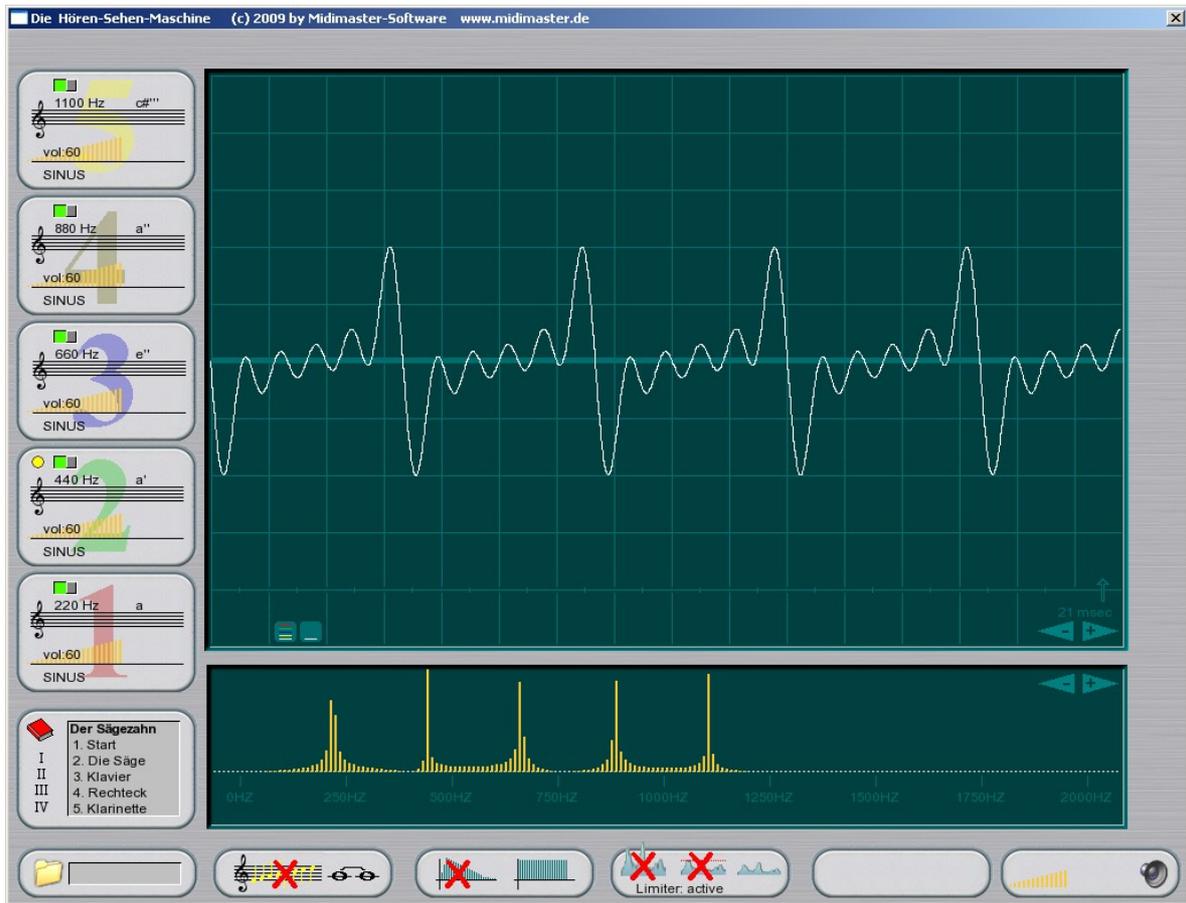


Manual

MIDIMASTER: The HEAR'N'SEE-MACHINE

Description of the User Interface



The Tone Generator

On the left hand you find 5 identical tone generators – the so called oscillators. The frequency and volume of each oscillator can be adjusted separately. You can hear and see the result of the 5 oscillators as sum signal. Each tone generator offers these adjustments:

On/Off-Button

(green/red) switches the tone generator active

Focus Indicator

(yellow) you can control the volume of the tone generator that possesses the focus with the <+> and the <-> keys, and its pitch with the arrow keys.

Note Staff for the Pitch Input

By moving the mouse with pressed left mouse button left to right the pitch of the tone generator is changed in half tone Steps. The fine tuning can only be done with the up/down arrow keys.

Volume Control

By moving the mouse with pressed left mouse button left to right the volume of the tone generator is changed. This can be done also with the <+>/<-> keys if the tone generator has the focus.

Wave Form Choise

With mouse clicking the wave form of the tone generator can be changed between sinus, square or sawtooth.

The Workshop Field

Below the tone generators is the field for the workshop presets. By pressing on a roman number you choose the workshop, by pressing the particular lines you load the presets for the different parts of the workshops. This adjustment should rather be done manually. But it helps when the attendant has not succeeded in adjusting it himself.

The corresponding entries are highlighted with "(POS:xxxxx)" in the following.

The Sample Display

The upper display shows the 5 individual oscillations corresponding to the colours of the tone generator numbering. The resulting sum wave is shown white. The zoom factor of the time axis can be adjusted with the arrow symbols or the <Q> and <W> keys from 1msec till 1000msec.

You can draw waves with the mouse too.

The Frequency Spectrum

The lower display shows the total oscillation and its resulting frequencies depending on their volumes. The zoom factor of the pitch range can be adjusted with the arrow symbols or the key from 2000 Hz till 16.000 Hz.

The Bottom Row

The Wave Example Field

Underneath the workshop field you can choose the 5 wave examples. With every mouse click the next wave is loaded. By activating one of the oscillators the example will be finished.

Scale Button

Here you select the output as single tone or scaled notes.

Envelope Button

Switches between continuous tone and fading tone (s.a. plucked instruments).

Limiter Button

Advice:

Although changes of the limiter's adjustment can lead to dramatical results, your equipment (computer, amplifier, speakers) is always safe because it is only a simulation.

The Limiter has three adjustments:

Active

This calculates a reasonable volume of the created signal in order to avoid distortion. It is the ideal adjustment for students, not realistic.

Clip

This limits the volume when overrunning the threshold. This mode simulates the clipping of the components and speakers, very realistic.

Off

Does not limit volume, so it simulates the behavior of digital components (overflow)

Manual Field

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Sum Field

Here you adjust the volume or mute the output. This adjustment has no effect on the simulation.

Working with the Hear'n'See Machine

You can create a complete signal in three different ways:

- A. Compound 5 sinus waves
- B. Drawing with the mouse
- C. Load an audio file

A. Compound 5 Sinus Waves

On the left hand there are 5 generators. Select a particular generator with the <1> - <5> keys and edit it.

You can switch it on/off with the <O> key. Inactive generators are displayed grey. You can hear an active generator immediately. Their signal is shown in the same colour as the corresponding numeration with the actual volume.

With the arrow keys left/right you can change the pitch of the selected generator chromatically (half tone steps). With the arrow keys up/down you change the fine tuning in Hertz steps. You see the changes in the sample window.

The program calculates a resulting signal depending on the particular active generators.

Caution: The total volume of the resulting signal as it comes out of the speakers is a standardized value. So the volume seems not to change no matter how many generators are working. In reality the signal gets louder. Equally the sum signal would be similar to the generator if only one generator is active. This is for a better usability of the Hear'n'See machine: no overdriving will happen. This aim can be switched off with the <L> key. In this case the sum of the particular volumes should not exceed the value of 100. Otherwise seldom effects would happen: the wave sum breaks.

B. Drawing of a Wave Form

First change the display of the sample with the <W> key until it shows 18 msec. Start drawing with the mouse at the very left hand of the 0 line of the sample display. All generators are switched off automatically. Now you draw the wave with moving up and down the mouse. The x movement

automatically happens. If you release the mouse button before entering the right limit of the sample display the action is aborted and you will not hear the wave. You can start again.

If the drawn wave reaches the right limit of the sample display the wave will be taken and you can hear it. Now you can release the mouse button.

C. Load a Prefabricated Wave Form

With the <X> key you can load one of the included wave forms into the sample display. All generators are switched of. You can remove the sample by activating one of the generators.

Options for the Music Lessons

Make Audible Visible

Tones and noises reach the ear as waves. Students can make this waves visible with the Hear'n'See machin. They mess around with the frequencies and watch and hear the changes of the wave.

Using the Workshop Presets

At the bottom left you find the field with the workshop presets (book symbol). So you can prepare the Hear'n'See machine fitting the respective workshop. Clicking on the Roman numbers selects the workshop; clicking on the individual lines adjusts it for a particular text passage as mentioned in this manual (POS:xxxxx).

The student should do these adjustments manually. But for some exceptional reasons you can establish a defined adjustment.

Workshop No. I: Pitch and Waves

Here the student works with only one generator. He changes the frequency and can hear and see the wave. He can fathom the limits of his hear sense and the speakers. He also can see the context of volume and amplitude.

As first activate the generator 1 (POS: Start). You hear and see a sine wave. You can change the pitch with the <left>/<right> keys in half steps. The student understands: As higher the pitch as more narrow the wave.

Change the volume with the <+>/<-> keys. The student understands: As louder the tone as higher the amplitudes.

Change the display to 1000 msec. (POS: 1000msec) now. The wave now appears like a wide band. By changing the envelope (<H> key) the temporal development of the tone changes (piano mode).

Reduce the display to 20 msec again. Activate a second generator. Immediately the look of the wave changes: it is no more a perfect sine wave (POS: Two Tones). You can see two notes in the frequency display now.

Let the students draw and test their own waves directly into the sample display with the mouse. The result can have more or less waves, is regular or chaotic, squares or oscillations.

Advice:

If you realise rhythmical clicking noises the reason is that the drawn wave is played over and over again from the beginning (similar to old vinyl long players that 'hang'). To avoid this effect, start and end drawing on the zero line.

Now load and watch the examples.

Workshop No. II: Tuning an Instrument

In this workshop the students get to know the effect of beating waves and how to use it to tune an instrument.

Two generators oscillate totally equal, the wave is perfect (POS: Start). Now fine (de-)tune generator 2 with the <up>/<down> keys. A vibration of the volume arises. As closer the tuning of the two generators as slower is the vibration (POS: detuned) until it disappears with total consonance.

You can watch this effect in the frequency spectrum display, but also when you compress the sample display to 300 msec. (POS: 3000msec).

Detune the generators and let the students fix it with closed eyes.

Workshop No. III: Square and Saw

Under special circumstances many sine waves result into another perfect wave form. Therefore all five generators are used.

Saw

The student adjusts the five generators to the following frequencies and volumes (POS: Start):

220Hz Volume 100 = Tone A
440Hz Volume 45 = Tone a
660Hz Volume 22 = Tone e'
880Hz Volume 9 = Tone a'
1100Hz Volume 4 = Tone c#''

The resulting signal becomes more and more a triangle (POS: Saw). The saw tone is almost perfect. That is how string instruments sound like violin, guitar or piano. Switch to scale and envelope (POS: Klavier).

The Series of Overtones

A sound is never only a sine wave but always a series of root note and overtones. The frequencies of the overtones are always a multiple of the root tone. By the reason a octave is exact doubling of the frequency, 400 Hz is an "A", 800 Hz is an "A" again, because $400 \text{ Hz} * 2 = 800 \text{ Hz}$.

A bit more complicate it is with 660 Hz. It is exactly between a and a' and is the quint e'. $440 \text{ Hz} : 660 \text{ Hz}$ gives a ratio of 2:3 for quints.

Because this e' (660 Hz) is in relation to the high a' (880 Hz) a fourth, you can find the ratio of a fourth by pure calculating. $660 \text{ Hz} : 880 \text{ Hz}$ gives 3:4. With 1320 Hz (octave = $2 \times 660 \text{ Hz}$) we would get an e''.

Now remains 1100 Hz. At 1320 Hz is the e''. 1100 Hz ist he middle between a' und e'', so it is the major third c#''. The ratio from a' to cis'' is $880 \text{ Hz} : 1100 \text{ Hz}$, yields 4:5. The interval from e'' to c#'' is a minor third. $1100 \text{ Hz} : 1320 \text{ Hz}$ has the ratio of 5:6.

Conclusion:

Octave 1:2

Quint 2:3

Fourth 3:4

Major Third 4:5

Minor Third 5:6

Overtone series: A - a' - e' - a'' - c#'' - e'' - g'' - a'''

The Square

Now switch off the 440 Hz and 880 Hz. The saw tone becomes a square tone (POS: square). This sound is typically for wood instruments. This group of

instruments misses all overtones with even multiples of the root tone. Only the frequencies 220 Hz, 660 Hz, 1100 Hz, 1540 Hz exist (1 x 220Hz, 3 x 220 Hz, 5 x 220 Hz ,7 x 220 Hz,....) (POS: Clarinet).

Workshop No. IV: Distortion

Whilst recording own music distortion happens often. The reason is that the recording volume is too high and overcharges the possibilities of the equipment. The results are ugly distortions.

This workshop shows how to provoke such distortions and feel its effect on sound and wave form.

Advice: Even though this workshop leads to dramatically results, you hardware (computer, amplifier and speakers) will not be overloaded because it is only a simulation. Switch the limiter to "Clip" with the <L> key.

Activate generator 1 with 440 Hz and volume 60. Then generator 2 with 440 volume 30. The sum signal gets louder and the amplitude higher but the sound does not change (POS: Start).

Now change the volume of generator 2 step by step. From volume 40 on you can hear little changes of the sound that you also can see as horizontal cutting the wave's peaks. Jump between volume 30 and 50.

Raise the volume up to 100. When you could see only the 440 Hz in the sample display before, now more and more disturbance frequencies appear at about 1200 Hz and 3200 Hz.

But oftentimes distortions can not be detected that easy. Here a practical example:

Generator 1 350 Hz Volume 60
Generator 2 450 Hz Volume 30
Generator 3 92 Hz Volume 22

You might hear a rasping sound, but the image of the wave seems correct. The problem is the very slow frequencies of the bass note by generator 3. It distorts the signal only casually. Change the display range of the sample with the <W> key until 21 msec. Now you can see a trimmed wave (POS: rasping). Sometimes the maximum will be exceeded and the wave breaks. With the <L> key you can switch between the original, the limited and the corrected signal.

The Distorted Guitar

Mostly a distortion is perceived as disturbance. But sometimes you want this effect. Now we build an e-guitar. We begin with muting the output <S>.

Change to the scale mode with the <T> key. Take care that the limiter <L> is off. Adjust the generators like this:

Generator 1 236 Hz Volume 90

Generator 2 237 Hz Volume 90

Generator 3 155 Hz Volume 90

Remove the muting with <S>. We have built an e-guitar (POS: E-Gitarre).

Keyboard Layout

Keys for the Generators

<1> <2> <3> <4> <5>

select the generator you want to edit.

<O>

switches the selected generator on or off.

<+> <->

changes the volume of the selected generator.

Arrow Keys Left or Right

changes the pitch of the selected generator in half tone steps.
(Coarse tuning)

Arrow Keys Up or Down

changes the pitch of the selected generator in Hertz steps. (Fine tuning)

Keys for the Total Control

<Q> <W>

trims/expands the visible range in the sample display. Very fine gradation from 0 – 1 msec till 0 - 1.000 msec.

expands the visual range of the frequency display between 0 - 2.000 Hz and 0 - 16.000 Hz in multiple steps.

<Z>

switches the display of the single generators on and off. So only the sum signal is shown.

<F1>

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<H>

switches the envelope between continuous tone (organ) and sloping tone (piano).

<T>

scale mode on/off.

<L>

The limiter controls the volume of the sum signal in order to avoid distortions. Three variants are available:

1. **Active:** The sum signal is corrected to eliminate distortions.
2. **Clip:** The sum signal is corrected in a way that when exceeds the maximum it is reduced to the maximum.
3. **Off:** The distortion produces errors.

<X>

loads a integrated example wave form into the sample display. The generators is switched off.

<S>

Muting (Silence)