



**for sound applications in MATLAB®  
and GNU Octave**

## HtVst-Plugin Documentation

“Virtual Studio Technology“ (VST) plugins for SoundMexPro

Version 2.3

<http://www.soundmexpro.de>

*User Manual*



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## 2 Introduction

This manual is part of the “SoundMexPro - ASIO Sound-Toolkit for MATLAB®” documentation. It describes the Hörzentrum Oldenburg “Virtual Studio Technology“ (VST) effect plugins shipped with SoundMexPro. For a description of SoundMexPro please refer to <http://www.soundmexpro.de> and the separate SoundMexPro manual.

The VST plugins described in this manual require SoundMexPro with a VST+ license but can be evaluated with the demo version. At the moment all plugins can be loaded with the VST license as well, but this may be changed at any time without notification.

All plugins are located in the ‘plugins’ subdirectory of SoundMexPro, examples using the plugins can be found in the ‘Examples’ subdirectory.

If you are missing a VST plugin with the features you need, please contact Hörzentrum Oldenburg for development on demand.



SoundMexPro uses the ASIO technology.

ASIO is a trademark and software of Steinberg Media Technologies GmbH.



SoundMexPro and the plugins described in this manual use the VST technology.

VST is a trademark and software of Steinberg Media Technologies GmbH.



### 3 Plugins

This section describes the VST plugins shipped with SoundMexPro including all supported parameters and programs.

Please note that all parameter values passed to a plugin with the “vstparam” command has to be within the range from 0 to 1. This is a basic feature/restriction for VST plugins. The plugin itself may calculate other values from this ‘raw’ parameter. Thus the GUI-editor may show other values (as returned from plugin).

#### 3.1 *HtVSTGain: Gain plugin*

A simple gain plugin “HtVSTGain.dll” applying linear or logarithmic gains is shipped with SoundMexPro. It is used in the vst-tutorial examples. Please refer to these examples for a description.

#### 3.2 *HtVSTVisualize: Visualization plugin*

The visualization plugin “HtVSTVisualize.dll” is an extension plugin to the regular visualization of playback or recording data in SoundMexPro. It can show level, spectrum, spectrogram and time signal of one audio channel:

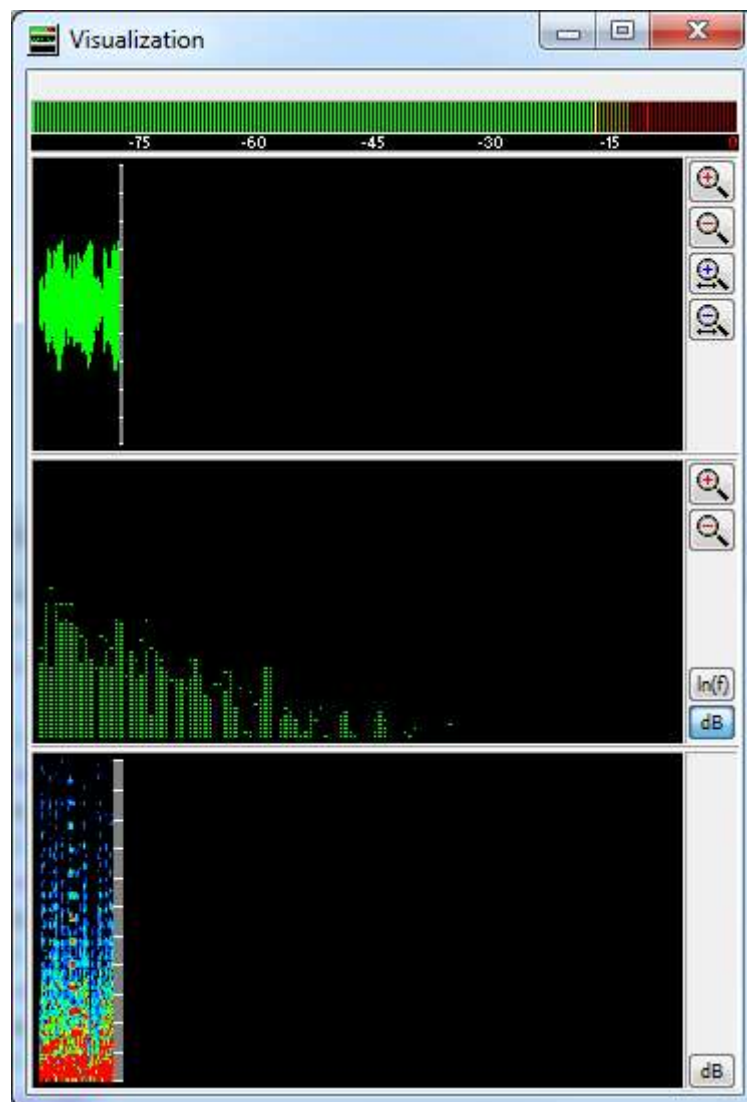


Figure 1

Use the buttons with the magnifying glasses to zoom horizontally or vertically into spectrum or waveform. If the waveform freezes, please click the horizontal 'Zoom In' (blue magnifying glass with the '+') until it shows up again. Note: the magnifying glasses for the waveform have no function if you have selected 'Scroll display' in the options dialog (see below).

The 'dB' buttons toggle linear/logarithmic view of amplitudes/levels, the 'ln(f)' button toggles linear/logarithmic view of the spectrum frequency axis.

The properties of the visualization can be customized calling the options dialog by selecting the 'Options' command from the context menu (see the resulting view in Figure 3):

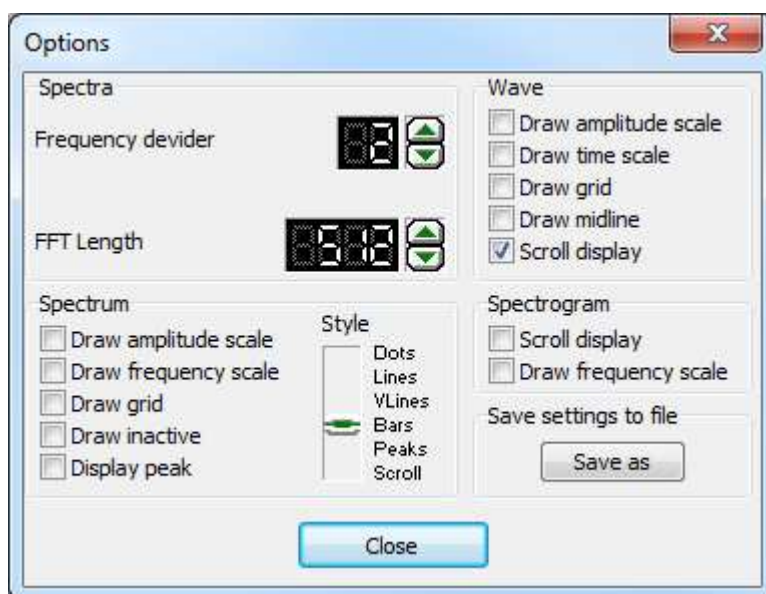


Figure 2

The options are described in Table 2.

All changes are saved if an inifile was specified in the plugins configuration section. On clicking 'Save as' you are prompted for a filename to save the settings to. After using 'Save as' all further changes will automatically be written to the selected file.

The plugin has the following parameters that can be changed with the GUI editor (SoundMexPro command "vstedit") or directly with the commands "vstload" or "vstparam":

| Parameter | Description  |
|-----------|--|
| visible   | If visible is set to values $> 0.5$ the visualization is shown, otherwise it is hidden |

Actual settings can be loaded from an inifile by setting the program of the only program supported by the plugin with the command "vstprogramname", e.g.:

When the name is set, all values are read from that file. If a program name was set changes are stored in that file on unloading of the plugin automatically. All known parameters/values are listed in the tables below.

| Group   | Option            | Description   |
|---------|-------------------|---|
| Spectra | Frequency divider | Restricts maximum frequency shown in spectrum and spectrogram, calculated by $\text{SamplingFrequency}/\text{FrequencyDivider}$ |
| Spectra | FFT Length        | FFT Length used for spectrum and spectrogram. Possible values are restricted by the buffer length of the                        |

|             |                      |   |
|-------------|----------------------|---|
|             |                      | corresponding wave device. The value might be decreased automatically after starting the device (if buffer length of device is small)     |
| Wave        | Draw amplitude scale | Shows relative amplitude scale (insensitive to vertical scale)  |
| Wave        | Draw time scale      | Shows amplitude scale in ms   |
| Wave        | Draw grid            | Shows ‘oscilloscope-like’ grid  |
| Wave        | Draw midline         | Shows a ‘zero-line’   |
| Wave        | Scroll display       | scrolls the visualization of the waveform in a large timescale  |
| Spectrum    | Draw amplitude scale | Shows amplitude scale of spectrum   |
| Spectrum    | Draw frequency scale | Shows frequency scale in Hz   |
| Spectrum    | Draw grid            | Shows ‘oscilloscope-like’ grid  |
| Spectrum    | Draw inactive        | Draws ‘active’ and ‘inactive’ values with different colors (only for styles ‘Bars’ and ‘Peaks’)   |
| Spectrum    | Display peak         | Shows numerical value of one or more spectral peaks   |
| Spectrum    | Style                | Different visualization styles. Just try it out...  |
| Spectrogram | Scroll display       | When reaching the right border, the spectrogram is scrolled. If not checked, the spectrogram is cleared and restarted at the left border. |
| Spectrogram | Draw frequency scale | Shows frequency scale in kHz  |
| Save...     | Save as              | Prompts for an inifile name to save actual settings to  |

The following additional values are read from the inifile:

| Section     | Field          | Description                                    | Value(s) |
|-------------|----------------|--|----------|
| General     | Left           | Left position on the screen in pixels          | integer  |
| General     | Top            | Top position on the screen in pixels           | integer  |
| General     | Right          | Right position on the screen in pixels         | integer  |
| General     | Bottom         | Bottom position on the screen in pixels        | integer  |
| General     | LevelHeight    | Height of the level visualization in pixels    | integer  |
| General     | WaveHeight     | Height of the waveform visualization in pixels | integer  |
| General     | SpectrumHeight | Height of the spectrum visualization in pixels | integer  |
| Level       | Hide           | Show or hide level visualization section       | 0 or 1   |
| Wave        | Hide           | Show or hide waveform visualization section    | 0 or 1   |
| Spectrum    | Hide           | Show or hide spectrum visualization section    | 0 or 1   |
| Spectrogram | Hide           | Show or hide spectrogram visualization section | 0 or 1   |

An example ‘vst\_visualize.m’ showing the features of the plugin is located in the ‘examples’ subdirectory of the SoundMexPro installation.





### 3.3 HtVSTEq: Overlapped add equalizer plugin

The plugin “HtVSTEq.dll” implements a two-channel equalizer with variable FFT-length and using overlapped add with zero padding and a window shift of  $\frac{1}{2}$  respectively.

The filter can be configured with a ‘filter-file’ (see below) by setting the program name to the filter-file name, e.g.

```
soundmexpro('vstprogramname', 'programname', 'filter.flt');
```

The filters are stored in windows inifiles containing two sections (see test.flt in the examples directory of SoundMexPro):

```
[Settings]
Log=0
FFTLen=512

[Filter]
100=1;0.001
501=0.001;0.9
3000=0.001;1
3001=1;0.001
```

The 'Settings' section contains general settings is optional:

| Parameter    | Description  |
|--------------|--|
| Log          | If set to '1' the filter values in the section 'Filter' are treated as dB fullscale, otherwise as linear factors.  |
| FFTLen       | FFT-Length. Must be a power of two between 64 and 32768  |
| InterpolMode | Directive, how to interpolate filter values between values specified in the 'Filter' section. Available modes are:<br><b>lin_lin</b> : interpolation on the linear frequency axis AND linear level (linear factors) axis<br><b>log_lin</b> : interpolation on the logarithmic frequency axis and the linear level (linear factors) axis<br><b>lin_dB</b> : interpolation on the linear frequency axis and the level axis in dB<br><b>log_dB</b> : interpolation on the logarithmic frequency axis and the level axis in dB<br><br>The default value (if not specified) is <b>lin_lin</b> .<br>Real and imaginary parts are interpolated independantly. |

The section 'Filter' contains the filter itself. It can contain an unlimited number of values of the form:



```
frequency=LeftValue;RightValue
```

If only one value is specified on the right it is applied for left and right channel the same way. The values may be either real or complex, e.g.:

1000=0.2;0.5

or

1000=0.2+0.4i;0.3-0.1i

#### Important notes:

- if one value at least is complex, the filter cannot be edited with the GUI filter editor described below!
- complex values are only allowed for linear filters.

From these values the complete filter is computed by interpolation according to the InterpolMode set in 'Settings' section (see above). Real and imaginary parts are interpolated independantly.

**ATTENTION:** values above 1 (or above 0 if Log=1) will amplify the signal and may result in digital overdrive.

The plugin has the following parameters that can be changed with the GUI editor (SoundMexPro command "vstedit") or directly with the commands "vstload" or "vstparam":

| Parameter | Description   |
|-----------|---|
| visible   | If visible is set to values > 0.5 the visualization/filter editing dialog is shown, otherwise it is hidden. |
| enabled   | If enabled is set to values > 0.5 filter is applied, otherwise the filter is skipped.                       |

Setting the 'visible' parameter to values > 0.5 will show the filter visualization and manipulation window. On this window the filter shapes themselves as well as input and output spectra of the current signal (if any) can be visualized.



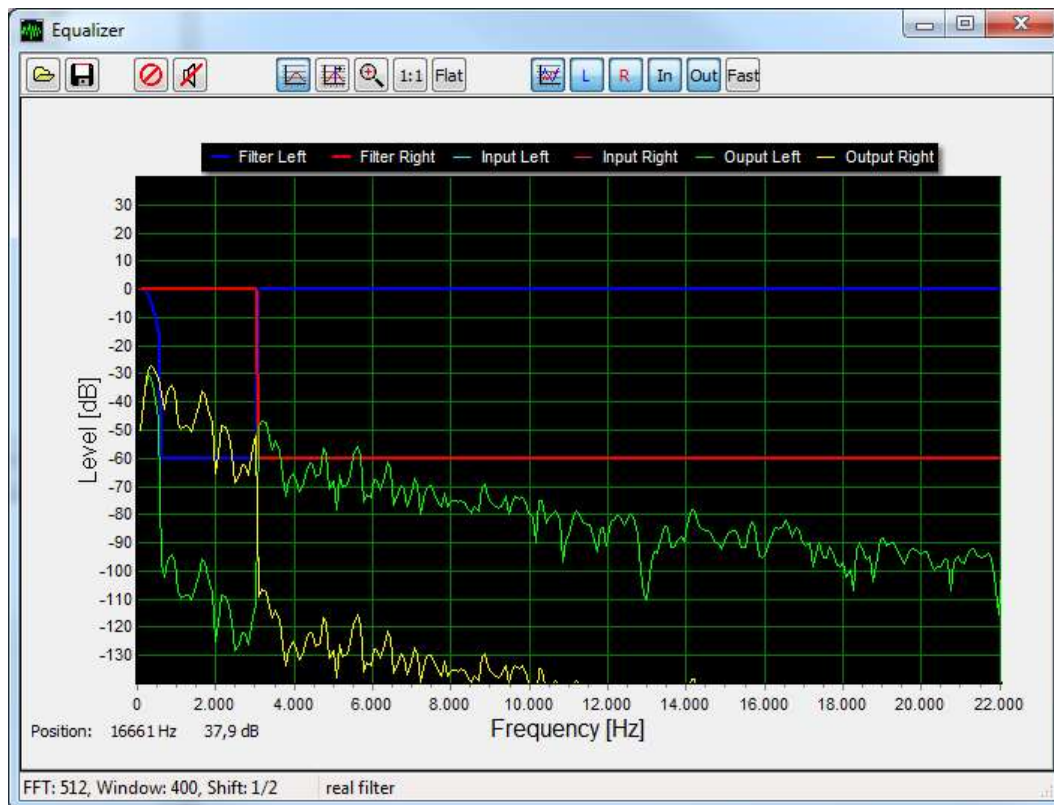















Figure 3

| Button  | Description  |
|---|--|
|  | Opens a file open dialog to load a filter file to the equalizer  |
|  | Saves actual filter to a filter file. When using the filter visualization and manipulation window for saving filters, frequency values will be written for every FFT-bin (depending on FFT-length and actual sampling frequency).          |
|  | Enters 'Filter-Drawing-Mode': when this button is pressed, you can simply 'draw' the desired filter. Keeping left mouse button pressed will draw left channels filter, keeping right mouse button pressed will draw right channels filter. |
|  | Enters 'Filter-Shifting-Mode': when this button is pressed, you can shift the filters up and down. Keeping left mouse button pressed will shift left channels filter, keeping right mouse button pressed will shift right channels filter. |
|  | Enters 'Zoom-Mode': when this button is pressed, you can zoom into the visualization by drawing a window with the mouse (left mouse button pressed) beginning at the top left corner. Pressing the right mouse button 'un-zooms'           |
|  | Un-zooms the visualization   |
|  | Flattens left and right filter.  |
|  | Toggles drawing of all realtime spectra  |

|   |   |
|---|---|
|  | Toggles drawing of realtime spectra of the left (or mono) channel |
|  | Toggles drawing of realtime spectra of the right channel          |
|  | Toggles drawing of the input spectra                              |
|  | Toggles drawing of the output spectra                             |
|  | Toggles fast/slow update of the realtime spectra                  |

An example 'vst\_equalizer.m' showing the features of the plugin is located in the 'examples' subdirectory of the SoundMexPro installation.



### 3.4 HtVSTEqualizer: Overlapped add equalizer plugin

**Note: this plugin is deprecated and replaced by HtVSTEq.**

The plugin “HtVSTEqualizer.dll” implements a two-channel equalizer with variable FFT-length and window length using overlapped add with zero padding (variable window length) and a window shift of  $\frac{1}{2}$ ,  $\frac{1}{4}$  or  $\frac{1}{8}$  respectively.

The filter can be configured with a ‘filter-file’ (see below) by setting the program name to the filter-file name, e.g.

```
soundmexpro('vstprogramname', 'programname', 'filter.flt');
```

The filters are stored in windows inifiles containing two sections (see test.flt in the examples directory of SoundMexPro):

```
[Settings]
Log=0
FFTLen=512
WindowLen=400
WindowShift=0.5

[Filter]
100=1;0.001
501=0.001;0.9
3000=0.001;1
3001=1;0.001
```

The 'Settings' section contains general settings is optional:

| Parameter   | Description   |
|-------------|---|
| Log         | If set to '1' the filter values in the section 'Filter' are treated as dB fullscale, otherwise as linear factors.                   |
| FFTLen      | FFT-Length. Must be a power of two between 64 and 32768   |
| WindowLen   | Length of window. Must be between FFTLen and FFTLen/2. Is rounded to even number. Padded zeros then will be (FFTLen - WindowLen)/2. |
| WindowShift | Shift of the window. Must be 0.5, 0.25 or 0.125 resulting in an overlap of the buffers of 0.5, 0.75 or 0.875.                       |

The section 'Filter' contains the filter itself. It can contain an unlimited number of values of the form:

```
frequency=LeftValue;RightValue
```



If only one value is specified on the right it is applied for left and right channel the same way. The values may be either real or complex, e.g.:

1000=0.2;0.5

or

1000=0.2+0.4i;0.3-0.1i

**Important notes:**

- if one value at least is complex, the filter cannot be edited with the GUI filter editor described below!
- complex values are only allowed for linear filters.

From these values the complete filter is computed by linear interpolation on the frequency axis and linear interpolation on the linear gain axis. Real and imaginary parts are interpolated independantly.

**ATTENTION:** values above 1 (or above 0 if Log=1) will amplify the signal and may result in digital overdrive.

The plugin has the following parameters that can be changed with the GUI editor (SoundMexPro command “vstedit”) or directly with the commands “vstload” or “vstparam”:

| Parameter | Description   |
|-----------|---|
| visible   | If visible is set to values > 0.5 the visualization/filter editing dialog is shown, otherwise it is hidden. |
| enabled   | If enabled is set to values > 0.5 filter is applied, otherwise the filter is skipped.                       |

Setting the ‘visible’ parameter to values > 0.5 will show the filter visualization and manipulation window. On this window the filter shapes themselves as well as input and output spectra of the current signal (if any) can be visualized.



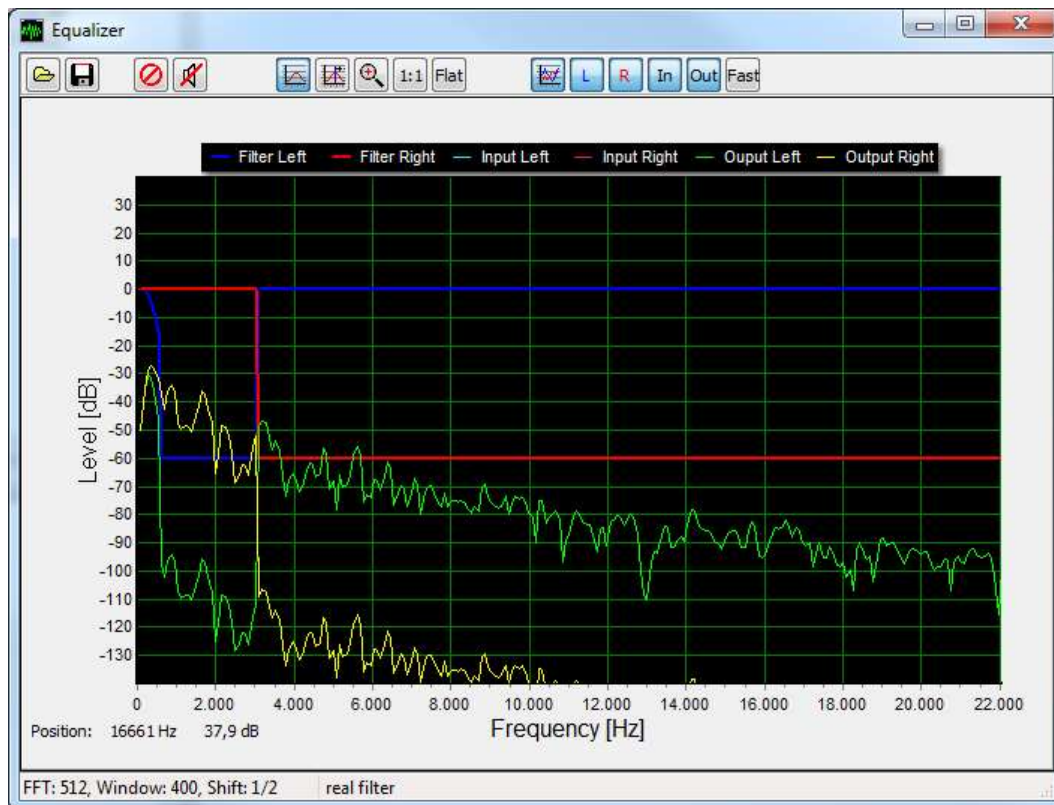















Figure 4

| Button  | Description  |
|---|--|
|  | Opens a file open dialog to load a filter file to the equalizer  |
|  | Saves actual filter to a filter file. When using the filter visualization and manipulation window for saving filters, frequency values will be written for every FFT-bin (depending on FFT-length and actual sampling frequency).          |
|  | Enters 'Filter-Drawing-Mode': when this button is pressed, you can simply 'draw' the desired filter. Keeping left mouse button pressed will draw left channels filter, keeping right mouse button pressed will draw right channels filter. |
|  | Enters 'Filter-Shifting-Mode': when this button is pressed, you can shift the filters up and down. Keeping left mouse button pressed will shift left channels filter, keeping right mouse button pressed will shift right channels filter. |
|  | Enters 'Zoom-Mode': when this button is pressed, you can zoom into the visualization by drawing a window with the mouse (left mouse button pressed) beginning at the top left corner. Pressing the right mouse button 'un-zooms'           |
|  | Un-zooms the visualization   |
|  | Flattens left and right filter.  |
|  | Toggles drawing of all realtime spectra  |

|   |   |
|---|---|
|  | Toggles drawing of realtime spectra of the left (or mono) channel |
|  | Toggles drawing of realtime spectra of the right channel          |
|  | Toggles drawing of the input spectra                              |
|  | Toggles drawing of the output spectra                             |
|  | Toggles fast/slow update of the realtime spectra                  |

An example 'vst\_equalizer.m' showing the features of the plugin is located in the 'examples' subdirectory of the SoundMexPro installation.





### 3.5 HtVSTHeteroDyning: Hetero-dyning plugin

The plugin “HtVSTHeteroDyning.dll” multiplies the audio data with a sine of configurable frequency on the fly. It supports two channels with independent frequencies.

The plugin has the following parameters that can be changed with the GUI editor (SoundMexPro command “vstedit”) or directly with the commands “vstload” or “vstparam”:

| Parameter                  | Description   |
|----------------------------|---|
| enabled                    | If enabled is set to values > 0.5 the data are multiplied with the corresponding sine signals. Otherwise the data are returned unchanged. |
| frequency_0<br>frequency_1 | hetero-dyning frequency for first and second channel in fractions of actual samplerate.   |

An example ‘vst\_hetero\_dyning.m’ showing the features of the plugin is located in the ‘examples’ subdirectory of the SoundMexPro installation.

### 3.6 HtVSTConv.dll: Fast convolution plugin

The plugin “HtVSTConv.dll” is a fast two-channel partitioned convolution plugin. The partition size is set to the actual ASIO buffersize.

An impulse response to be used for the convolution can be loaded from normalized 32bit wave files using the ‘vstprogramname’ command:

```
soundmexpro('vstprogramname', 'programname', '..\plugins\ir.wav' );
```

If a mono signal is loaded, both channels are convoluted with these data, otherwise the first channel is convoluted with the left the second with the right channel of the impulse response

**Note:** although the impulse response is loaded from a wave file the samplerate of the file is ignored! The impulse response is applied sample by sample to the audio data at the current playback samplerate.

**Important note:** the partitioned convolution consumes much processing time, that depends strongly on the buffer size. If you try to convolute long impulse responses with small ASIO buffer sizes you may get xruns up to a total system hang!

The plugin has the following parameters that can be changed with the GUI editor (SoundMexPro command “vstedit”) or directly with the commands “vstload” or “vstparam”:

| Parameter | Description  |
|-----------|--|
| enabled   | If enabled is set to values <= 0.5 the convolution is skipped.   |
| gain      | gain to be applied to to all audio channels. The gain value (between 0 and 1) is converted to a logarithmic gain between 0 and -50 dB as follows:<br>$\text{Applied\_Gain} = 50 * \text{gain} - 50 \text{ dB}$ |

An example ‘vst\_conv.m’ showing the features of the plugin is located in the ‘examples’ subdirectory of the SoundMexPro installation.



NOTE: a special version of this plugin with a variable block size is available at HoerTech. This version is much more powerful and allows the convolution with huge impulse responses even if you use very small ASIO buffers for ultra-low delay. Please contact Hörzentrum Oldenburg for pricing of this plugin.

