

# Manual for Groven+Sampler

NOTAM

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Version beta1

## INTRODUCTION

Groven+Sampler is a program for adaptive tuning in just intonation based on the work of Eivind Groven. There is a built-in sampler which can upload and play various instrumental timbres. The program is currently available for Mac OS X only.

The program was developed at NOTAM by Dag Henning Kalvøy and Henrik Sundt, in collaboration with David Loberg Code, Western Michigan University.

## DOWNLOADING

The complete software package for Groven+Sampler can be downloaded from the following internet address:

<http://www.notam02.no/renstemming/programvare.html>

The package is formatted as a zip-file with the name "Groven+Sample\_pk", and opens by double-clicking on the file after it has been downloaded. This will open a window with the following content:

- "Groven+Sampler-beta1" --- the application
- "Instrumenter" --- folder with instrumental sound files
- "Manual" -- folder with this user manual (both English and Norwegian version)
- "Read\_me" -- information that should be read before starting the program

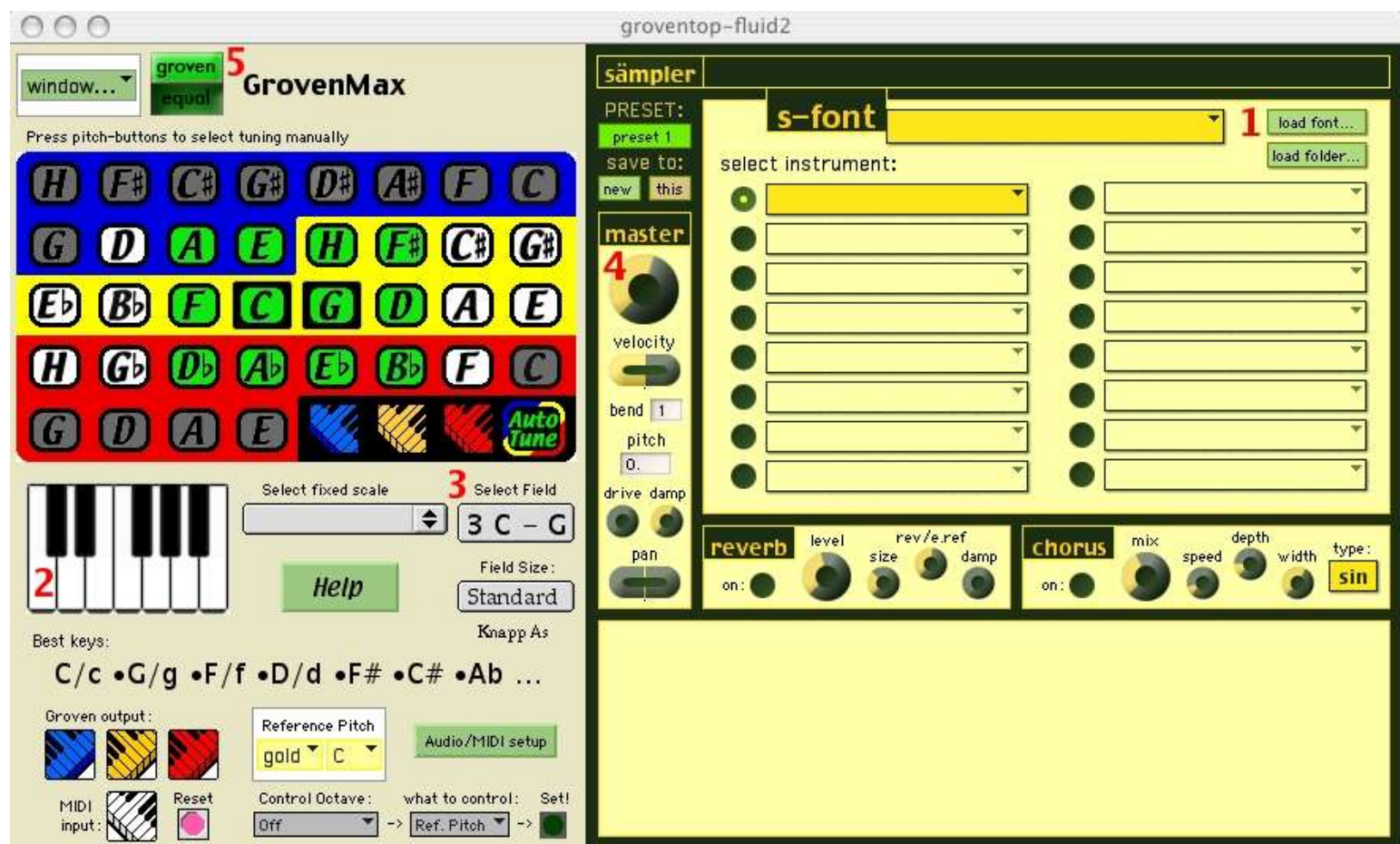
Additional instruments can also be downloaded from the internet address above.

# BASIC FUNCTIONS

## STARTING THE PROGRAM

If you are playing on a MIDI-keyboard, it must be connected to your computer before starting the program. (Check the manual that accompanies the MIDI-keyboard for instructions on how to do this.) For the best sound, it is also recommended that you connect either headphones or speakers to the computer's audio output.

Double-click on the program "Grove+Sampler-beta1" to start. The following window should appear upon launch. (During launch, you may see the window blink and be redrawn again. This is normal.)



The program is comprised of two parts: **GrovenMax** (on the left with a beige background), which controls the tuning function; and **sampler** (on the right with a yellow background), which plays the instrumental timbres.

## USING THE PROGRAM

The functions needed to get started are marked in order with red numbers in the figure above (from 1 to 5).

### 1. Load-in instrument sounds:

At launch, there are no instrument sounds (called "soundfonts") loaded into the program. Open the folder "Instrumenter" which accompanies the package. This contains a variety of instrumental sounds in the form of soundfonts. Drag one of these into the dark-yellow region of sampler and the files will automatically be uploaded.

You choose which particular instrument sound you want by clicking one of the circles below "select instrument."

In each soundfont, there are several instruments. You can try other instruments by dragging in another one of the soundfonts in the folder.

### 2. Playing:

After an instrument is selected, you can play on the connected MIDI-keyboard. The one-octave display keyboard on the screen should blink green when a key is pressed and you should hear sound. If not, see the section titled "Audio and MIDI" below.

You are all set to play in adaptive just intonation. When AutoTune is on (i.e., the AutoTune button is green), GrovenMax will automatically determine the tuning while you play. The keys which appear in the "Best Keys" line are those which work the best for the current setting.

### 2. Select key center:

Choosing from the pull-down menu below "Select Field," you can change the key center (pitch field) to match the primary key in which you are playing. (More detailed information appears below.)

When a field is selected, the listing of "Best Keys" will also change. These are Eivind Groven's recommendations of which keys function well in this particular field. The uppercase letters refer to major keys; lowercase to minor. Those listed on the far left are the keys which sound the best.

You can turn off the adaptive tuning function by clicking the "AutoTune" button (so that it turns white). GrovenMax will then use a fixed tuning, which you can change manually by clicking on the individual pitch

buttons (with blue, gold, or red background color) in the pitch box. To turn on "AutoTune", click the button again so that it turns green.

#### 4. Adjust volume and effects:

In the s ampler window, the volume can be adjusted with the velocity dial located under "master." Click and hold on the dial with the mouse and drag it up or down to adjust the volume. This might be necessary if you hear distortion of the sound, particularly when several notes are playing simultaneously.

If an instrumental timbre sounds too dry, you can add reverb and chorus effects to enhance the sound. Simply click the on button for either of these effects and experiment with different levels.

#### 5. Equal Temperament (12-ET):

To directly compare GrovenMax's tuning system with so-called regular piano tuning (12-ET), you can shift back and forth between them using the "groven/equal" button. Please note that when playing in 12-ET, none of the pitch box or AutoTune settings will have any effect.

## AUDIO AND MIDI SETTINGS

If you do not get any sound after having loaded in a soundfont, you should first verify that your computer is receiving a MIDI signal from the keyboard. Check if the keys in the on-screen display keyboard are blinking green when you play (see 2 in the figure above). If not, click on the button marked "Audio/MIDI setup" and choose a different port for "MIDI in." If there is still not response from the display keyboard, consult the user's manual of your MIDI-keyboard or MIDI-interface.

If the keys are turning green, but there is no sound, then click "Audio/MIDI setup" and choose a different output in "Sound out." If this doesn't help, check if there is any sound coming from other programs on the machine. Consult the user's manual for your computer for additional assistance.

## ADDITIONAL FUNCTIONS

The above and additional functions are described in more detail in the following sections titled **GrovenMax** and **s ampler**.

# GrovenMax

by David Loberg Code

This section describes the functions and tuning specifications controlled by GrovenMax (the panel on the left side of the program).

## OPERATING INSTRUCTIONS

**GrovenMax** controls the tuning output of **sampler**. You may either pre-select a fixed tuning or engage AutoTune for adaptive tuning. When starting Groven+Sampler, the default setting is with AutoTune on, with Gold-C and Gold-G as the pitch centers.

### Groven/Equal:

The green button near the top of the screen will toggle between the 36-tone Groven tuning system and the more common 12-tone equal temperament. When Equal is on, the pitchbox settings that appear below have no effect. More detailed information about the 36-tone scale appears below.

### Pitchbox:

The multi-colored pitch-box displays the current status of the 36 available tones. The pitches are arranged in rows of just-tuned perfect fifths and columns of just-tuned major thirds. (Please note that H represents the pitch B-natural.) There are four possible states for each individual tone:

Green = On. The tuning variant that will sound when this note is played.

White = Off. This tuning variant is available, but not currently engaged.

Grey = Inactive. This tuning variant is outside of the available field of pitches.

Green with Black Square. This tuning variant is on and will remain fixed (i.e., AutoTune will not change it).

Clicking on a pitch button will turn it green (on) and turn its alternate color variants white (off). The grey and black-square modes are set by AutoTune.

### AutoTune:

AutoTune is the adaptive tuning logic. It will change the tuning automatically while you play using a tuning logic originally conceived by Eivind Groven (described in more detail below). It can be turned on and off by clicking on the AutoTune button in the lower corner of the pitch box. It also turns on automatically when a new pitch field is selected. It turns off automatically whenever a pitch-button is clicked in the pitch-box or when a preset scale is selected.

### Pitch Fields.

There are 14 available pitch fields that can be chosen using the Pitch Field pull-down menu (below the

pitchbox). Each of these has two fixed tones in the center of the field. These often work well as the tonic and dominant of the primary key. Other keys that work well within this field are automatically displayed on the Best Keys line below.

### **Pitch Size.**

The Standard pitch field has 22 available (active) tones. There are two alternate field sizes called Z and Py. Both of these have 18 available tones: 6 fixed and 12 variable. The tuning logic for these field variants is also different. (NB: as of the beta 1 version, there are still some bugs in these fields, particularly the Z-field.)

### **Manual tuning:**

A fixed scale can be selected manually by simply clicking on the desired pitch buttons. You may also select all of the tones of a single color by clicking on the Blue, Gold, or Red keyboard buttons. AutoTune is always off when a manual scale is selected.

### **Preset Scales:**

There are a variety of preset scales available from the pull-down menu. Most of the scales indicate the intended tonic for the scale. Random will generate a different random scale each time it is selected. Overtone scales approximate partials 8 through 16 of the harmonic overtone series. The major/minor scales are recommended just intonation scales for those keys. The remaining scales are tunings used for specific compositions by Eivind Groven.

### **Display Keyboard:**

The one-octave piano keyboard simply displays the notes currently being played on the external MIDI keyboard (without regard to octave registrar). It provides visual confirmation that the keyboard connection is operating correctly.

### **Reference Pitch:**

This is a global fine-tuning function relative to A440. It is to accommodate ensemble playing with other instruments. The selected reference pitch will sound the same in both Groven tuning and 12-tone equal temperament (based on A = 440 Hertz). (None of the other pitches will match exactly, but the perfect fifths above and below the reference pitch will be very close to the same.) The default setting is Gold-C (261.6 Hertz). It is also possible to globally adjust the entire tuning above or below A440 using the pitch bend function of sampler.

### **Control Octave:**

It is possible to use part of the external MIDI keyboard to control the selection of Pitch Fields, Reference Pitch, or both simultaneously. Middle C (MIDI note 60) is in octave 0 and other octaves are indicated above

or below this. Once activated, the control octave will be silent. When controlling pitch fields, the pitch played on the keyboard will select the field that features that pitch as a fixed tone (duplicating the "Select Field" pull-down menu). When controlling the reference pitch, the screen display will rotate through all three color variants of the pitch being pressed. Simply release the key when you reach the desired color. When field and reference pitch are controlled simultaneously, GrovenMax will automatically select the color variant which matches the fixed tone within the field.

### **Set:**

Set allows you to temporarily control the field, reference pitch, or both from the keyboard without specifying a control octave. After you click on the Set button, the next key pressed on the MIDI-keyboard (in any octave) will set that pitch according to the function indicated. Once you release the key, the keyboard will return to its normal playing mode.

## **TUNING SYSTEM**

If you have never played in other tuning systems, it will take some time to get acclimated. From a firmly entrenched background of 12-ET, just intonation will most certainly sound out-of-tune. One tuning system is not inherently better than another; each has its own qualities and characteristics. The main strengths of 12-ET are that all keys are accessible and none of them have extremely dissonant, or so-called 'wolf', intervals. The main weaknesses are that none of the keys have an individual character (they are all the same) and none of the intervals are acoustically pure (except the octave). In historic (fixed) just intonation, some of the intervals and chords are very pure and consonant, while many others are very sour. As a result, only a few keys are really palatable and functional within any given just scale. In the adaptive tuning system employed by GrovenMax, the majority of the intervals are just and all keys are functional. Because the 36-tone scale is not equally spaced, however, each key has its own distinctive sound and character. Overall, it is a much richer and more complex musical universe.

### **Tuning Specifications:**

The 36-tone scale employed by GrovenMax is based in 5-limit just intonation, using perfect fifths and major thirds as its building blocks. As described above, the pitch box arranges these tones in rows of perfect fifths and columns of just major thirds. The sequence of fifths wraps around from the last pitch in each row, for example Blue-C, to the first pitch in the next row (Blue-G). This same tone (Blue-C) is also a just major third above the tone below it (Gold-G#). This dual function is accomplished by a slight reduction in the size of the perfect fifths. In theoretical terms, the fifths are 1/8th of a skhisma smaller, or 0.244 cents, than acoustically pure fifths. (NB: There are 1200 cents in an octave; 100 cents in an equal tempered half-step.) Since it is impossible for the pitch box to display the correct pitch spelling for all of the perfect fifths and all of the major thirds simultaneously, some of them appear enharmonically as augmented sixths or diminished fourths,

respectively.

The scale as a whole contains three variants of each pitch class designated by the tuning colors blue, gold, and red. The distance between each variant is 20.5 cents, which is about 1/8th of a tone or approximately a syntonic comma, the difference between a just major third (5:4 ratio) and a Pythagorean major third (81:64 ratio). The table below shows the precise deviation (up or down) from 12-tone equal temperament for each tuned pitch class (with Gold-C as the reference pitch).

	<u>Blue</u>	<u>Gold</u>	<u>Red</u>
C	-20.5	0.0	+20.5
C#	-29.1	-8.5	+12.0
D	-17.1	+3.4	+23.9
Eb	-25.6	-5.1	+15.4
E	-13.6	+6.9	+27.4
F	-22.2	-1.7	+18.8
F#	-30.8	-10.3	+10.2
G	-18.8	+1.7	+22.2
Ab	-27.4	-6.9	+13.6
A	-15.4	+5.1	+25.6
Bb	-23.9	-3.4	+17.1
H (B)	-32.5	-12.0	+8.5

**Comparison with 12-ET:**

In practical terms, the perfect fifths produced by this scale should sound quite close to equal tempered fifths, being less than 2 cents different. If another instrument (in 12-ET) is tuned to match the reference pitch, the fifths immediately above and below this should be good matches as well. The further out you go in the sequence of fifths, however, the larger the discrepancy between the two instruments. Major seconds are also fairly similar in just and 12-ET; they are less than 4 cents different. The just major thirds are noticeably smaller (14 cents) than in 12-ET. At first, they may seem flat, especially when played melodically. Heard harmonically, in triads for example, they should sound very natural. Just minor thirds (formed by adjacent pitches on a downward diagonal axis of the pitch box) are about 15 cents larger than 12-ET minor thirds. If you compare tunings of a triad side-by-side using the Groven/Equal button, you should notice a kind of shaking or fuzziness in 12-ET; the just triad should sound very clear and pure, as if all of the tones have fused together.

**Additional interval types:**

In general, the simplest (or purest) just intervals are those formed between adjacent buttons in the pitch



box. When selecting scales manually, however, it is possible to incorporate a wide variety of other interval qualities by using the full resources of the 36 tones. It is in this way that you can create distinctive scales based on folk traditions or unique original scales. From any given tuned pitch, there are, of course, three variants of each interval class available. In total, there are from five to eight variants of each interval class available within the entire system (some of which are plentiful, others occurring only between one single pair of tuned pitches). There are, for example, seven different shades of minor thirds (including the just, Pythagorean, and 11:9 ratio minor thirds). Examples of different types of scales are found in the fixed-scales pull-down menu; you are encouraged to invent your own.

**Tuning Logic:**

GrovenMax's adaptive tuning logic relies on a combination of intelligence and memory. The same combination of pitch classes may get tuned differently depending on the context. When notes are played, they are analyzed to determine which particular tuned pitch classes are required to produce just intervals (i.e., intelligence), with preference usually, but not always, given to the tuned pitch class that sounded most recently (i.e., memory). At any given moment, there are tuning colors designated for each of the twelve pitch classes. When a key is actually played on the MIDI keyboard, the corresponding pitch class and tuned pitch class are flagged as active. When a new chord is played, whichever chord member was most recently flagged is designated as the reference point for tuning the chord. In other words, if possible, the flagged pitch remains fixed, and the other chord members are adjusted (if necessary) in relation to that fixed pitch (in accordance with Groven's principles of just intonation). The following example demonstrates this within a simple chord progression:

<u>Blue-D</u>	<u>Blue-D</u>	<u>Gold-C</u>	<u>Gold-C</u>	Gold-H
<u>Gold-Bb</u>	<u>Gold-Bb</u>	Blue-A	<u>Gold-G</u>	<u>Gold-G</u>
Blue-G	<u>Gold-F</u>	<u>Gold-F</u>	Blue-E	Gold-D

After the opening G minor chord, the common tones (underlined) serve as the reference point in tuning the next chord. In the second chord, for example, Gold-F is used (rather than Blue or Red), because that is the tuned pitch class of F that forms a just major triad with the already active pitches Blue-D and Gold-Bb. Notice in the final chord that the tuned pitch class Gold-D now occupies pitch class D, instead of the previously sounding Blue-D. This occurs because, within the final chord, G has priority over D as the more recently active pitch class, and thus Gold-G serves as the reference point.

In general terms, a tuned pitch class is selected if 1) the alternate tuned color for that pitch class has not been selected, 2) it was used recently and that pitch class is currently being played, or 3) it is part of a combination of pitch classes (i.e., a particular chord) that requires it. The second of these condition involves what Groven called the self-holding relays. When a tuned pitch class is played, the selection is also stored in the s-array. An s-value will remain positive after the current note has ended until (or unless) some new

tuned pitch class is played with which it is incompatible. This logic is the primary source for the implicit harmonic context described above. For example, Blue-D can be turned off by Gold-D (the alternate tuning color), Gold-G (which is not a pure perfect fifth), Blue-Bb or Gold-F# (not pure major thirds). There is an even more complex set of criteria for determining if Blue-D should be turned on. You can learn more about the specific details of the tuning logic by reading Groven's book, Renstemmingsautomaten (1968).

A few additional comments. First of all, you should not expect that playing in just intonation guarantees that all intervals will always be tuned as acoustically pure as possible. This is impossible. Take for example the chord C-D-G-A. If all of the fifths are kept just, then the minor third A-C will not be just; if the minor third is kept just, then one of the fifths must be sacrificed. Groven methodically anticipated all of these exceptional situations and worked out his solution to each. This brings up the second point: you may not always agree with the tuning choice made by GrovenMax. The tuning logic embodies a rather comprehensive system of consonances and dissonances according to, in this case, Groven's aesthetic priorities. You may have a different opinion about how a particular chord should be tuned. Eventually, we plan to develop alternate tuning logics for different styles of music.

## **SAMPLER**

Documentation of this part is forthcoming.

## **LICENCE**

The program is distributed under the Lesser GNU Public Licence (LGPL). See <http://www.gnu.org/licenses/lgpl.html>

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## **PARTICIPANTS AND SUPPORT**

The project is supported by the Norwegian Cultural Council.

The project has been realized in cooperation between NOTAM, David Løberg Code (Western Michigan University), Eivind Groven's Institute for Just Intonation, and the National Library of Norway.

The sampler is based on the "Fluidsynth" soundfont synthesizer by Peter Hanappe et al, and ported to Max by Norbert Schnell, who also added microtonal functionality for the Groven project.