Scanned Generators

Intro

Scanned synthesis involves a slow dynamic system whose frequencies of vibration are below about 15 hz. The system is directly manipulated by motions of the performer. The vibrations of the system are a function of the initial conditions, the forces applied by the performer, and the dynamics of the system. Examples include slowly vibrating strings, two dimensional surfaces obeying the wave equation, and a waterbed. We have simulated the string and surface models on a computer. Our waterbed model is purely conceptual.

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The Scanned Generators for Blue consists of 4 main parts:
1. Scanned Matrix Generator
2. Scanned Matrix Plot
3. Scanned Trajectory Generator
4. Scanned Trajectory Plot

The idea is to generate patterns for use with the Scanned Synthesis opcodes scanu/scanu2 and a trajectory for the scans opcode of Csound.

Blue provides a way to run formulas in Csound code using a GUI: buttons and sliders, creating Matrices and Trajectories. In addition, 2 Python scripts allow creating a visual representation of these matrices and trajectories.

1. Scanned Matrix Generator

- Used to generate patterns for the Matrix.
- Adds the .matrxT extension to the outputfile
- in the format as needed by GEN44: *f33 0 16384 -44 "cylinder_128.matrxT"*

The Generator starts counting at 1, but the real start value is up to the user. It ends generating values for Lines or Clusterts until matrix size or lower by setting the 'matrix size' slider.
In the example below the matrix size is set to 128.

Both the start value and end value can be set . Start may be >1, end values < matrix values; in that case, a cut section of that Pattern will be generated.

Matrix size value is printed to the name of the output file, for example: string_128.matrxT.
This provides the user the information so that he/she can use this to set the correct value to the other tables that are needed: initial position, damping, masses, centering and displace (=velocity).
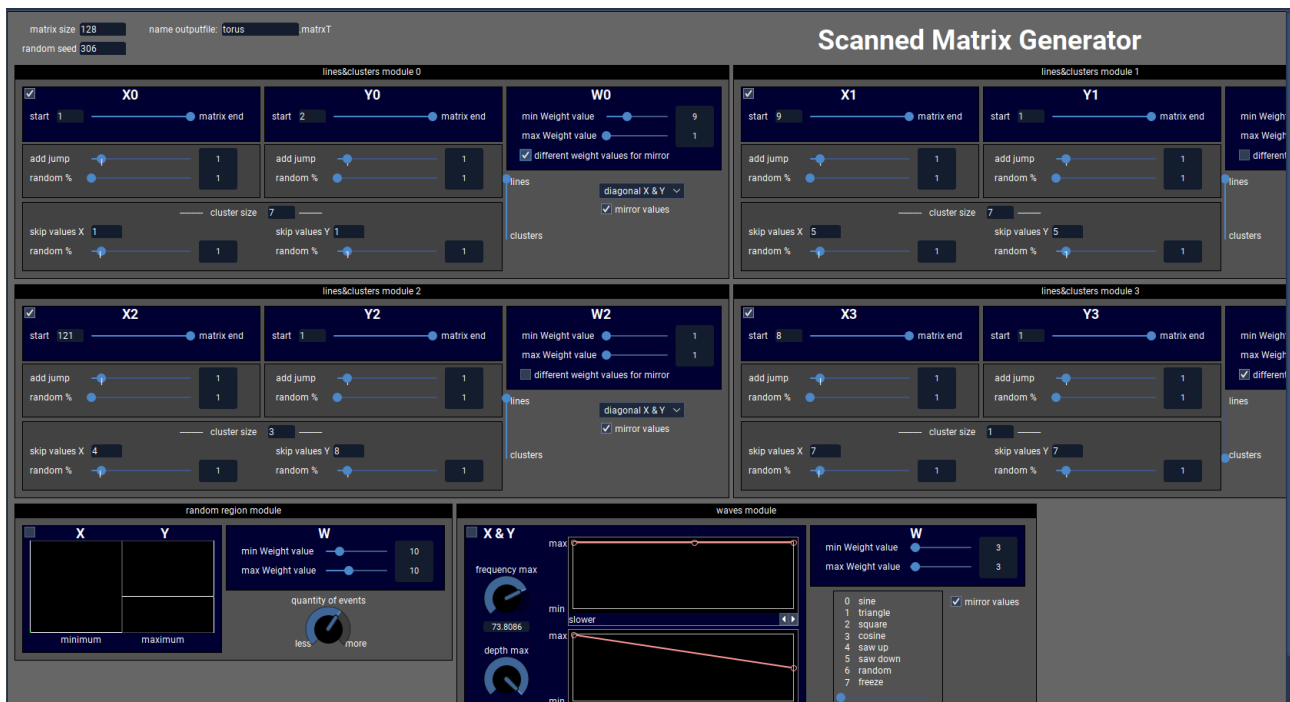
The Scanned Matrix Generator provides 3 different ways for generating the X, Y and W coordinates. X and Y are the coordinates, W is the weight of that node (see GEN44 information):

1. **Lines & Clusters**: Lines are uninterrupted lines (although the lines can contain value jumps in between the nodes). Clusters are interrupted, or several 'sections' of short lines.
2. **Random Pattern**: a defined section in the Matrix can be populated with an adjustable number of nodes.
3. **Waves**: sines and other waveforms can be used to generate a continuous flow of nodes but in a waveform.

All these generator modules can be mixed to get really complicated matrices.

The 'traditional' Matrix with 128 node points (the .matrxB format) can be found as presets in the Preset list of the Instrument: string, stringcircular, grid, cylinder and torus. See tutorials: https://www.csounds.com/scanned.
They are converted 1:1 to the text format .matrxT.

2. Scanned Matrix Plot

This Python script uses the Matlabplot Python library to plot the mass nodes of a Scanned Synthesis Matrix of type 'text'.

The presentation is one comparable to the Matrix Editor from Steven Yi, a Java Matrix editor.
This Scanned Synthesis Matrix Editor is a part of the program Blue (https://blue.kunstmusik.com/).

But there are differences with the Scanned Matrix Generator:
- Steven's Matrix presentation of a Matrix starts at the top left and reads downwards. The Scanned Matrix Plot starts at the bottom left and moves upwards.
- Steven's Matrix Editor loads and edits binary matrix files (.matrxB) only, the Scanned Matrix MatLabplot reads text matrix files (.matrxT) only.
- The Scanned Matrix Plot can **not** be edited but is meant as a visual presentation only.

The Blue file has all Presets matrices, like cylinder, string and torus. These .matrxT files should sound exactly like their older brothers that are in .matrxB format.
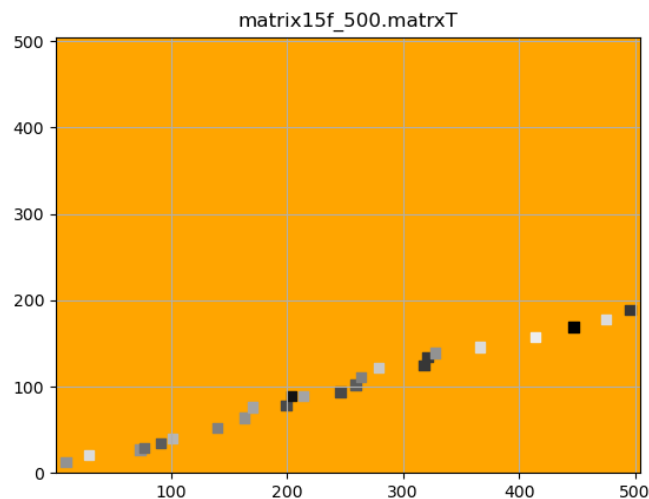
In this example, looking at the name of the file: matrix15f_500.matrxT, you can see that a Matrix, named matrix15f, contains 500 points. The dots show their coordinates. The dots have a color range from white to black, representing the lowest and the highest weight of that mass.

3. Scanned Trajectory Generator

For the scans opcode, the table of a Trajectory does not need to have the same size as the other ftables used in scanu/scanu2. Size can be higher, equal or smaller. There can even be empty values (spaces).
In short: you do not have to scan all the masses in a Matrix, but you can decide what portions you want to scan and how many times you want to scan that portion- or another section:
a smaller size ftable makes a 'slice' of the masses to scan, and repeats the scan of that portion of the matrix nodes.

Example of the 'old' Trajectory text format in action, read by GEN23:

ifntraj ftgen   7, 0, 0, -23, "128-spiral-8,16,128,2,1over2.traj"

(Let Csound determine the size of the elements by using '0'. The negative value for GEN23 (-23) is to avoid normalization.)

The format of the Scanned Trajectory Generator is: **NAME_maxVALUE_NUMBER.traj**
where:
1. NAME : the name to identify this trajectory. Can be anything that makes sense to you.
2. _maxNUMBER : the maximum value of the mass node you want to include
3. _NUMBER   : length of the trajectory. May be higher, equal or lower than the number of mass nodes in the Matrix.

Example of the format as generated by the Scanned Trajectory Generator :

ifntraj ftgen   7, 0, 0, -23, "spiral_max128_128.traj"

The value must be between 0 and the max or equal amount of nodes in the Matrix.
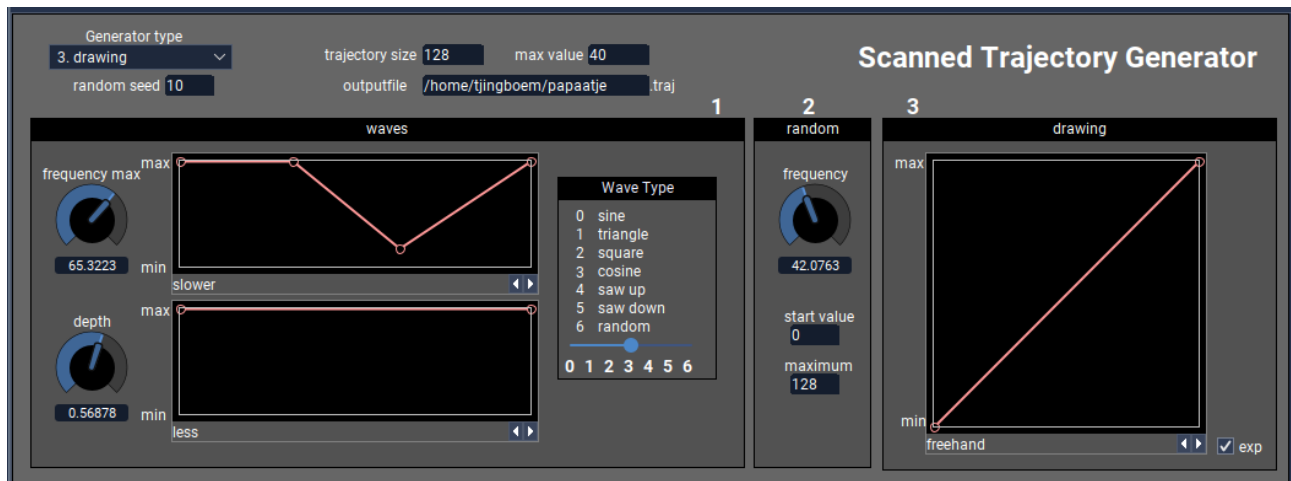
4. Scanned Trajectory Plot

This Python script uses the Matlabplot Python library to plot a Scanned Synthesis Trajectory. This is a trajectory connecting the value points, showing how the mass nodes of the scanned synthesis Matrix are going to be read.

The Trajectory has a great influence on the sonic result.

When the trajectory would be linear, like going from beginning to end, all mass nodes would be scanned in sequence like a straight line, scanning the Matrix from zero to end.
The Scanned Trajectory Generator is used to generate the Trajectory by the Waves, Random points or Drawing modules manually;
the Scanned Trajectory Plot shows the generated routes reading through the Matrix. It is a visual presentation of this route.

The format of the Scanned Trajectory Generator is: **NAME_maxVALUE_NUMBER.traj**
where:
1. NAME : the name to identify this trajectory. Can be anything that makes sense to you.
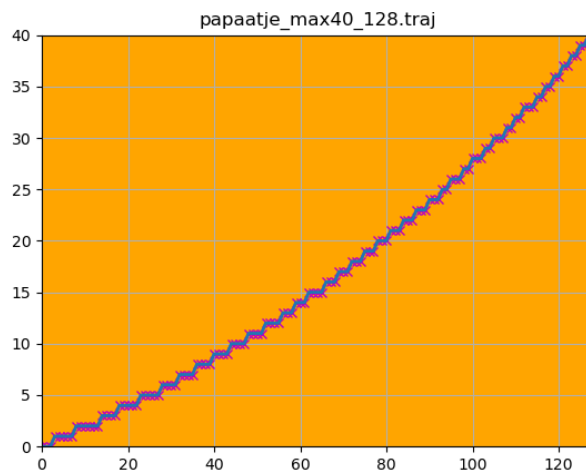
2. _maxNUMBER : the maximum value of the mass node you want to include
3. _NUMBER   : length of the trajectory. May be higher, equal or lower than the number of mass nodes in the Matrix.

Trajectories that are NOT in this format can not be recognized and shown.

Example 1: *ifntraj1 ftgen   7, 0, 0, -23, "spiral01_max128_129.traj"*
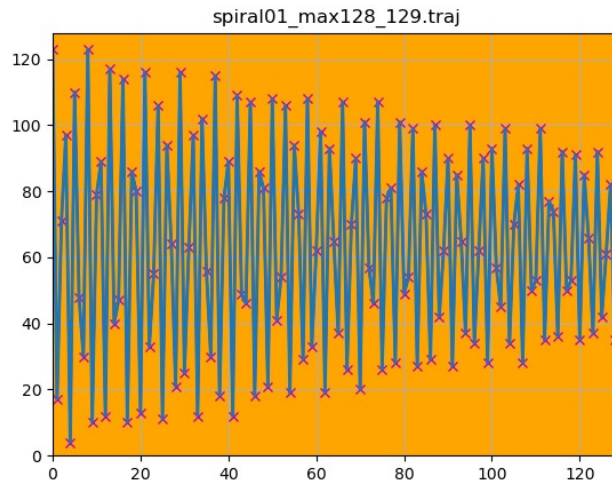
Example 2: *ifntraj2 ftgen   7, 0, 0, -23, "papaatje_max40_128.traj"*

Final Thoughts

2 things are needed to set an existing table in motion: the matrix and the trajectory. Using different matrices results the table to sound in **different harmonics**. While different trajectories (reading back the table) result in a **filter** effect on these harmonics: when a Trajectory does not scan the matrix from 1 to matrix size completely, it will not scan all matrix nodes so some harmonics (that are in movement) will not all be read at all or are less strong. And a fast scan trajectory like the one you see above, adds a FM like distortion.