any noise profile can, with some degree of accuracy, be used to process other clips captured by the same device working in the same or similar mode. This is less accurate than building a profile for each clip but saves time because building a new profile usually takes more time than re-using a ready-made one.

## 7. Preferences

There are several preferences that adjust the behavior of the Neat Video plug-in.

Use the Tools > Preferences menu item to open the Preferences dialog box.

### 7.1. General preferences

#### On opening plug-in window

##### Do not change viewer zoom and window size

Use this option to **not** let Neat Video automatically modify the window size and zoom level when opening the Neat Video plug-in. The Neat Video window will remember its size from the last time and will not try to adjust its size and viewer zoom to show the whole frame. The initial zoom level will be 100%.

##### Adjust viewer zoom to fit frame to window

Use this option to make the Neat Video viewer automatically adjust the zoom level to fit the whole frame into the viewer window, without modifying the window size. The Neat Video window will remember its size from the last time.

##### Adjust window size to accommodate whole frame

Use this option to make the Neat Video windows automatically adjust its window size (and if necessary, the viewer zoom level as well) to accommodate the whole frame when opening the Neat Video plug-in.

#### Color theme

##### Normal brightness

Neat Video will display its interface elements using the current color theme of the OS.

##### Reduced brightness

Select this option to switch Neat Video to a custom color theme with reduced brightness.

#### Show hints over interface controls

This option switches on/off the hints explaining the purpose of Neat Video controls (like a button, slider, etc.). The hints are displayed when the mouse pointer is placed over controls in the Neat Video interface.

### 7.2. Profiling preferences

#### Save noise samples in profiles

Enable this option to make Neat Video save a noise sample from the analyzed frame area into device noise profile (\*.*dnp* file). This will increase the size of the \*.*dnp* file but will also improve the compatibility with the future versions of the software (Neat Video will be able to re-build the profile using the saved noise sample).

#### Show warnings about selected frame areas

Enable this option to let Neat Video display warnings about selected frame areas during profiling. For example, Neat Video may warn you about clipping or non-uniformity detected in the selected area, thus helping you select a better area for profiling.

## 7.3. Performance preferences

The first group of settings in this tab selects the computing devices to be used for image processing. This group of settings is optional, it is shown only if at least one supported GPU (graphic processing unit) is available along with the regular CPU (central processing unit, or processor). This group includes the following items:

### Use CPU only

This option makes Neat Video perform all video processing using CPU only.

### Use GPU only

This option makes Neat Video perform all video processing using GPU only.

### Use CPU and GPU

If you select this option then Neat Video will process video data using both CPU and GPU.

Depending on individual performance of each computing device (CPU and GPU), each of the above options may be the most efficient. You can try different settings and measure the resulting speed using the Benchmark tool below.

## CPU

### Number of used cores

This option adjusts the number of CPU cores used by Neat Video for processing. The number of used cores can go up to the total number of cores in all CPUs in your computer (like 2 cores in Core Duo, 4 cores in Core Quad, 8 cores in a desktop version of i7 with enabled hyperthreading, etc.). If the computer includes two physical CPUs then the number of cores is correspondingly higher. Ideally, using all cores should provide the best overall performance. In some cases however, processing speed may be even higher if fewer cores are used (especially on CPUs with hyperthreading). For example, using fewer than all 8 virtual cores in i7 is in some cases faster, so you may want to test different values of this setting.

## GPU

In this box, you can specify which of the available computation-capable GPU devices (CUDA-capable NVIDIA cards and/or OpenCL-capable AMD/ATI cards) should be used (in addition to CPU or instead of CPU) for video processing. When you have one or more GPUs, you can let Neat Video use them and specify how much of the GPU memory may be used by Neat Video for its processing. If another application or another filter also uses the GPU at the same time, you may want to reserve only a part of the GPU memory for Neat Video and leave the rest free for other purposes. In any case, you can try different values and see which setting gives the best results.

## Benchmark

Use the **Benchmark** button to measure the speed of Neat Video processing with specified filter settings and current performance settings specified in the CPU and GPU boxes.

## Optimize

Use the **Optimize...** button to open a specialized dialog designed to measure image processing speeds achieved with different combinations of the CPU and GPU settings. It allows to automatically benchmark all possible combinations of settings and to identify the best combination. This is the easiest way to optimize the performance of Neat Video for specific CPU and GPU hardware.

## 7.4. Folders preferences

### Profile folder

Select the folder where Neat Video will store and look for device noise profiles. This should be the topmost folder of all the (sub)folders with device noise profiles. Neat Video will display all profiles (stored in all subfolders of the specified folder) in the popup menu in the *Device noise profile* panel of the plug-in window to help you quickly load those profiles.

By default, the *Profile folder* is located in your Documents folder:

*Documents\Neat Video for VirtualDub\Profiles\*

You can select another location to store and use your Neat Video profiles if you prefer.

### Preset folder

Select the folder where Neat Video will look for filter presets. This should be the topmost folder of all the (sub)folders with filter presets. Neat Video will display all presets (stored in all subfolders of the specified folder) in the popup menu in the *Filter Settings* panel of the plug-in window to help you quickly load those presets.

By default, the *Preset folder* is located in your Documents folder:

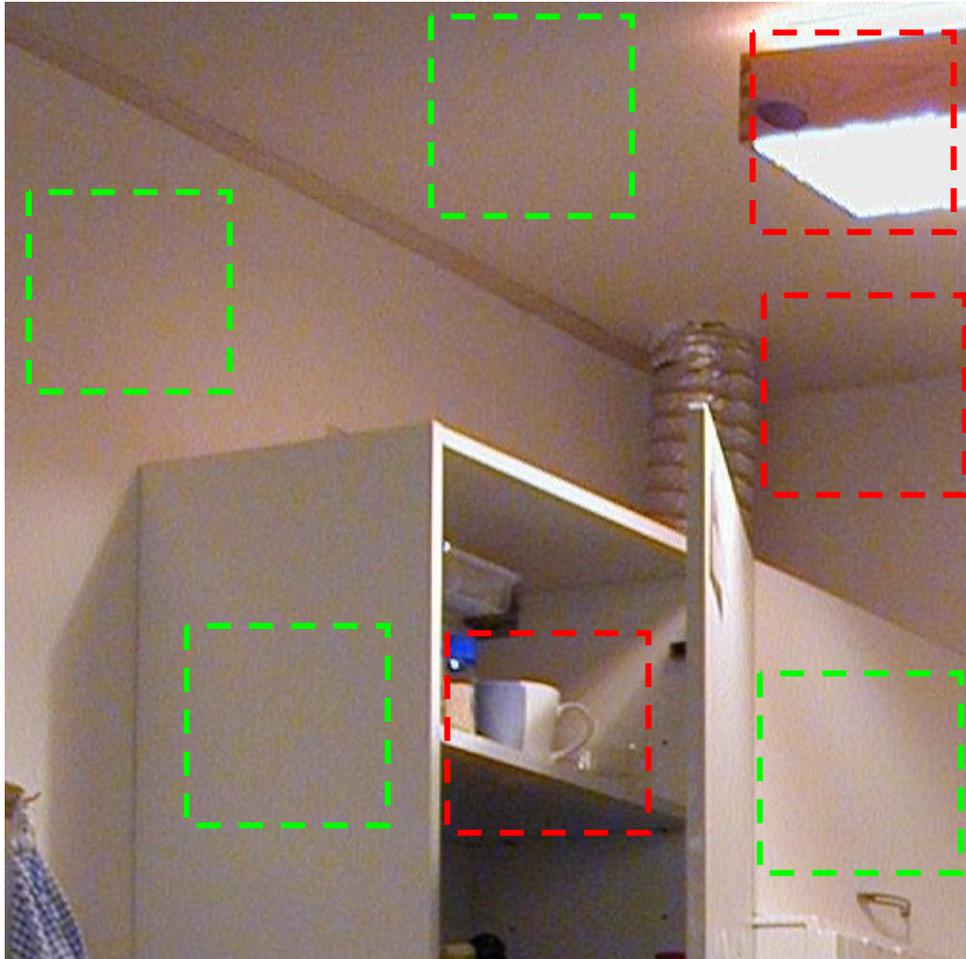
*Documents\Neat Video for VirtualDub\Presets\*

You can select another location to store and use your Neat Video presets if you prefer.

## 8. Examples

### 8.1. Building a noise profile

See the picture below for examples of areas that are good and bad for building device noise profiles. Here, the areas suitable for profiling are highlighted in green; those that should not be used are highlighted in red. Note that a frame area suitable for building a device noise profile should be at least 32x32 pixel large (preferably more than 128x128 pixels).



Additional comments regarding these areas are available in the next page.

These areas **can be used** to build device noise profiles, as they contain no visible details:



– **GOOD**, because this area contains no important details



– **GOOD**, no important details (this area is from another frame)

The following areas **should not be used** to build device noise profiles, because they contain details:



– **BAD**, because this area contains a detail: corner – junction of wall and ceiling



– **UNACCEPTABLE**, because this area contains many details



– **BAD**, because this area contains some details: clouds (this area is from another source)

## 8.2. Filtration results

Please see examples of noise reduction applied to video clips in the Neat Video web page:  
<http://www.neatvideo.com/examples.html>

## 9. Questions and answers

### 9.1. General questions

- Q What is the difference between Neat Video Demo, Home and Pro plug-in?**
- A The Demo plug-in has some functional limitations. For example, it can only process short video clips with limited frame size. Please see the Detailed feature map, page 28, for more details.
- Q Should I uninstall Demo plug-in prior to installing the Home / Pro plug-in?**
- A This is not necessary. You can install the Home / Pro plug-in over the Demo plug-in.
- Q Should I uninstall the older version of Neat Video prior to installing a newer one?**
- A This is not necessary. You can install a newer version of Neat Video over the older one.
- Q I think I have found a bug. How can I submit a bug report?**
- A Please use the online bug report form: <http://www.neatvideo.com/brf.html>  
Please fill it out to let us know all the details necessary to reproduce the problem.

See more information about bugs in the Known issues section in Neat Video webpage (<http://www.neatvideo.com/bugs.html>) and about bug fixes in the *WhatsNew.txt* file supplied with the software (also see the history section on the web page for the most up to date information: <http://www.neatvideo.com/history.html>).

### 9.2. Filtration-related questions

- Q Why do I receive some crystal-like artifacts in the filtered frame?**
- A The crystal-like artifacts (usually these are the residual compression artifacts or residual noise) look like thin lines in the filtered frame. They can be easily eliminated by increasing the high frequency noise level in the filter settings.  
Note: presence of many residual artifacts is usually a consequence of using a poorly built, inaccurate noise profile or a profile built for another device and/or device mode.
- Q Filtered frame looks 'plastic'. Why?**
- A The reason is that too much filtration was applied. Let Neat Video keep some noise to get more natural-looking results. Adjust the noise reduction amounts; for example, reduce the noise reduction amount in the luminance (Y) channel to 50-70%. Also, make sure the device noise profile does match the video clip processed. Using an incorrectly chosen or poorly built profile can either produce plastic-looking results or leave residual artifacts (see the previous question).
- Q What is frequency?**
- A The term (spatial) *frequency* is used in Neat Video to denote elements of a video clip (both important details and noise/grain) of certain size.
- High frequency* corresponds to elements of smallest size. *Medium (mid) frequency* corresponds to elements of medium size. *Low frequency* corresponds to elements of (relatively) large size.
- For reference, see the noise samples of different frequencies in the Noise Filter Settings tab of the Neat Video plug-in window.



- Q The filtration process is not very fast, is this normal?**
- A This is normal, because the filtration algorithm is quite complex. We work on further optimization to provide better performance.

---

**Q How to filter only the color noise (not the brightness noise)?**

- A** Set the value of the luminance (Y) channel noise reduction amount to 0%. This will disable filtration in the luminance (brightness) channel.

**Q What is YCrCb?**

- A** YCrCb is the name of a family of color spaces widely used in digital imaging, television, video, etc. In 'YCrCb', 'Y' corresponds to the luminance channel, 'Cr' - to the Cr chrominance channel covering the red to blue-green color range, 'Cb' - to the Cb chrominance channel covering the blue to yellow color range. Because this space enables easy separation of the luminance and chrominance information, it is very suitable to conduct noise reduction.

**Q Is processing via Neat Video best done before or after any other processing (i.e. tonal/color correction)?**

- A** Such operations as tonal/color correction are quite conservative from the standpoint of noise, i.e., they do not significantly change the noise characteristics of the video clip. Therefore, filtering before or after makes little difference – as long as the noise profile is built and applied at the same stage of your workflow. For example, don't use a device noise profile built with an unprocessed (the color correction is not yet applied) clip to filter the same clip with the color correction applied.

On the other hand, certain effects, like sharpening or resampling, applied to a noisy video clip may considerably change its noise properties. In this sense, it is generally better to use Neat Video filtration before applying such effects.

## 10. Using Neat Video in AviSynth<sup>1</sup>

The Neat Video plug-in for VirtualDub can be used in AviSynth scripts provided a noise profile and filter preset are available (they can be built in the Neat Video plug-in in VirtualDub).

Currently, use of the Neat Video plug-in in AviSynth scripts is limited to one instance of Neat Video per script. This restriction may be reduced in the future versions of Neat Video.

### Loading Neat Video plug-in

The following function should be called from an AviSynth script to load the Neat Video plug-in:

```
LoadVirtualDubPlugin(Path, Name, Preroll)
```

*Path* – a string parameter, should contain the full path to the Neat Video plug-in (*NeatVideo.vdf*)

*Name* – a string parameter, should contain the internal AviSynth plug-in name

*Preroll* – an integer parameter, should specify the number of frames that must be initially passed to Neat Video to initialize its temporal filter. This parameter must be equal to the temporal filter radius (see *TemporalRadius* below).

### Configuring Neat Video filter

The following function should be called to configure the Neat Video filter:

```
NeatVideo(ProfilePath, PresetPath, TemporalThreshold, TemporalRadius,  
AdaptiveFiltration, Interlaced)
```

*ProfilePath* – a string parameter, specifies the device noise profile (.dnp) to be used

*PresetPath* – a string parameter, specifies the filter preset (.nfp) to be used

*TemporalThreshold* – a string parameter, specifies the temporal filter threshold  
(a floating point value from "0.0" to "2.5"; use "1.0" as the default value)

*TemporalRadius* – a string parameter, specifies the temporal filter radius  
(an integer value, from "0" to "5"; use "1" as the default value)

*AdaptiveFiltration* – a string parameter, specifies whether adaptive filtration is disabled or enabled  
(an integer value, "0" – disabled; "1" – enabled)

*Interlaced* – a string parameter, specifies whether the video sequence is interlaced or progressive  
(an integer value, "0" – progressive (the default value); "1" – interlaced)

### Script example

```
DirectShowSource("C:\AVS\SampleClip.avi", fps=30)  
ConvertToRGB32()  
LoadVirtualDubPlugin("C:\VIRTUALDUB\PLUGINS\NeatVideo.vdf", "NeatVideo", 3)  
NeatVideo("C:\AVS\SampleProfile.dnp", "C:\AVS\SamplePreset.nfp", "1.0", "3", "1", "0")
```

---

<sup>1</sup> This feature is available in non-Demo editions of Neat Video plug-in for VirtualDub.

## 11. Information

### 11.1. Issues and bugs

Please report any bugs or issues you encounter while working with Neat Video. Use the online bug report form: <http://www.neatvideo.com/brf.html>.

Your feedback will greatly help us to improve the software and provide you with newer and better versions of Neat Video.

### 11.2. Plans

The current version of Neat Video is the result of our ongoing research on noise filtration. We continue to work on the core noise reduction algorithms to improve the quality and speed of noise reduction.

Please let us know if you have ideas that can make Neat Video better. Participate in the discussion on the Neat Video message board, express your opinion, make suggestions, and ask questions.

### 11.3. Detailed feature map

Features		Neat Video		
		Demo plug-in	Home plug-in	Pro plug-in
Video data	File formats supported	all formats supported by plug-in host		
	8 bits/channel (24-bit RGB) rendering	+		
	Maximum size / length of filtered video data	1024x640 pixels 30 minutes	1280x720 pixels unlimited length	unlimited size unlimited length
	Neat Video label added to filtered clip	added	not added	
Intra-frame and temporal filter		+		
Noise reduction	Channel-wise (Y, Cr, Cb)	+		
	Frequency-wise (High, Mid, Low, Very low)	+		
Smart sharpening	Channel-wise (Y, Cr, Cb)	+		
	Frequency-wise (High, Mid, Low)	+		
Device noise profiles	Automatic and semi-automatic profiling of any video-capturing device	+		
Filter presets (reusable filter settings)		+		

### 11.4. Contacts

We really appreciate your opinion of Neat Video. Please let us know what you think about the software. Feel free to ask questions regarding Neat Video. You can contact us using the following means:

#### E-mails

- [info@neatvideo.com](mailto:info@neatvideo.com) — for general inquiries
- [virtualdub@neatvideo.com](mailto:virtualdub@neatvideo.com) — for any inquiries regarding use of Neat Video plug-in
- [sales@neatvideo.com](mailto:sales@neatvideo.com) — for any inquiries regarding purchase of Neat Video software

#### Forum

Register in Neat Video community forum ( <http://www.neatvideo.com/nvforum/> ), and participate in discussions on the use and development of Neat Video. Such topics are covered in the forum as:

- announcements of new and updated version of the software;
- questions about use of Neat Video;
- examples of using Neat Video with comments and suggestions;
- feedback from the users: suggestions of new features and improvements;
- contacts and general comments.

#### Web page

<http://www.neatvideo.com/>

## 11.5. Legal information

### Copyright

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#### Distribution

The Demo edition of Neat Video may be distributed unmodified provided any charge is to cover distribution costs only.

The Demo edition of Neat Video may be placed on magazine CDs as long as the Neat Video team is informed.

## 11.6. Registration

To become a registered user and to get a fully functional edition of Neat Video Home or Pro plug-in for VirtualDub you must purchase a license (a single- or multi-user license). This can be done through an online software shop. Please find the detailed information in the purchase section of the Neat Video web page: <http://www.neatvideo.com/purchase.html>

After you have purchased a license, you will receive an e-mail from the Neat Video team with detailed download and registration instructions. These instructions will help you download and become a registered user of the Neat Video software.

By becoming a registered user of Neat Video plug-in for VirtualDub you will:

- Encourage the authors to further develop and improve the software;
- Get access to all functions of Neat Video Home or Pro plug-in for VirtualDub (see the Detailed feature map, page 28);
- Be able to use Neat Video Home or Pro plug-in for VirtualDub for commercial and other purposes;
- Get free updates of the software (minor modifications with the same major version number, for example, updates from the version v3.0 to any v3.x);
- Enjoy reduced upgrade prices for new major future modifications of Neat Video Home or Pro plug-in for VirtualDub or will get a free upgrade;
- Receive the primary attention of Neat Video support group;
- Receive the primary attention of Neat Video development group (tell us what you want to see in the next version).

#### Message from Neat Video team

By becoming a registered user you are helping us to further develop and improve the software.

**Become a registered user and we will make Neat Video better for YOU!**

## 11.7. Acknowledgments

Thank you to all the users who contribute by proposing improvements and new features.

Thanks to all the people who help us to find bugs in Neat Video.

Thank you to all the users who stimulate the development of Neat Video by their word and deed.

*Neat Video team, ABSOft*

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