

Audio Toolkit 2.0.9

Audio and MIDI functionality for GNU Octave.

John Donoghue

Copyright © 2019-2024 John Donoghue

Permission is granted to make and distribute verbatim copies of this manual provided the copyright notice and this permission notice are preserved on all copies.

Permission is granted to copy and distribute modified versions of this manual under the conditions for verbatim copying, provided that the entire resulting derived work is distributed under the terms of a permission notice identical to this one.

Permission is granted to copy and distribute translations of this manual into another language, under the same conditions as for modified versions.

Distribution

The GNU Octave Audio package is *free* software. Free software is a matter of the users' freedom to run, copy, distribute, study, change and improve the software. This means that everyone is free to use it and free to redistribute it on certain conditions. The GNU Octave Audio package is not, however, in the public domain. It is copyrighted and there are restrictions on its distribution, but the restrictions are designed to ensure that others will have the same freedom to use and redistribute Octave that you have. The precise conditions can be found in the GNU General Public License that comes with the GNU Octave Audio package and that also appears in [Appendix A \[Copying\]](#), page 19.

To download a copy of the GNU Octave Audio package, please visit <https://gnu-octave.github.io/octave-audio/index>.

Table of Contents

1	Installing and loading	1
1.1	Windows install	1
1.2	Online Direct install	1
1.3	Off-line install	1
1.4	Loading	1
2	Basic Usage Overview	2
2.1	Conversion Functionality	2
2.2	Waveform Generation	2
2.3	MIDI Functionality	2
3	Function Reference	4
3.1	MIDI Device Interface	4
3.1.1	@octave_midi/hasdata	4
3.1.2	mididevice	4
3.1.3	mididevinfo	5
3.1.4	midiflush	6
3.1.5	midimsg	6
3.1.6	midireceive	8
3.1.7	midisend	9
3.2	MIDI Controller Interface	9
3.2.1	midicallback	9
3.2.2	midicontrols	10
3.2.3	midiid	10
3.2.4	midiread	11
3.2.5	midisync	11
3.3	MIDI File I/O	11
3.3.1	ismidfile	12
3.3.2	midifileinfo	12
3.3.3	midifileread	12
3.3.4	midifilewrite	13
3.4	Enumerations	13
3.4.1	midimsgtype	13
3.5	Waveform Generation	14
3.5.1	audioOscillator	14
3.6	Domain Conversion	15
3.6.1	bark2hz	15
3.6.2	erb2hz	15
3.6.3	hz2bark	16
3.6.4	hz2erb	16
3.6.5	hz2mel	17
3.6.6	mel2hz	17
3.6.7	phon2sone	17
3.6.8	sone2phon	18
Appendix A	GNU General Public License	19

Index	29
--------------------	-----------

1 Installing and loading

The Audio toolkit must be installed and then loaded to be used.

It can be installed in GNU Octave directly from octave-forge, or can be installed in an off-line mode via a downloaded tarball.

The toolkit has a dependency on the RTMIDI library (<https://github.com/thestk/rtmidi>), so it must be installed in order to successfully install the toolkit.

For Fedora: `yum install rtmidi-devel`

For Ubuntu: `apt install librtmidi-dev`

The toolkit must be then be loaded once per each GNU Octave session in order to use its functionality.

1.1 Windows install

If running in Windows, the package may already be installed, to check run:

```
pkg list audio
```

Otherwise it can be installed by installing the requirements and then using the online or offline install method.

1.2 Online Direct install

With an internet connection available, the Audio package can be installed from octave-forge using the following command within GNU Octave:

```
pkg install -forge audio
```

The latest released version of the toolkit will be downloaded and installed.

1.3 Off-line install

With the Audio toolkit package already downloaded, and in the current directory when running GNU Octave, the package can be installed using the following command within GNU Octave:

```
pkg install audio-2.0.9.tar.gz
```

1.4 Loading

Regardless of the method of installing the Audio toolkit, in order to use its functions, the toolkit must be loaded using the `pkg load` command:

```
pkg load audio
```

The toolkit must be loaded on each GNU Octave session.

2 Basic Usage Overview

The Audio package must be loaded each time a GNU Octave session is started:

```
pkg load audio
```

An overview of the package can be displayed by running `help audio`

Help for each function can be displayed by `help thefunctionname`

ie:

```
help mididevice
```

2.1 Conversion Functionality

The following functions are available to convert between audio domains:

`hz2erb`, `erb2hz`

Conversion between hz and equivalent rectangular bandwidths (ERP) frequency scales

`hz2mel`, `mel2hz`

Conversion between hz and equivalent mel frequency scales

`hz2bark`, `bark2hz`

Conversion between hz and equivalent bark frequency scales

`phon2sone`, `sone2phone`

Conversion between sone and phon loudness scales

2.2 Waveform Generation

The `audioOscillator` function provides a method of creating a waveform generator for sine, square and sawtooth waveforms.

```
% create a sawtooth audio generator
osc = audioOscillator("sawtooth");
% get a frame of data
data = osc();
% plot the data
plot(data);
```

2.3 MIDI Functionality

The Audio toolkit provides 3 main types of MIDI functionality:

Device functions

These are functions that directly allow opening, sending and receiving MIDI messages.

Controller functions

Functions that provide a layer on top of the device functions for using MIDI controls.

File functions

Basic functions that allow read and write of MIDI files.

To read and write to a MIDI device, a MIDI device object must be created, using the name or id of a known MIDI device as provided by the `mididevinfo` function.

MIDI devices can then be read using the `midisend` and `midireceive` functions that use `midimsg` type to encapsulate the MIDI data.

```
% list the midi devices
```

```
devs = mididevinfo

% open a midi device, specifying the first input and output MIDI device
dev = mididevice("input", devs.input{1}.ID, "output", devs.output{1}.ID)

% receive data and echo it through the output port
while true
    msg = midireceive(dev, 1);
    if !isempty(msg)
        midisend(msg);
    endif
endwhile
```


3 Function Reference

The functions currently available in the Audio toolkit are described below:

3.1 MIDI Device Interface

3.1.1 @octave_midi/hasdata

tf = `hasdata` (*dev*)

Return whether there is data available to read

Inputs

dev - a octave midi device opened using `mididevice`.

Outputs

tf - true if device has data available to read

See also: `mididevice`.

3.1.2 mididevice

dev = `mididevice` (*mididev*)

dev = `mididevice` (*mididir*, *mididev*)

dev = `mididevice` ("input", *midiindev*, "output", *midioutdev*)

Create a midi device using the input parameters.

When a single device name or id is provided, attempt to create the midi device using the same name for both input and output.

Otherwise, use the name or device id for the given input or output direction.

Inputs

mididev - name or id of device to load.

mididir - midi direction of "input" or "output"

midiindev - midi input name or id

midioutdev - midi output name or id

Outputs

dev - octave_midi class for opened device

Properties

Input - Input device name (read only).

Output - Output device name (read only).

InputID - Input device id (read only).

OutputID - Output device id (read only).

Examples

Open midi device with ID of 0.

```
> dev = mididevice(0);
```

```

mididevice connected to
  input: "SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0" (1)
  output: "SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0" (0)

```

Open a named midi device:

```
> dev = mididevice("SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0");
```

```

mididevice connected to
  input: "SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0" (1)
  output: "SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0" (0)

```

See also: `mididevinfo`.

3.1.3 `mididevinfo`

```
devlist = mididevinfo ()
mididevinfo ()
```

Retrieve the midi devices detected within the system.

The list will be stored with variable *devlist* as either a input or output device. If no output variable is provided, the devices will be displayed.

Inputs

None

Outputs

devlist - a structure containing the midi device information

Examples

Display the known devices of the system.

```
> mididevinfo
```

```

MIDI devices available
ID Direction Interface  Name
0 output  Alsa      Midi Through:Midi Through Port-0 14:0
1 output  Alsa      Ensoniq AudioPCI:ES1371 16:0
2 output  Alsa      SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0
3 input   Alsa      Midi Through:Midi Through Port-0 14:0
4 input   Alsa      Ensoniq AudioPCI:ES1371 16:0
5 input   Alsa      SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0

```

Assign variable *mididevices* with the values from the known devices

```
> mididevices = mididevinfo
```

```

mididevices =
  scalar structure containing the fields:
    input =
    {
      [1,1] =
        scalar structure containing the fields:
          Name = SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0
          Interface = Alsa
          ID = 0
    }

```

```

output =
{
    [1,1] =
        scalar structure containing the fields:
            Name = SparkFun Pro Micro:SparkFun Pro Micro MIDI 1 20:0
            Interface = Alsa
            ID = 1
}

```

See also: `mididevice`.

3.1.4 `midiflush`

`midiflush (dev)`

Flush the receive buffers on a midi device

Inputs

dev - midi device opened using `mididevice`

Outputs

None

Examples

Flush a midi device

```
midiflush(dev);
```

See also: `mididevice`, `midireceive`.

3.1.5 `midimsg`

```

msg = midimsg (0)
msg = midimsg (type ....)
msg = midimsg ("note", channel, note, velocity, duration, timestamp)
msg = midimsg ("noteon", channel, note, velocity, timestamp)
msg = midimsg ("noteoff", channel, note, velocity, timestamp)
msg = midimsg ("programchange", channel, prog, timestamp)
msg = midimsg ("controlchange", channel, ccnum, ccval, timestamp)
msg = midimsg ("polykeypressure", channel, note, keypressure,
    timestamp)
msg = midimsg ("channelpressure", channel, chanpressure, timestamp)
msg = midimsg ("localcontrol", channel, localcontrol, timestamp)
msg = midimsg ("pitchbend", channel, pitchchange, timestamp)
msg = midimsg ("polyon", channel, timestamp)
msg = midimsg ("monoon", channel, monochannels, timestamp)
msg = midimsg ("omnion", channel, timestamp)
msg = midimsg ("omnioff", channel, timestamp)
msg = midimsg ("allsoundoff", channel, timestamp)
msg = midimsg ("allnotesoff", channel, timestamp)
msg = midimsg ("resetallcontrollers", channel, timestamp)
msg = midimsg ("start", timestamp)
msg = midimsg ("stop", timestamp)
msg = midimsg ("continue", timestamp)

```

```

msg = midimsg ("systemreset", timestamp)
msg = midimsg ("activesensing", timestamp)
msg = midimsg ("timingclock", timestamp)
msg = midimsg ("systemexclusive", timestamp)
msg = midimsg ("systemexclusive", bytes, timestamp)
msg = midimsg ("eox", timestamp)
msg = midimsg ("data", bytes, timestamp)
msg = midimsg ("songselect", song, timestamp)
msg = midimsg ("songpositionpointer", songposition, timestamp)
msg = midimsg ("tunerequest", timestamp)
msg = midimsg ("miditimecodequarterframe", timeseq, timevalue,
               timestamp)

```

Create a midimsg object

If the input parameter is 0, create an empty midi message object. Otherwise the first variable is the type of message to create, followed by the additional parameters for the message.

For each message type, the timestamp value is optional.

Inputs

type - string message type or a midimsgtype.

timestamp - optional seconds time stamp for the event

channel - the channel to use for the message (1..16)

note - the value of the note to play/stop

velocity - the velocity value for a note on/off, with 0 stopping a note from sounding.

duration - seconds between starting and stopping a note when created a 'note' message.

prog - program number when doing a program change message.

ccnum - control change control number.

ccval - control change control value.

keypressure - key pressure value when creating a key pressure message.

chanpressure - channel pressure value when creating a channelpressure message.

pitchchange - pitch change value when creating a pitch bend message.

localcontrol - boolean value when creating a localcontrol message.

monochannels - channels specified for a mono on message.

bytes - array of data in range of 0 to 127 specified as part of a data message or system exclusive message.

song - song selection number for a song selection message.

songposition - song position value for a song position message.

timeseq - timecode sequence number for a miditimecodequarterframe message.

timevalue - timecode value number for a miditimecodequarterframe message.

Outputs

msg - a midimsg object containing the midi data of the message

Properties

timestamp - timestamp of the message, or an array of timestamps if the message is a compound message.

msgbytes - the raw message bytes that make up the MIDI message.

nummsgbytes - the number of message bytes that make up the MIDI message.

type - string or midimsgtype that represents the message type.

channel - the channel number for message.

note - the note value for message (Only valid for noteon/off and polykeypressure).

velocity - the velocity value for message (Only valid for noteon/off).
keypressure - the keypressure value for message (Only valid for polykeypressure).
channelpressure - the chanpressure value for message (Only valid for channelpressure).
localcontrol - the localcontrol value for message (Only valid for localcontrol messages).
monochannels - channels specified for a mono on message.
program - program number specified for a program change message.
ccnumber - control change number specified for a control change message.
ccvalue - control change value specified for a control change message.
song - song number for a song selection message.
songposition - song position value for a song position message.
pitchchange - pitch change value for a pitch bend message.
timecodesequences - timecode sequence number for a miditimecodequarterframe message.
timecodevalue - timecode value number for a miditimecodequarterframe message.

Examples

Create a note on/off pair with a duration of 1.5 seconds

```
msg = midimsg('note', 1, 60, 100, 1.5)
```

Create a separate note on/off pair with a time between them of 1.5 seconds

```
msg = [midimsg('noteon', 1, 60, 100, 0), midimsg('noteoff', 1, 60, 0, 1.5)]
```

Create a system reset message

```
msg = midimsg('systemreset')
```

See also: midifileread, midisend, midireceive, midimsgtype.

3.1.6 midireceive

```
midimsg = midireceive (dev)
```

```
midimsg = midireceive (dev, maxmsg)
```

Attempt to receive midi messages from a midi device.

Inputs

dev - a octave midi device opened using mididevice.

maxmsg - Maximum number of messages to retrieve. If not specified, the function will attempt to get all pending.

Outputs

midimsg - a midimsg containing the messages retrieved from the device.

If no messages are available, *midimsg* will be empty.

Examples

Open device 0, and poll and display read messages

```
dev = mididevice(0);
while true
    mx = midireceive(dev);
    if isempty(mx)
        % display message
        mx
    endif
endwhile
```

See also: mididevice, midisend.

3.1.7 midisend

```
midisend (dev, msg)
midisend (dev, ...)
```

Send a midimsg to a midi device

Inputs

dev - midi device opened using mididevice

msg - a midi message class with messages to send to the midi device

If the msg isn't a midimsg class, the input data is expected to be in same format as the inputs to a midimsg object.

Outputs

None

Examples

Send a note on/off command to a opened midi device *dev*

```
midisend(dev, midimsg("note", 1, 60, 100, 2.0));
```

See also: midimsg, mididevice, midireceive.

3.2 MIDI Controller Interface

3.2.1 midicallback

```
oldhandle = midicallback (midicontrolsObj, functionHandle)
oldhandle = midicallback (midicontrolsObj, [])
currhandle = midicallback (midicontrolsObj)
```

Get, set or clear the midicontrol object callback.

Inputs

midicontrolObj - control object created using midicontrols.

functionHandle - function handle to set for call back. If it is [], the callback function will be cleared.

NOTE: currently anonymous functions will not work.

NOTE: callbacks should be cleared before losing all references to the midicontrols object.

Outputs

oldhandle The previously set midicallback function handle when setting a new callback.

currhandle The current set midicallback function handle.

Examples

Set a callback on a midicontrols object

```
ctrl = midicontrols(2001)
function dispCallback(ctrl),disp(midiread(ctrl)),endfunction;
midicallback(ctrl, @dispCallback);
```

Clear the callback on a midicontrols object

```
ctrl = midicontrols(2001)
midicallback(ctrl, []);
```

Get the current callback on a midicontrols object

```
ctrl = midicontrols(2001)
cb = midicallback(ctrl);
```

See also: midicontrols, midisync, midiread.

3.2.2 midicontrols

```
obj = midicontrols ()
obj = midicontrols (ctrlid)
obj = midicontrols (ctrlid, initialvalues)
obj = midicontrols (_, propertyname, propertyvalue)
```

Create a midi controls object

Inputs

ctrlid - single control id or array of control ids to monitor, or [] to use any controller.

initialvalues - initial values to use for controls. It should be the same size as *ctrlid*

propertyname, propertyvalue - properties to set on the controller. If a device is not specified the value from `getpref("midi", "DefaultDevice", 0)` will be used.

Known properties are:

mididevice

name of the mididevice to monitor.

outputmode

the scaling mode for values: 'rawmidi' will return values between 0 .. 127, 'normalized' will use values between 0 .. 1.

Outputs

obj - returns a midicontrols object

Examples

Create a midicontrols object monitoring control id 2001 on the default midi device

```
ctrl = midicontrols(2001)
```

Create a midicontrols object monitoring control id 2001 on a a non default device

```
ctrl = midicontrols(2001, 'mididevice', 1)
```

See also: midiread, midisync.

3.2.3 midiid

```
[ctrlid, dev] = midiid ()
```

Scan for control messages from midi devices to get the id of the device

Function will display a prompt for the user to move the midi control and return when a control messages is detected or ctrl-C is pressed.

Inputs

None

Outputs

ctrlid - control id made from the controller channel * 1000 + controller number.

dev = name of the midi device the controller was detected on.

Examples

Monitor midi devices for first moving controller

```
[ctrlid, devname] = midiid()
```

See also: mididevinfo, midicontrols.

3.2.4 midiread

```
val = midiread (midicontrolsObj)
```

Read current values of midi controls

Inputs

midicontrolObj - control object created using midicontrols

Outputs

val single value or array of current values from the midi device.

Examples

Read current value of midicontrols with a ctrlid 2001 on the default midi device.

```
ctrl = midicontrols(2001)
val = midiread(ctrl);
```

Read current value of midicontrols with a ctrlid 2001 on a non default midi device.

```
ctrl = midicontrols(2001, 'mididevice', 1)
val = midiread(ctrl);
```

See also: midicontrols, midisync.

3.2.5 midisync

```
midisync (midicontrolsObj)
```

```
midisync (midicontrolsObj, ctrlvalues)
```

Send the values of control object to the control, using *ctrlvalues* values if specified instead

Inputs

midicontrolObj - control object created using midicontrols

ctrlvalues - values to send to the controls instead of initial values

Outputs

None

Examples

Send sync command to a midicontrols with a ctrlid 2001 to set a value of 1

```
ctrl = midicontrols(2001)
midisync(ctrl, 1);
```

See also: midicontrols.

3.3 MIDI File I/O

3.3.1 ismidifile

`ismidi = ismidifile (filename)`

Check if *filename* is a midi file.

The function only checks whether it is an existing file and the file starts with a valid 'MThd' header.

Non existing files, or files that do not meet the header criteria will return false.

Inputs

filename - filename of file to check.

Outputs

ismidi - true if it is a midi file, false otherwise

See also: midifileread, midifilewrite.

3.3.2 midifileinfo

`info = midifileinfo (filename)`

Read MIDI file and display information about the tracks and data

Inputs

filename - filename of file to open.

Outputs

info - structure of the midi file data with the following fields:

<i>filename</i>	the name of the file
<i>header</i>	The header block information
<i>track</i>	An array of tracks read from the file
<i>other</i>	An array of non-track midi blocks read from the file

See also: midifileread.

3.3.3 midifileread

`msg = midifileread (filename, [propertyname, propertyvalue ...])`

Read MIDI file into a midimsg

Inputs

filename - filename of file to open.

propertyname, *propertyvalue* - optional propertyname/value pairs.

Known property values are:

includemetaevents

A True/False value to include MetaEvents in the out message list.

Outputs

msg - a midimsg struct containing the messages read from the file

See also: midifileinfo, midimsg.

3.3.4 midifilewrite

`midifilewrite (filename, msgs)`

`midifilewrite (filename, msgs, optionname, optionvalue)`

Write a midifile

Inputs

filename - filename of file to open.

msg - a midimsg struct or a cell array of midimsg containing data to write to file

optionname, optionvalue - option value/name pairs

Known options are:

format MIDI file format number. (0 (default), 1, 2)

Where *format* is 0, if a cell array is passed to `midifilewrite`, the midimsg values will be concatenated together before saving.

Where *format* is not 0, the cell array is treated as tracks of midimsg.

Outputs

None

See also: midifileread, midimsg.

3.4 Enumerations

3.4.1 midimsgtype

`midimsgtype`

A midimsg type enumeration for values of the midimsg type.

Enumeration values are:

Data	Stop	SongPositionPointer
PolyOn	PolyKeyPressure	NoteOff
EOX	ActiveSensing	SongSelect
MonoOn	ChannelPressure	ControlChange
TimingClock	SystemReset	AllSoundOff
OmniOn	PitchBend	ProgramChange
Start	TuneRequest	ResetAllControllers
OmniOff	Undefined	SystemExclusive
Continue	MIDITimeCodeQuarterFrame	LocalControl
AllNotesOff	MetaEvent	

The enumeration value can be used instead of a string in midimsg creation.

Examples

Use both a string and a `midimsgtype` for the type parameter of a midimsg.

```
# both statements are equivalent
```

```
msg = midimsg('NoteOn', 1, 60, 100);
msg = midimsg(midimsgtype.NoteOn, 1, 60, 100);
```

See also: `midimsg`.

3.5 Waveform Generation

3.5.1 audioOscillator

audioOscillator

Generate sine, sawtooth and square waveforms

Methods

```
obj = audioOscillator ()
obj = audioOscillator (signalTypeValue)
obj = audioOscillator (signalTypeValue, frequencyValue)
obj = audioOscillator (__ , propertyname, propertyvalue)
```

Create a audioOscillator object

Inputs

signalTypeValue - signal type of "sine" (default), "square", "sawtooth".

frequencyValue - hz frequency value of waveform (default 100).

propertyname, propertyvalue - properties to set on the object.

Known properties are:

SignalType

signal type of "sine" (default), "square" or "sawtooth". (readonly)

Frequency frequency of the waveform (default 100)

Amplitude

amplitude of the signal (default 1)

SampleRate

sample rate of the signal (default 44100)

PhaseOffset

phase offset of signal 0 (default) - 1 (readonly)

DutyCycle

dutycycle of the signal 0 - 1 (default 0.5) when signal is a square wave.

SamplePerFrame

Samples per frame as returned from () (default 512)

MaxSamplePerFrame

Max samples per frame (default 192000)

DCOffset DC Offset of signal (default 0)

Width Width of sawtooth (default 1)

OutputDataType

Output data type of 'single' or 'double' (default 'double')

Outputs

obj - signalGenerator object

Examples

Create a 100 hz sine wave and plot first 512 samples

```
sinosc = audioOscillator
data = sinosc();
plot(data);
```

Create a 2 hz square wave with duty cycle of 0.5

```
sqosc = audioOscillator('square', 'DutyCycle', 0.50, 'Frequency', 2);
```

`data = obj()`

Generate a frame of waveform data from the generator function

Inputs

obj - signalGenerator object

Outputs

data - waveform data

`release(obj)`

Release resources of generator

Inputs

obj - signalGenerator object

Outputs

None

3.6 Domain Conversion

3.6.1 bark2hz

`hz = bark2hz (bark)`

Convert equivalent Bark Frequency to Hz.

Inputs

bark - input frequency in bark.

Outputs

hz - Output frequency in Hz.

References

Trautmüller, Hartmut. *Analytical Expressions for the Tonotopic Sensory Scale. Journal of the Acoustical Society of America. Vol. 88, Issue 1, 1990*

See also: hz2bark.

3.6.2 erb2hz

`hz = erb2hz (erb)`

Convert equivalent rectangular bandwidth (ERB) to Hz.

Inputs

erb - input frequency in erb.

Outputs

hz - Output frequency in Hz.

References

Glasberg and Moore. *Derivation of Auditory Filter Shapes from Notched-Noise Data. Hearing Research. Vol. 47, 1990*

See also: `hz2erb`.

3.6.3 `hz2bark`

`bark = hz2bark (hz)`

Convert *hz* to equivalent bark frequency

Inputs

hz - input frequency in Hz.

Outputs

bark - Output frequency as a bark value

Examples

Convert 4000 Hz to erb

```
erb = hz2erb(4000)
```

References

Traunmüller, Hartmut. *Analytical Expressions for the Tonotopic Sensory Scale. Journal of the Acoustical Society of America. Vol. 88, Issue 1, 1990*

See also: `bark2hz`.

3.6.4 `hz2erb`

`erb = hz2erb (hz)`

Convert *hz* to equivalent rectangular bandwidth (ERB)

Inputs

hz - input frequency in Hz.

Outputs

erb - Output frequency as a erb value

Examples

Convert 4000 Hz to erb

```
erb = hz2erb(4000)
```

Convert a range of Hz to erb

```
erb = hz2erb(4000:100:5000)
```

References

Glasberg and Moore. *Derivation of Auditory Filter Shapes from Notched-Noise Data. Hearing Research. Vol. 47, 1990*

See also: `erb2hz`.

3.6.5 hz2mel

`mel = hz2mel (hz)`

Convert hz to equivalent mel frequency.

Inputs

`hz` - input frequency in Hz.

Outputs

`mel` - Output frequency as a mel value

Examples

Convert 4000 Hz to mel

```
mel = hz2mel(4000)
```

Convert a range of Hz to mel

```
mel = hz2erb(4000:100:5000)
```

References

O'Shaghnessy, Douglas. *Speech Communication: Human and Machine*. Reading, MA: Addison-Wesley Publishing Company, 1987

See also: mel2hz.

3.6.6 mel2hz

`hz = mel2hz (mel)`

Convert equivalent mel frequency to Hz.

Inputs

`mel` - input frequency in mel.

Outputs

`hz` - Output frequency in Hz.

References

O'Shaghnessy, Douglas. *Speech Communication: Human and Machine*. Reading, MA: Addison-Wesley Publishing Company, 1987

See also: hz2mel.

3.6.7 phon2sone

`sone = phon2sone (phon)`

`sone = phon2sone (phon, standard)`

Convert from phon to sone

Inputs

`phon` - Loudness level in phon

`standard` - Standard to use in conversion. Options are 'ISO 532-1' or 'ISO 532-2'.

'ISO 532-1' is used if no standard is provided.

Outputs

`sone` - Loudness level in sone

Examples

Convert 100 phon to sone

```
sone = phon2sone(100)
```

References

International Organization for Standardization., *ISO 532-1 Acoustics – Methods for calculating loudness – Part 1: Zwicker method.*

International Organization for Standardization., *ISO 532-2 Acoustics – Methods for calculating loudness – Part 2: Moore-Glasberg method.*

<https://sengpielaudio.com/calculatorSonephon.htm>

See also: sone2phon.

3.6.8 sone2phon

```
phon = sone2phon (sone)
```

```
phon = sone2phon (sone, standard)
```

Convert from sone to phon.

Inputs

sone - Loudness level in sone

standard - Standard to use in conversion. Options are 'ISO 532-1' or 'ISO 532-2'.

'ISO 532-1' is used if no standard is provided.

Outputs

sone - Loudness level in sone

Examples

Convert 100 sone to phon

```
phon = sone2phon(100)
```

References

International Organization for Standardization., *ISO 532-1 Acoustics – Methods for calculating loudness – Part 1: Zwicker method.*

International Organization for Standardization., *ISO 532-2 Acoustics – Methods for calculating loudness – Part 2: Moore-Glasberg method.*

<https://sengpielaudio.com/calculatorSonephon.htm>

See also: sone2phon.

Appendix A GNU General Public License

Version 3, 29 June 2007

Copyright © 2007 Free Software Foundation, Inc. <http://fsf.org/>

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

Preamble

The GNU General Public License is a free, copyleft license for software and other kinds of works. The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program—to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS

0. Definitions.

“This License” refers to version 3 of the GNU General Public License.

“Copyright” also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

“The Program” refers to any copyrightable work licensed under this License. Each licensee is addressed as “you”. “Licensees” and “recipients” may be individuals or organizations.

To “modify” a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a “modified version” of the earlier work or a work “based on” the earlier work.

A “covered work” means either the unmodified Program or a work based on the Program.

To “propagate” a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To “convey” a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays “Appropriate Legal Notices” to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

1. Source Code.

The “source code” for a work means the preferred form of the work for making modifications to it. “Object code” means any non-source form of a work.

A “Standard Interface” means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The “System Libraries” of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A “Major Component”, in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The “Corresponding Source” for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work’s System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

2. Basic Permissions.

All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.

You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.

Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.

3. Protecting Users' Legal Rights From Anti-Circumvention Law.

No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.

When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures.

4. Conveying Verbatim Copies.

You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.

You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.

5. Conveying Modified Source Versions.

You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

- a. The work must carry prominent notices stating that you modified it, and giving a relevant date.
- b. The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to "keep intact all notices".
- c. You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable

section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.

- d. If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an “aggregate” if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation’s users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.

6. Conveying Non-Source Forms.

You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

- a. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.
- b. Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.
- c. Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.
- d. Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.
- e. Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.

A “User Product” is either (1) a “consumer product”, which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything

designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, “normally used” refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.

“Installation Information” for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.

If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).

The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.

Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

7. Additional Terms.

“Additional permissions” are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.

When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

- a. Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or
- b. Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or

- c. Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or
- d. Limiting the use for publicity purposes of names of licensors or authors of the material; or
- e. Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or
- f. Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered “further restrictions” within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.

Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way.

8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10.

9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so.

10. Automatic Licensing of Downstream Recipients.

Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.

An “entity transaction” is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party’s predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.

You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.

11. Patents.

A “contributor” is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor’s “contributor version”.

A contributor’s “essential patent claims” are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, “control” includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.

Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor’s essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.

In the following three paragraphs, a “patent license” is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To “grant” such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.

If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. “Knowingly relying” means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient’s use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.

If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.

A patent license is “discriminatory” if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.

Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law.

12. No Surrender of Others’ Freedom.

If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.

13. Use with the GNU Affero General Public License.

Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such.

14. Revised Versions of this License.

The Free Software Foundation may publish revised and/or new versions of the GNU General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.

If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy’s public statement of acceptance of a version permanently authorizes you to choose that version for the Program.

Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

15. Disclaimer of Warranty.

THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRIT-

ING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM “AS IS” WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. Limitation of Liability.

IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

17. Interpretation of Sections 15 and 16.

If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively state the exclusion of warranty; and each file should have at least the “copyright” line and a pointer to where the full notice is found.

one line to give the program's name and a brief idea of what it does.
Copyright (C) year name of author

This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program. If not, see <http://www.gnu.org/licenses/>.

Also add information on how to contact you by electronic and paper mail.

If the program does terminal interaction, make it output a short notice like this when it starts in an interactive mode:

program Copyright (C) year name of author


```
This program comes with ABSOLUTELY NO WARRANTY; for details type 'show w'.  
This is free software, and you are welcome to redistribute it  
under certain conditions; type 'show c' for details.
```

The hypothetical commands ‘show w’ and ‘show c’ should show the appropriate parts of the General Public License. Of course, your program’s commands might be different; for a GUI interface, you would use an “about box”.

You should also get your employer (if you work as a programmer) or school, if any, to sign a “copyright disclaimer” for the program, if necessary. For more information on this, and how to apply and follow the GNU GPL, see <http://www.gnu.org/licenses/>.

The GNU General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License. But first, please read <http://www.gnu.org/philosophy/why-not-lgpl.html>.

Index

A

audioOscillator 14

B

bark2hz 15
Basic Usage Overview 2

C

Conversion Functionality 2
copyright 19

D

Domain Conversion 15

E

Enumerations 13
erb2hz 15

F

Function Reference 4

H

hasdata 4
hz2bark 16
hz2erb 16
hz2mel 17

I

Installing and loading 1
ismidfile 12

L

Loading 1

M

mel2hz 17
MIDI Controller Interface 9
MIDI Device Interface 4
MIDI File I/O 11
MIDI Functionality 2
midicallback 9
midicontrols 10
mididevice 4
mididevinfo 5
midifileinfo 12
midifileread 12
midifilewrite 13
midiflush 6
midiid 10
midimsg 6
midimsgtype 13
midiread 11
midireceive 8
midisend 9
midisync 11

O

Off-line install 1
Online install 1

P

phon2sone 17

S

sone2phon 18

W

warranty 19
Waveform Generation 2, 14
Windows install 1