

# Density GSC

Granular Synthesis for Csound

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(compiled by George Gumulinski, with help from Google Translate, on Jan 24, 2011)

## Introduction

Density GSC (Granular Synthesis for Csound) is an environment for granular synthesis developed under CsoundAV. The package includes three files with the extension "csd" (Unified File Format introduced by Michael Gogins) and Shell control for compilation. The shell also implements additional features "settings flags" such as the sampling rate, the number of audio port I / O and Midi.

1. Soundfiles Granular Synthesis
2. Live Granular Synthesis
3. Prototypes Granular Synthesis

The general algorithmic structure follows the contours of the "Asynchronous Granular Synthesis."

Granular Sounfile Syntethesis implements granular sources wav or aiff, that is loaded into memory permentte prerecorded material.

Live Granular Synthesis work directly on signals from the sound card (microphone).

Prototypes Granular Synthesis implements granules through the direct generation of waveforms on developing mathematical models also feature a synth that can be played by a remote MIDI device, such as a master keyboard. The Sinthesizer Density is polyphonic and has an ADSR envelope generator and a filter bank. In addition, several synthesis parameters are directly associated with the more general control change.

All algorithms can generate up to eight parallel streams of granules. Each channel or item is totally independent and properly configured. For each entry can store up to sixteen snapshots. In all three algorithms can generally save a project file and in the case of the soundfile and live independently on a counter to export the wav or aiff files are preloaded into memory.

## Operation

Density requires CsoundAV 0.0431 or Superioris Win or console mode. CsoundAV is sent to a distribution of real-time Csound created by Gabriel Maldonado. <http://csounds.com/maldonado>

mailto: @ g.maldonado inwind.it

Please note that I / 0 Live

Version 0.0431 supports native ASIO driver and Audio Port.

- P + audio output

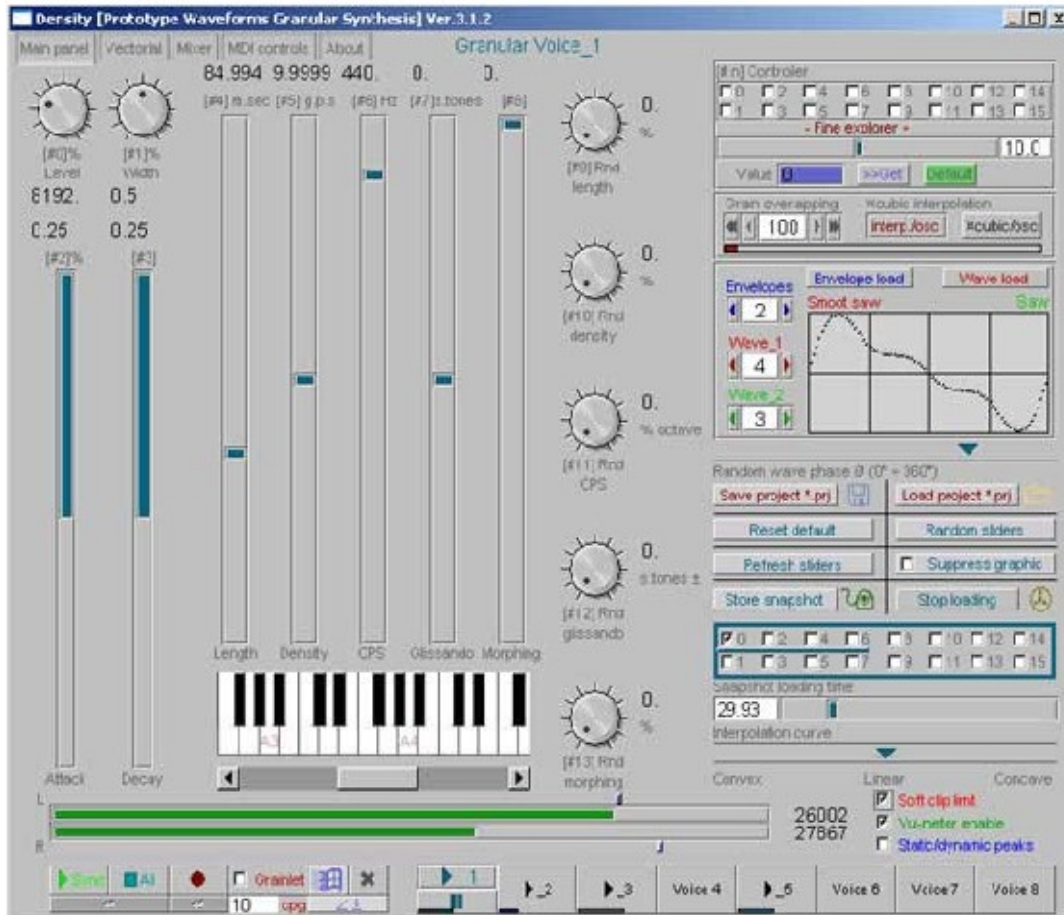
- + The audio input

We recommend setting the sampling rate (48000 Hz default)

In addition to lower latency and improve performance with Live input is preferable to enable the flag-f, but only if your sound card supports ASIO drivers for 20.24 or 32-bit

If you do not use the control shell, you can initialize the CSD file by dragging the executable (CsoundAV.exe).

## Main panel



[# 0] Level Range 0 to 1, default 0.5

Expresses the amplitude normalized. During the granulation process the signal amplitude varies with the density and duration of grain, this parameter controls the level of peak amplitude of the grains.

[# 1] Width Range 0-1, default 0.5

When the value is zero grains are replicated on both the left channel that right (mono), is greater than zero is triggered when a pro rata distribution of a random process. This is an amplitude modulation "inversely proportional" between the two channels, each channel on a decrease in amplitude corresponds to a proportional increase in the other channel. The maximum range of random deviation is controlled by the potentiometer itself. A value of 0.5 means that they can be subtracted and added values of up to 50% of the amplitude of the instantaneous grain randomly. A large number of grains creates a pseudo-stereo.

[# 2] Attack Range 0 - default 0.5 00:25

[# 3] Decay Range 0 - default 0.5 00:25

Control the slope of attack and decay of wheat as a percentage of the duration (length). Refer to the type of windows used (window), for example with a triangular window values of 0.5 does not induce distortion of the envelope, the values of 0.25 to degenerate into a trapezoid, values close to 0 in a rectangular window. The effect of these parameters can be observed on the oscilloscope of Density.

[# 4] Beginning loop point

[# 5] Ending loop point

Selectors time of the file (sound or sound loaded Density\_soundfiles frozen Density\_live).

You can isolate a segment of time simply by moving the file to your liking.

Please note that Pointers can not cross, ie, can not be greater dell'ending beginning, when the condition occurs, Density automatically drag the slider that is at fault.

The horizontal movement of the pointer describes virtually the "arrow of time" of sound samples (from left to right).

[# 6] Length Range from 0000 to 1000, default 85

It expresses the length of the grain in milliseconds.

Please note that Density\_Prototypes in this slider is mapped on an exponential scale.

[# 7] Density Range 0.5 - 1600, default 100

Expresses the density of the granulation which is the number of grains per second. A value of 0.5 means a grain every two seconds, 100 (default) 100 grains per second. The overlap factor (overlap) is calculated by multiplying the length of the grain density. For example, a density of 10 grains per second with grain length of 85 ms (0085 seconds) results in a factor of  $100 * 0085 = 8.5$  overlap (about 8.5 polyphonic voices). Please note that This slider is mapped to scale exponentially.

[# 7] Glissando Range -12 - 12, default 0 Only in Density\_prototypes

This parameter affects the frequency (CPS), is expressed in semitones and refers to the amount of glissando in each of the grains. For example, a CPS frequency of 100 Hz and a range of 12 semitones produce a glissando of an octave that is, a frequency range from 100 to 200 Hz all negative values produce a descending glissando.

Please note that is the only parameter that acts within the "Microtemp" grain.

[# 8] Pitch Range -12 - +12, default 0

Check the high frequency signal in terms of tempered semitones. Given a sample (wav or aiff) the natural frequency will determine the correct pitch is obtained by dividing the sampling frequency (48 KHz Density\_2 default) for the length in samples of the file (sr / L) \* Pitch. The rescaling the value of the pitch changes the natural frequency.

[# 8] Morphing Range 0-1, default 0 Only in Density\_prototypes

Adjusts the point of interpolation between the prototypes wave 1 and wave 2 For example, if a wave is a sine wave and square wave 2, with a 0.5 Morphing place the resulting prototype will be a waveform interpolation of the two resulted.

The effect of this parameter can be seen on the oscilloscope of Density.

[# 9] Speed Range -2 - +2, default 1

Applies explicitly to the pitch but refers to the speed of time reading the file. A value of 1 means that the time is not affected, the second pointer goes twice as fast and 0 the pointer is stationary (frozen), negative values, for example -1 implies a reading backwards, usually negative values produce the same effect of the back button instead sulal bottoniera à see Description of the control parameters.

[# 10]% Rnd grain dur Range 0 to 100, default 50

This parameter refers to the Grain Length, controls the random deviation expressed as a percentage. Essentially sets the width of the random mask value refers to the deterministic (Length). Length A value of 100 ms and a random deviation of 50% produces a random fluctuation of the duration of grain from 75 to 125 ms, ie, the deterministic value (100 ms) will be the band center for hiking pole to 50 % (50 Ms).

[# 11] Rnd% density range from 0 to 100, default 50

Rnd% dur-like grain but acts only on density.

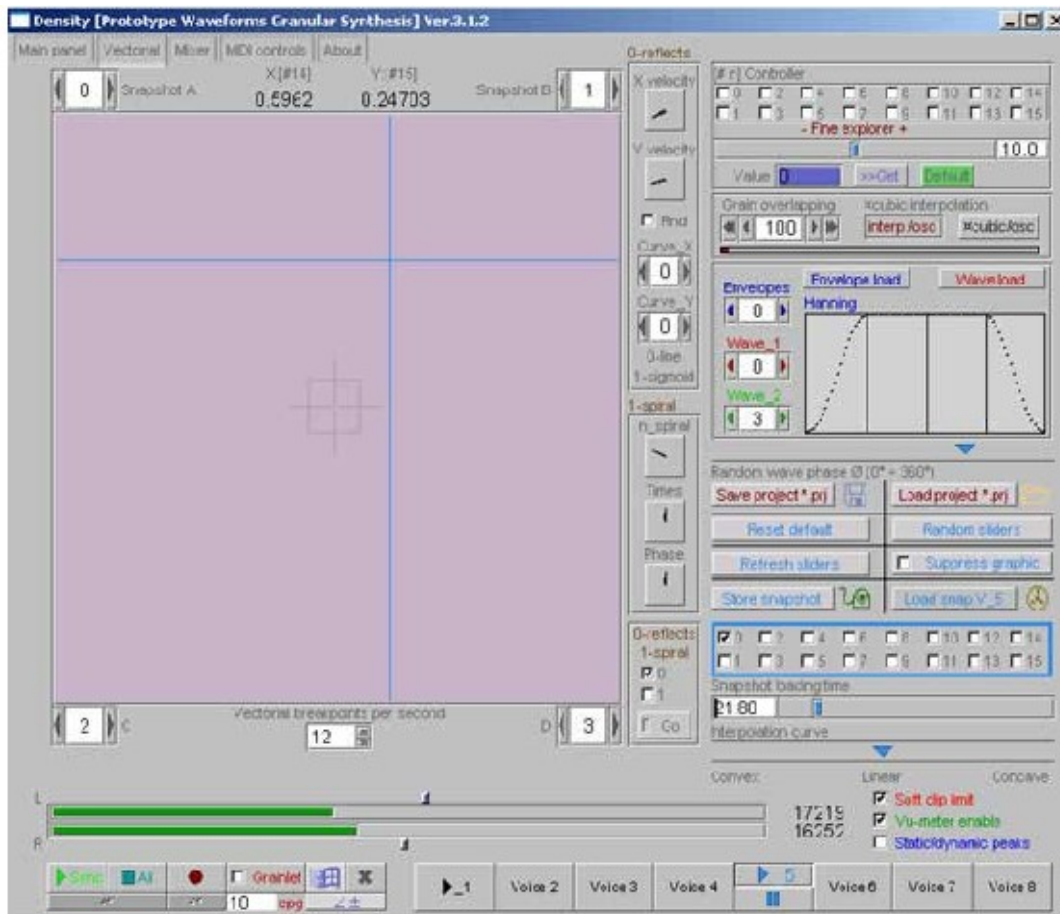
[# 12] Rnd% pitch range from 0 to 12, default 0

Rnd% dur-like grain and density, expressed in semitones temperate acts on the pitch parameter.

[# 13] Rnd start (jitter) Range 0 to 300, default 2

Check the deviation of the pointer to the file, to be released by the scanning speed (Speed). The parameters are in milliseconds, zero means no deviation, high values produce jumps of the pointer to the file. If the Speed parameter is not zero, the deviations occur around the pointer moving.

## Vectorial panel

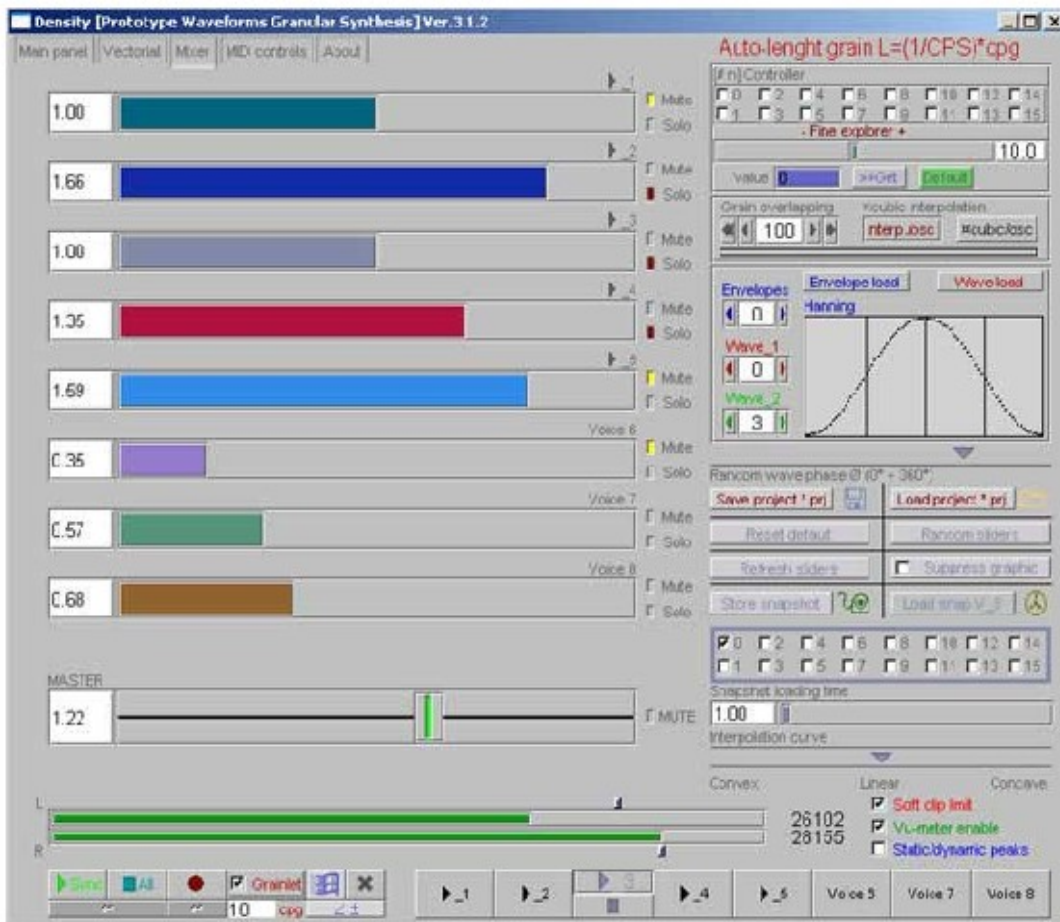


In Vectorial panel is accessed through the appropriate tab, is primarily designed as an explorer of possibilities taken from snapshots of the complex interpolation. At each corner of the pad are selected different snapshots. Moving with the mouse within the Density box implements a quadruple interpolation that calculates the average of the four snapshots. Also found a position you can save it to another snapshot, and so on. The Text Control Vectorial breakpoints lets you choose how many points per second interpolate. Higher values decrease performance but increase the

temporal precision of the vector. The default is 12 points per second, ie, a tween every 83 milliseconds.

The column on the right leads to a series of controls to automatically move the pointer in the pad. There are two types of motion, 0-Reflects the pointer when it reaches the ends of the pad bounces, you can also choose two curves mapping for each axis (XY), the curves are a straight line and a sigmoid. 1-spiral, the spirals are plotted with the option to decide the total time to travel the perimeter and the density of turns, moving the phase can also escalate the spiral ellipse.

## Mixer



The mixer is used to manage the contributions of a wide variety of granular items. You can also listen to each item individually by using the button only or exclude the item via mute.

When items are in play on the number appears on the symbol. There is also a master to rescale or emphasize the sum of all signals.

## MIDI controls (gruppo 1)

Group 1	Group 2	Synthesizer					
Cc [_0] Level	Min(%)	Max(%)	Channel	Cc [_9] Random grain length	0	100	1
7	0	100	1	Cc [_10] Random density	0	100	1
Cc [_1] Stereo width	0	100	1	Cc [_11] Random CPS	0	100	1
10	0	100	1	Cc [_12] Random glissando	0	100	1
Cc [_2] Attack grain envelope	0	100	1	Cc [_13] Random morphing	0	100	1
12	0	100	1	Cc [_14] Vectorial X	0	100	1
Cc [_3] Decay grain envelope	0	100	1	Cc [_15] Vectorial Y	0	100	1
13	0	100	1	Cc Snapshot loading time	0	100	1
Cc [_4] Grain length	0	100	1	Cc Interpolation curve	0	100	1
14	0	100	1				
Cc [_5] Density of grains	0	100	1				
15	0	100	1				
Cc [_6] CPS frequency	0	100	1				
16	0	100	1				
Cc [_7] Glissando grain CPS	0	100	1				
17	0	100	1				
Cc [_8] Waveshape morphing	0	100	1				
18	0	100	1				

MIDI monitor

Event	Status Byte	Data Byte 1	Data Byte 2	Channel
-------	-------------	-------------	-------------	---------

Enable Midi input  Midi monitor On  Enable Midi Log

The section of the MIDI controls eService is divided into two groups for the allocation of the parameters for the synthesis of Density with midi control change in input from a physical or virtual device. Each control parameter (slider or knob or button) is assigned to a parameter on a specific midi channel (1-16), each control can also be mapped to an appropriate range (minimum and maximum value expressed as a percentage of the parameter itself). All assignments are responsive in real time. When the button is disabled Enable midi in, midi received messages have no effect and you receive the following message: "No MIDI input enabled", so every program change, control change, pitch bend, aftertouch and key notes on-off have no effect. If the midi is on, all messages are assigned and interpreted in accordance with the user's configuration.



## MIDI controls (gruppo 2)



The group manages two controls assigned to the mixer using the control change and program changes are being made to select items; possibly can switch the voice call load on the snapshot.

Channel after touch and pitch bend are assignable to any parameter of the same basic criterion of the late explorer (see end of explorer).

Note there are two response options (three in Prototype) for the management of the note on and note off, Density assign any note messages on the Play button and Notes Sync Stop off at all. The Stop option stops running off key notes (to stop) when a message comes off of notes and the second switch off when a new instance activates (note on), this is the equivalent of a negative value p3 declared in the score. Synthesizer is present only in Density\_prototypes, when you activate the selected synthesizer Density so you can play the selected item from a master keyboard. The synthesizer is controlled by the Synthesizer (see MIDI synthesizer).

MIDI Monitor is a small display of the most common MIDI messages, the colors assigned to the corresponding controls are in Midi-Ox is also possible to enable log Midi, this command writes

to a text file list of all messages received, with the command view midi log can be edited in real time.

Please note that Channel after touch and pitch bend are for instance triggered by a note on message.

### MIDI controls (synthesizer)



The Synthesizer has a classic ADSR envelope generator (Attack-Decay-Sustain-Release) You reported the event. Weather explained in R (release) extends the "notes"after the note-off message (note-off sensor and release time extender).

LFO (Low Frequency Oscillator) implements a low-frequency modulation (modulation / vibrato) that affects the ability to control the frequency modulation amplitude (delta) which is also assigned to a control change and the modulation speed (rate) .

Midi polyphony limits the number of polyphony, the default is 16. It must be said that a full-time high as stated in the parameter R nell'ADSR involves an overlap of instances, and then consumption of polyphony.

Pitch bend is the mapping of the "wheel" on the keyboard, since it uses a 14-bit control is very precise and refers to the number of sempitoni that modulate the pitch midi.

Please note that Pitch bend as Channell touch after they become active only in reference to the instance triggered by a note on message.

FILTER implemented a 3 pole sweepable resonant low-pass filter, a filter for each channel. You can enable or disable the appropriate button and choose the cutoff frequency of the filter is variable depending on the pitch midi or fixed. all the controls are parameterized.

## Control parameters



Under each selection of number of voice there is a button called on the play, the voice on and off individually referenced, and when the entry is marked by the white color means that the item is allocated to a file. On each item displays the progress of the load snapshot.



The following bottoniera houses the main controls for density, the buttons marked returnarrow show a dialog box on command options.

## Play sync



The switch allows you to simultaneously play sync all entries enabled the command to hand off the switch off. Entries for the play sync selected using the optional command buttons on the right. The command displays the following dialog box:



The buttons colored red identify the enabled items to sync to play. When V\_sync is On, you set a number for the "synchronize" (V\_sync). In this case, the "pilot" is the V\_3. For example caricondo multiple files on different voices, with the sync command, you can choose what is the reference entry for time progress. All entries are allocated that are lit simultaneously (with the play command sync) or independently (with the play on the selection of the item), are synchronized with the Sync voice, that engage in it (the pointer of the voice sync). Please note that In order for sync to take effect you must put off and then back to play in sync.

### Restart to loop

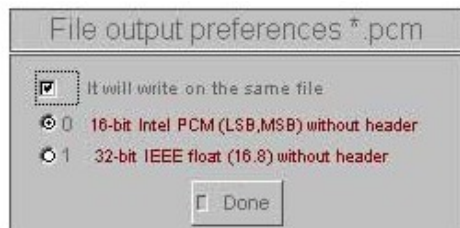


When enabled, every time you turn on the voice (with the play / pause key) or come back on the items (play sync), the pointer to the file again from the cut indicated by beginning the loop.

### Record file out




The record button writes to disk in an audio file format. pcm and the same symbol appears on the button breaks. The small button below refers to the command options:





If enabled it will write on the Same file every time you net breaks record tool, Density log file on the same output file, producing a juxtaposition of the audio segments on a single file. When disabled (default) the Browse\_file appear every time you enter the record button. Density at the moment can not save files with audio header, such as the most common wav or aif, therefore, you must save a file with extension or other raw pcm or user-defined, open the file declaring the

editor (Adobe Audition, for example) that the sampling frequency set to the same file deve'essere orchestra (48000 default) and the quantizer (16 bit).

## Tools

 reverses the direction of reading soundfile, retrogradation is a simple, equivalent to the corresponding negative value of the speed parameter.

 also acts on the slider speed, zero when it freezes time, is a small utility that works as a gearbox, pressed the first time will reset the slider always to zero, the second time last non-zero value.

 reverses the reading of only the samples within the grain. For example, the pointer can move in the direction of time but the samples are read into the beads back and vice versa. Please note that This parameter acts indiscriminately on all 8 grained voice.

 \* exitnow, send a message that ends in Csound. When pressed, a confirmation window appears.



open windows routines, sndvol32.exe and properties of the system,



access the test input, this window opens automatically when you launch Density\_Live, is used to verivicare if your system requires rescaling or not.

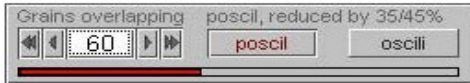
## Selecting Voices



Density\_2.5 and higher allow you to upload up to eight different audio soundfiles, or load the same sample multiple times on different voices and processes simultaneously. Each entry is characterized by a different color of sliders and buttons. When the button appears with a white background means that the item is allocated a sound-sample file. All the parameters of synthesis and control such as the rescue of snapshots, transitions, and the panel vector are independent

exploration. When the entries are in the play symbol appears on them. Please note that play-pause button for each item appears only when the item is selected.

## Overlapping grain



The overlapping factor determines the number of polyphony of the system. For example, a high density associated with a long service life of the grain produced in the same instant in time, overlap, the default is 75. In other words, this control provides a maximum of instances of the instrument granulator. This parameter refers to the overall density of all eight items. The red indicator will automatically remaps the number spelled out by the Guard point.

The selection poscil reduced by 35-45% performance, but the quality is significantly better h when using very long samples, h generally advisable to use poscil allocated when the table exceeds  $2^{18}$ . The oscillation but does not work in float h piy considerably faster.

Please note that is not used in Density\_Prototype poscil but oscil3 that implements cubic interpolation on the signal.

## Sound file load



This section displays and manages the sample-file. The level of memory allocation depends on the space pre-allocated, in this case  $2^{19}$ . If the uploaded file can not be contained in a message memory Warning! Exceeds. The button-Aiff LoadWav opens a dialog box while! clear removes the file from memory and prepares the item for a new allocation.



In this part you can change the memory Preallocation Gen 1 and choose the channel you want to import (left or right). The OK button opens a Browse\_file to upload any file (wav or aif) on disk. The tables in Csound can allocate a maximum  $2^{24}$  space about 6 minutes and 33 seconds of sound (sr 44 100 16-bit). It is recommended to keep the level of allocation always above half

because doing so will maximize the number of pointers to the file. If an entry of granular synthesis does not have any uploaded file the message Empty (load sound file).

It also displayed information about the length of the loaded sound and its sampling frequency. The time it refers to the point where the pointer to the file in seconds.

### Freeze and resize memory



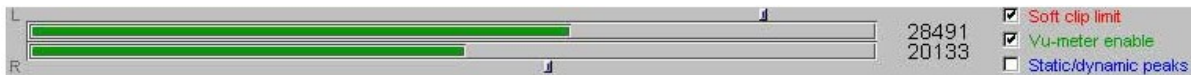
The buttons are only present in Density\_Live Freeze. When pressed disable writing Live audio input on the function, when a voice is frozen samples "captured" will be saved and can be processed in a similar way Density\_Soundfiles, time (Alloc. time) indicates the availability of the function.

The command Clear / Resize opens the following dialog-box:



From here you can redefine the length of the function and then delete the samples "captured" (overwrite with zeros). à see Sound File in Preferences Density\_Soundfiles.

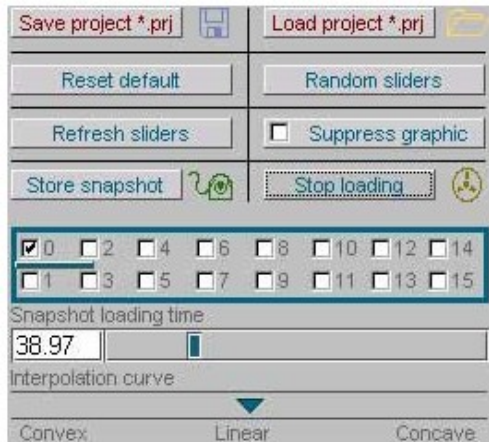
### V-meters



V-Meters is the part that displays the total size of the front of the stereo granulation. The level can be further retouched by the MASTER slider in the Mixer, as well as the amplitude weighting of each item can be controlled from the mixer or the potentiometer Level of each item. The button on / off switches on and off the indicator, and Static / Dynamic dell'ampòiezza keeps track reached the peak, may help to establish, on the whole of a performance that amplitude level is reached. If the threshold is exceeded (32767 16-bit) another indicator appears as a red signal

clipping. Soft clip (soft 'fashion Rather Than A straight cutoff) is a limiter that prevents Saturating signal, it is very useful when using a high density and a large number of items at once.

## Transitions (load snapshot)



The transition between two different positions of one or more sliders in the movement is timed and mapped to a function (curve) distorting.

To implement a transition is necessary to save the configuration (sound) on snapshots (snapshots). You can register a maximum of 16 snapshots for each entry, as follows:

Given a position of the sliders of the synthesis parameters, you can choose a snapshot, such as zero and then press the Store snapshot, the command keeps track of the values of the sliders in the memory. There will be one or more configurations and saving, for example, this number one, etc. ... To recall a position (snapshot) then you must select the number from the list and proceed to load the snapshot. You may decide on a transition time that is the time duration of the transition. Also, you can define the curvature of the transition, can be concave or convex linear interpolation with all of them. When non-linear, while retaining the same total time of transition, there will be an acceleration and deceleration according to the distorting function.

$$ia + (ib - ia) * (1 - \exp(i * itype / (n-1))) / (1 - \exp(itype))$$

When you load a snapshot with a configuration of the slider unsaved interpolation (transition) of the values is between the sliders and the pattern of usage of the snapshot.

Each entry is independent, ie you can upload snapshots at the same time on different items.

Furthermore, using the assign MIDI Program Change you can configure to control the various switching on and off load of snapshots from a MIDI sequencer, for example.

All presets or snapshots can be saved to a file project using Save Project in digital format. The project may be reallocated later with Load project. The project stores all the information about the status file saving.



## Management sliders



The default reset button returns all sliders to the default location

The Random sliders set random values of the sliders.

Suppress inhibits graphic graphics updates in the GUI (graphic user interface), this button is useful when you need to maximize resources during transitions.

Refresh Sliders graphically update the position of the sliders in conjunction with their values.

## Refined control

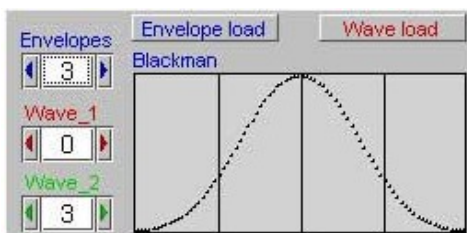


This section allows you to move in a refined individual slider. You are prompted to choose the number of control for the explorer view, the slider on the map mask% t the percentage calculated on the ranges of each controller.

The slider is bipolar with each new selection is reset to mid ` , moving to the left decreases the value and vice versa.

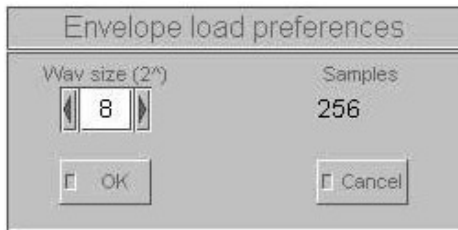
The lower part on the selected controller initializes with a declared value in the Value, the default button restores the default value setup.

## Windows and select Wave



The default density using an envelope for grains of type Hanning. There are 11 types of windows. The slope of attack and decay of the prototype can be modified by the controls [# 2] Attack [# 3] Decay and displays the result on the appropriate scope.

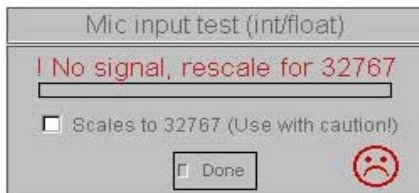
Envelope button is used to load the envelope import directly from a file type pcm (wav, aiff, raw etc. ... only 16 bit) in the dialog box stating the exact number of samples that must be power of two.



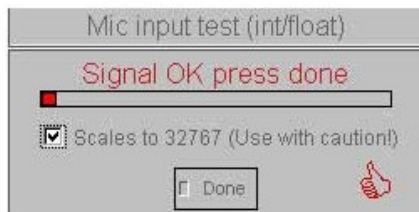
Only in the case of h Density\_prototypes can follow the same policy to import waveforms through the load button Wave.

### Test line input

When you initialize Density\_Live, the following window:



Not all sound cards operate the same way the "floating point", when the -f flag is present in the <CsOptions> the signal I / O is interpreted floating point, that is normalized (0 to 1). The hardware could make the process of standardization at the "upstream" (ADC input) or "downstream" (DAC out), then this will make the cards impossible to predict if the signal is processed by standard density or whole. The following rescaling for 32767 does not affect any case the output signal in real time, but acts only on the variables that go to the instrument is to record V-meters.



## Customizing the ranges and defaults of parameters controllo

When you launch the density, all the control parameters have their own range of action such as the parameter [# 8] Pitch ranges from a minimum value of -12 semitones to a maximum of +12 and defaults to 0. Editing the file. Csd can change all the parameters to suit your needs.

```
                                ;USER DEFAULT SETTINGS
#define LevelMin #0#
#define LevelMax #1#
#define LevelDef #0.5#

#define WidthMin #0#
#define WidthMax #1#
#define WidthDef #0.5#
#define AttackMin #0#
#define AttackMax #0.5#
#define AttackDef #0.25#

#define DecayMin #0#
#define DecayMax #0.5#
#define DecayDef #0.25#

etc ....
```

Above shows an extrapolation of some parameters, each parameter has a minimum value, maximum value and a default. To change them you need to write the number on its macro in space # n #

The following example shows how to modify the transition time between snapshots, bringing maximum value to 180 seconds (original 60) and defaults to 10 seconds (original 1).

```
#define LoadSnapTimeMin #0.1#
#define LoadSnapTimeMax #180#
#define LoadSnapTimeDef #10#
```

For your convenience you can handle this part on a file called SampleDef.txt. The file must be present inside the folder with DensityGSC all'exegiobile CsoundAV\_con.exe or in the path set up INCDIR. However, the absence of the file does not cause initialization errors of Density. If the file is initialized with the values contained in it, otherwise you start with the default values.

```
; Write the string after the segunte define
#include #SampleDef.txt#
```

## Port configuration

You can set a setup for the devices I / O hardware, so do not ask Csound, each time the density, the relative number for the ports you can edit the file. Csd and srivere on CsOptions:

```
<CsoundSynthesizer>  
<CsOptions>  
;Port Audio  
-+P -+I -+K -m0 -d -+O  
;DirectX  
;-+X -+C -+K -b800 -m0 -d -+O  
</CsOptions>  
<CsInstruments>
```

- + **P** refers to the output audio example - + P11 directs the output to the number of topics. If the value is known then simply set it to the CSD.

- + **I** refers to the audio input port.

- + **K** refers to the MIDI input port, which picks up where the values for the Csound MIDI control.