Mining the New GENDYN Program – Tilling Among Fields of Dynamic Stochastic Synthesis

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ABSTRACT **We report on a project that could be characterized as a mining and discovery expedition among the data fields that reside within, and are expressed with, the Dynamic Stochastic Synthesis (GENDYN) algorithm as realized in The New GENDYN Program[1]. The New GENDYN Program is a faithful implementation of Iannis Xenakis' sound synthesis algorithm (as realized in his work GENDY3, 1991), that also provides a framework within which extensive research into the world of rigorous algorithmic composition is possible. The GENDYN algorithm can generate an entire work of computable sonic art from a baseline of "nothing", i.e. with no a-priori defined sonic source material: all sound is the emergent result of the definition of initial conditions among the multitude of parameters within the algorithm, and as then executed by the probability distributions incorporated therein: a musical work is created by execution of a computational process obeying an algorithmic procedure. We report on work that has extended the GENDYN algorithm by implementing large-scale and massively parallel techniques, illuminating and demonstrating capabilities such as dynamic stochastic granular synthesis, stochastic melody (pitch distribution), and stochastic harmonic (vertical) structures. We focus our analytics on a custom user interface created with the Matlab algorithmic development environment that integrates with the New GENDYN Program, achieving a level of organizational control among the synthesis parameters within the GENDYN. We identify the relationships between the defined parameters of the algorithm's initial conditions and their ultimate influence on the characteristics of the resulting sound such as timbre, event duration, density, and pitch. We also investigate the problem of representing the multi-faceted dimensions of the stochastic synthesis: organizing the extensive and expansive quantities of numerical data generated by the GENDYN algorithm; systematizing the relationships across the initial conditions and the structural functions they serve within the computed compositional sonic work. Examples of computed etudes are presented as well as demonstrations of the aforementioned relationships between GENDYN initial conditions and resulting synthesized works. We propose areas of research for future investigation.**

[1] **Peter Hoffmann (2000). "The New GENDYN Program". Computer Music Journal 24(2) pp. 31-38.**

Computable Sound

What is Computable Sound?

One definition might be:

"Sound that is the result of the mechanized process of a general purpose computer, following procedures described by the instructions of a computer program (based on a formal logic system), and that can be represented abstractly as an algorithm."

"Tilling"

I chose this metaphor as it seems to capture the sense of the manner with which I explore and investigate the New GENDYN Program: digging, plowing, cultivating, raking, hoeing, preparing, etc., data and numbers in multiple manifestations of representation.

Computer Music

Peter Hoffmann describes[2] two primary cultures of Computer Music:

1. Disguised Computer Music

"This majority trend in computer music strives at emulating human music making by computers, e.g. by using Artificial Intelligence, Expert Systems, Neural Networks, Psychoacoustics, and Cognitive Sciences. These people want the machines to do what humans do. Humans are supposed to appreciate the machine's artifacts within their inherited cultural framework."

2. Explicit Computer Music

"This attitude, put forward by some computer music composers aims at creating music which is specific to machines, stressing the computational aspect in its composition, by using rigorous formalisms, machine sounds which have no equivalent in Nature, and by conceptualizing and problematizing the use of computers in music."

My work is aligned with the second, Explicit Computer Music.

[2] Peter Hoffmann (2009). "*Music Out of Nothing? A Rigorous Approach to Algorithmic Composition by Iannis Xenakis*". PhD Thesis, Technical University of Berlin, Berlin, 2009.

What is Dynamic Stochastic Synthesis, GENDYN, and The New GENDYN Program?

- **Practically, the first two terms can be interchangeable.**

- ***Dynamic Stochastic Synthesis or GÉNération DYNamique Stochastique (GENDYN for short),*** **can be considered the underlying algorithmic process that is utilized to synthesize the computer generated sound. An entire sonic creation is computed and delivered from essentially nothing but initial conditions.**

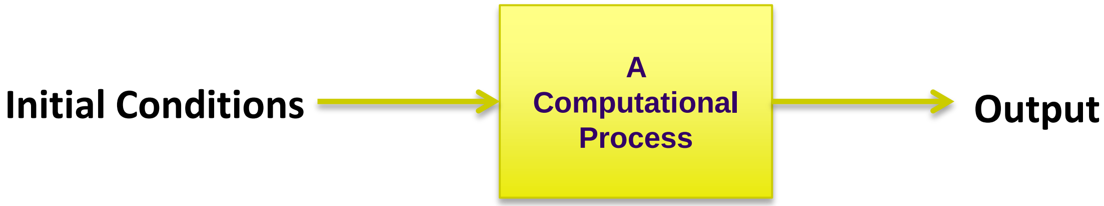
- ***The New GENDYN Program,*** **is a faithful reproduction of Xenakis' algorithm that has been expanded and augmented to incorporate additional capabilities not available at the time Xenakis originally developed his project, as a Windows application with real-time features. I adopted the Matlab algorithm development environment to further augment and facilitate large-scale manipulation of initial conditions and GENDYN parameters.**

Sounds, Images, and Data in the GENDYN Framework

- My paper may be misplaced in this conference; however it's possible it may also be applicable, by considering the following:
  - Computable Sound requires 44,100 numbers per audible second (based on the Compact Disc standard), for a monophonic digital sound file.
  - 1 minute contains 2,646,000 numbers (let's call this value "N").
  - With The New GENDYN Program, I have generated masses of sound that required {64 (tracks) x 50 (sections/track) x N} numbers to represent – or 8,467,200,000 numbers – for 1 minute of sound.
  - Extending further, a 15 minute GENDYN work (or any comparable computer-generated piece), could require 127,008,000,000 numbers to represent it.
  - This equates to 2,032,128,000,000 bits to represent those numbers (in excess of 2 Trillion bits, or 254,016,000,000 bytes, or 236.57 GB)
- How can such data be represented, manipulated, managed, or organized?

Representing Computable Sound

- Explicit Computer Music (or Computable Sound) Composition could be generalized as follows:

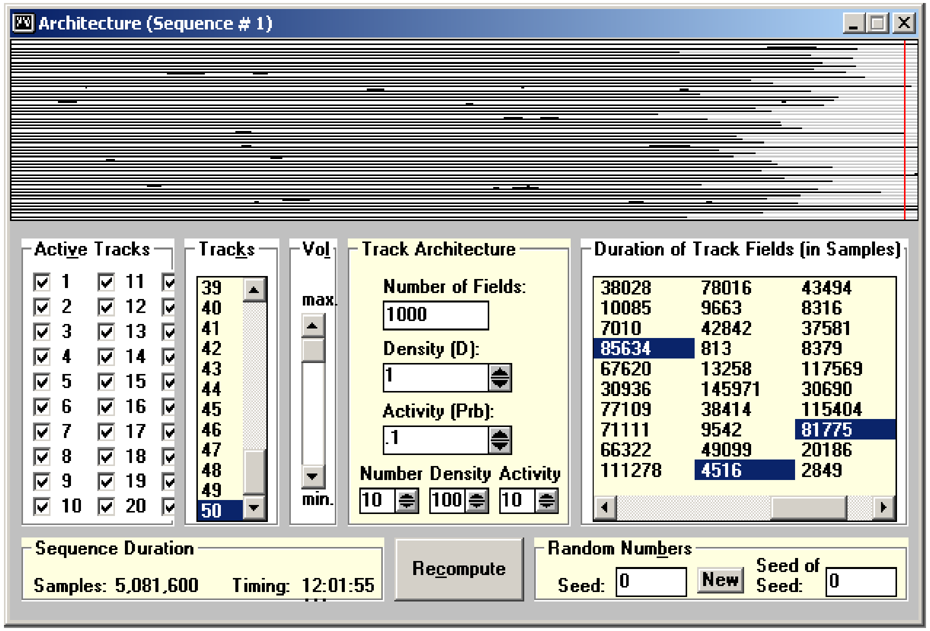


- The set(s) of *Initial Conditions* can be extensive and complex

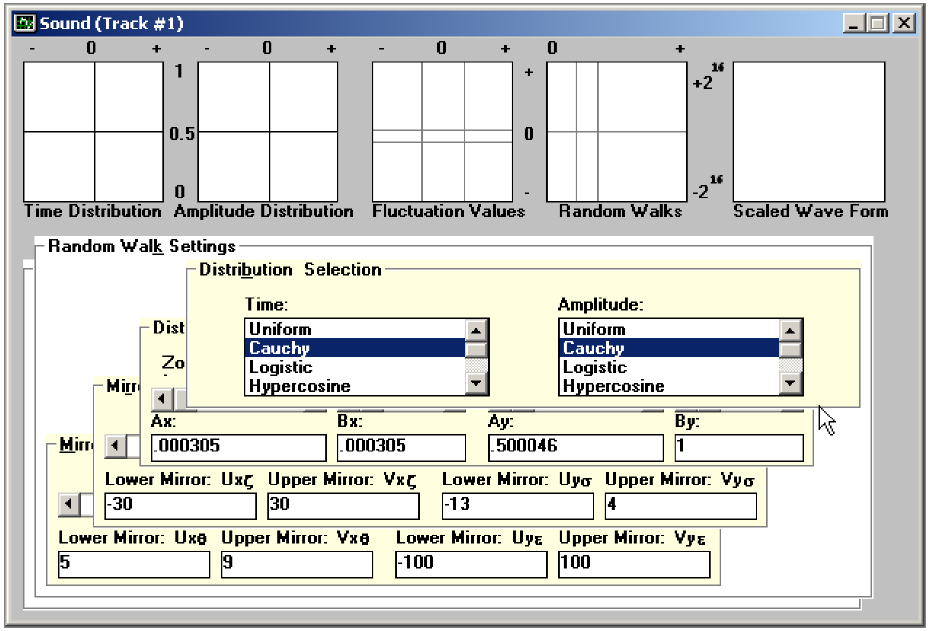
- The *Output(s)* can be as extensive and complex, or not, with respect to the input conditions

The New GENDYN Program

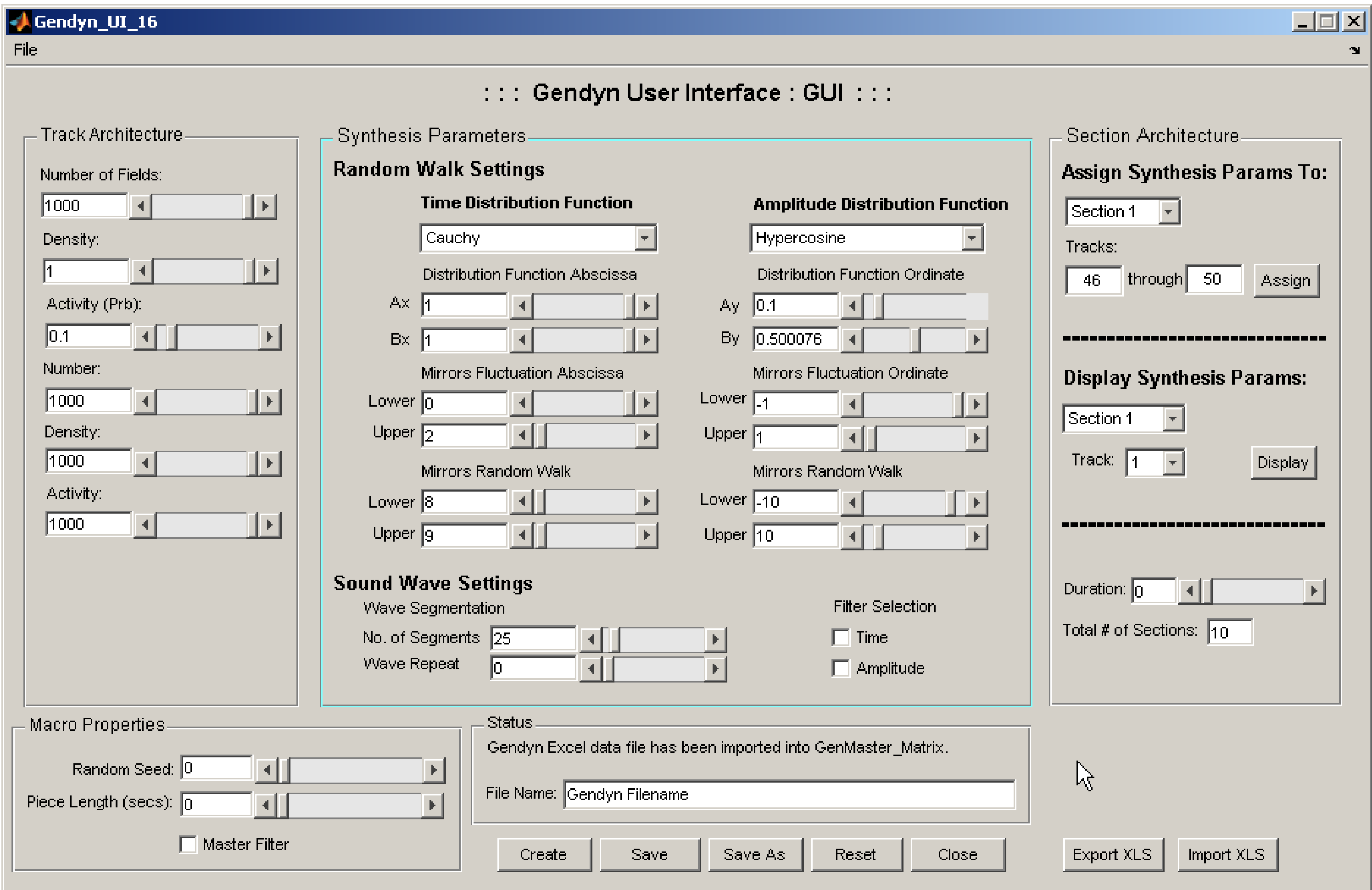
Architecture Synthesis



Timbre Synthesis



Extending The New GENDYN Program - Matlab



Quantifying and Representing

			Track Architecture									Waveform				
			Local			Global			Track Ranges			Breakpoints		Filter Selection		
Samplitude VIP	Clusters Reference #	Legacy Gendyn WAV File	# Fields	Density	Activity (Prb)	# Fields	Density	Activity (Prb)	Group #	# Tracks	Track Range	Wave Seg.	Wave Repeat	Time	Ampl	Pitch
Clusters_71.03 (d minor)		CAUHYP	1000	1	0.1	10	100	10	1	5	1-5	25	0	X	X	D5
		CAUHYP	1000	1	0.1	10	100	10	2	5	6-10	28	0	X	X	C5
		CAUHYP	1000	1	0.1	10	100	10	3	5	11-15	12	0	X	X	Bf4
		CAUHYP	1000	1	0.1	10	100	10	4	5	16-20	11	0	X	X	A4
		CAUHYP	1000	1	0.1	10	100	10	5	5	21-25	14	0	X	X	F4
		CAUHYP	1000	1	0.1	10	100	10	6	5	26-30	17	0	X	X	D4
		CAUHYP	1000	1	0.1	10	100	10	7	5	31-35	22	0	X	X	A3
		CAUHYP	1000	1	0.1	10	100	10	8	5	36-40	26	0	X	X	F3
		CAUHYP	1000	1	0.1	10	100	10	9	5	41-45	29	0	X	X	D3
		CAUHYP	1000	1	0.1	10	100	10	10	5	46-50	31	0	X	X	C#3

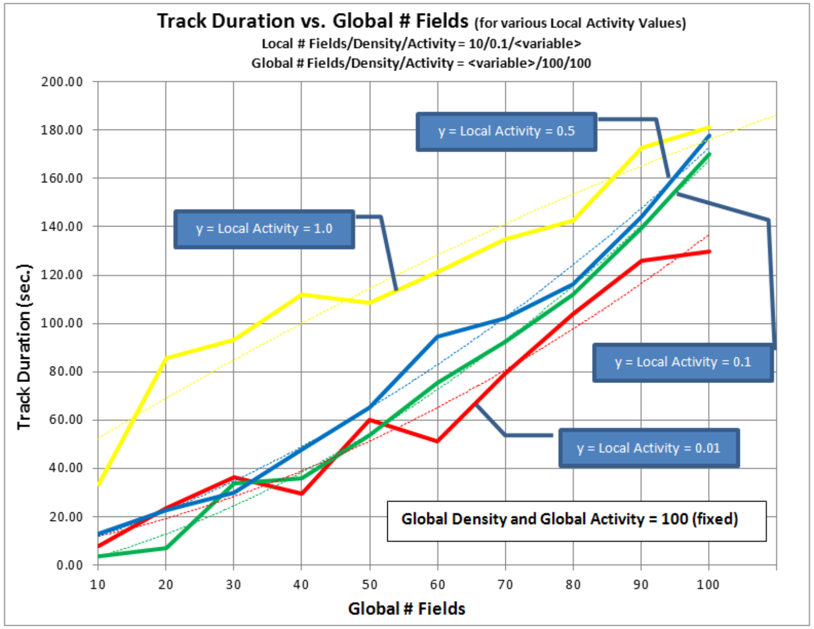
	Synthesis Parameters													
	Time							Amplitude						
		Distribution Function		Mirror Flucuations		Random Walk Mirror			Distribution Function		Mirror Flucuations		Random Walk Mirror	
Pitch	Distr	Ax	Bx	Lower	Upper	Lower	Upper	Distr	Ay	By	Lower	Upper	Lower	Upper
D5	Cauchy	1	1	0	2	8	9	Hyp	0.1	0.5000763	-1	1	-10	10
C5	Cauchy	1	1	0	2	8	9	Hyp	0.1	0.5000763	-1	1	-10	10
Bf4	Cauchy	1	1	0	2	8	8	Hyp	0.1	0.5000763	-1	1	-10	10
A4	Cauchy	1	1	0	2	9	9	Hyp	0.1	0.5000763	-1	1	-10	10
F4	Cauchy	1	1	0	2	9	9	Hyp	0.1	0.5000763	-1	1	-10	10
D4	Cauchy	1	1	0	2	9	9	Hyp	0.1	0.5000763	-1	1	-10	10
A3	Cauchy	1	1	0	2	18	28	Hyp	0.1	0.5000763	-1	1	-10	10
F3	Cauchy	1	1	0	2	18	30	Hyp	0.1	0.5000763	-1	1	-10	10
D3	Cauchy	1	1	0	2	18	32	Hyp	0.1	0.5000763	-1	1	-10	10
C#3	Cauchy	1	1	0	2	18	30	Hyp	0.1	0.5000763	-1	1	-10	10

Waveform										Synthesis Parameters													
Breakpoints		Filter Selection								Time							Amplitude						
											Distribution Function		Mirror Fluctuations		Random Walk Mirror			Distribution Function		Mirror Fluctuations		Random Walk Mirror	
Wave Seg.	Wave Repeat	Time	Ampl	Note	Pitch Frequency (Actual) (Hz)	Peak Level of Fund. Freq. (dB)	Pitch Frequency (Reference) (Hz)	Abs. Value Freq. Deviation	Percent Deviation	Distr	Ax	Bx	Lower	Upper	Lower	Upper	Distr	Ay	By	Lower	Upper	Lower	Upper
33	0	X	X	C2	65.000	-33.900	65.406	0.406	0.625	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
35	0	X	X	C#2	70.000	-38.500	69.296	0.704	1.006	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
34	0	X	X	D2	72.000	-30.100	73.416	1.416	1.957	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
32	0	X	X	D#2	76.000	-28.300	77.782	1.782	2.318	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
30	0	X	X	E2	82.000	-32.700	82.407	0.407	0.496	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
28	0	X	X	F2	88.000	-35.000	87.307	0.693	0.787	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
26	0	X	X	F#2	94.000	-30.000	92.499	1.501	1.597	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
25	0	X	X	G2	98.000	-28.900	97.999	0.001	0.001	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
24	0	X	X	G#2	103.000	-33.700	103.826	0.826	0.802	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
22	0	X	X	A2	112.000	-28.300	110.000	2.000	1.786	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
21	0	X	X	A#2	116.000	-34.600	116.541	0.541	0.466	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
20	0	X	X	B2	123.000	-35.100	123.470	0.470	0.382	Cauchy	1	1	0	2	18	18	Hypercosine	0.1	0.5000763	-1	1	-10	10
35	0	X	X	C3	127.000	-35.100	130.810	3.810	3.000	Cauchy	1	1	0	2	18	30	Hypercosine	0.1	0.5000763	-1	1	-10	10
31	0	X	X	C#3	142.000	-42.600	138.591	3.409	2.401	Cauchy	1	1	0	2	18	30	Hypercosine	0.1	0.5000763	-1	1	-10	10
29	0	X	X	D3	146.000	-38.300	146.832	0.832	0.570	Cauchy	1	1	0	2	18	32	Hypercosine	0.1	0.5000763	-1	1	-10	10
28	0	X	X	D#3	158.000	-35.100	155.563	2.437	1.542	Cauchy	1	1	0	2	18	31	Hypercosine	0.1	0.5000763	-1	1	-10	10
27	0	X	X	E3	163.000	-30.100	164.814	1.814	1.113	Cauchy	1	1	0	2	18	31	Hypercosine	0.1	0.5000763	-1	1	-10	10
26	0	X	X	F3	172.000	-31.000	174.614	2.614	1.520	Cauchy	1	1	0	2	18	30	Hypercosine	0.1	0.5000763	-1	1	-10	10
24	0	X	X	F#3	186.000	-37.300	184.997	1.003	0.539	Cauchy	1	1	0	2	18	30	Hypercosine	0.1	0.5000763	-1	1	-10	10
24	0	X	X	G3	196.000	-38.000	195.998	0.002	0.001	Cauchy	1	1	0	2	18	29	Hypercosine	0.1	0.5000763	-1	1	-10	10
22	0	X	X	G#3	203.000	-28.300	207.652	4.652	2.292	Cauchy	1	1	0	2	18	30	Hypercosine	0.1	0.5000763	-1	1	-10	10
22	0	X	X	A3	223.000	-27.600	220.000	3.000	1.345	Cauchy	1	1	0	2	18	28	Hypercosine	0.1	0.5000763	-1	1	-10	10
21	0	X	X	A#3	233.000	-25.400	233.082	0.082	0.035	Cauchy	1	1	0	2	18	28	Hypercosine	0.1	0.5000763	-1	1	-10	10
20	0	X	X	B3	245.000	-32.100	246.942	1.940	0.792	Cauchy	1	1	0	2	18	28	Hypercosine	0.1	0.5000763	-1	1	-10	10
19	0	X	X	C4	257.000	-30.700	261.630	4.630	1.802	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
18	0	X	X	C#4	272.000	-26.500	277.180	5.180	1.904	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
17	0	X	X	D4	288.000	-26.200	293.670	5.670	1.969	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
16	0	X	X	D#4	306.000	-27.600	311.130	5.130	1.676	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
15	0	X	X	E4	326.000	-32.200	329.630	3.630	1.113	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
14	0	X	X	F4	351.000	-25.500	349.230	1.770	0.504	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
13	0	X	X	F#4	373.000	-38.200	369.990	3.010	0.807	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
14	0	X	X	G4	394.000	-25.500	392.000	2.000	0.508	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	10
12	0	X	X	G#4	408.000	-28.200	415.300	7.300	1.789	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
11	0	X	X	A4	445.000	-30.000	440.000	5.000	1.124	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
12	0	X	X	A#4	460.000	-28.300	466.160	6.160	1.339	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	10
10	0	X	X	B4	490.000	-30.800	493.880	3.880	0.792	Cauchy	1	1	0	2	9	9	Hypercosine	0.1	0.5000763	-1	1	-10	10
28	0	X	X	C5	522.000	-39.200	523.250	1.250	0.239	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
27	0	X	X	C#5	544.000	-32.100	554.370	10.370	1.906	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
25	0	X	X	D5	587.000	-29.400	587.330	0.330	0.056	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
24	0	X	X	D#5	614.000	-36.100	622.250	8.250	1.344	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
22	0	X	X	E5	647.000	-54.600	659.260	12.260	1.895	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
21	0	X	X	F5	696.000	-36.500	698.460	2.460	0.353	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
20	0	X	X	F#5	735.000	-34.300	739.990	4.990	0.679	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
19	0	X	X	G5	774.000	-32.400	783.990	9.990	1.291	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
18	0	X	X	G#5	819.000	-28.600	830.610	11.610	1.418	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
17	0	X	X	A5	864.000	-28.200	880.000	16.000	1.852	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
16	0	X	X	A#5	916.000	-29.600	932.330	16.330	1.783	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
15	0	X	X	B5	974.000	-37.700	987.770	13.770	1.414	Cauchy	1	1	0	2	8	9	Hypercosine	0.1	0.5000763	-1	1	-10	-10
16	0		X	C6	1033.000	-39.200	1046.502	13.502	1.307	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	-10
15	0		X	C#6	1103.000	-32.100	1108.731	5.731	0.520	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	-10
14	0		X	D6	1197.000	-29.400	1174.659	22.341	1.866	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	-10
13	0		X	D#6	1272.000	-36.100	1244.508	27.492	2.161	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	-10
16	0		X	E6	1313.000	-54.600	1318.510	5.510	0.420	Cauchy	1	1	0	2	4	7	Hypercosine	0.1	0.5000763	-1	1	-10	-10
12	0		X	F6	1379.000	-36.500	1398.913	19.913	1.444	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	-10
11	0		X	F#6	1503.000	-34.300	1474.978	28.022	1.864	Cauchy	1	1	0	2	8	8	Hypercosine	0.1	0.5000763	-1	1	-10	-10
13	0		X	G6	1564.000	-32.400	1567.982	3.982	0.255	Cauchy	1	1	0	2	6	7	Hypercosine	0.1	0.5000763	-1	1	-10	-10
13	0		X	G#6	1618.000	-28.600	1661.219	43.219	2.671	Cauchy	1	1	0	2	4	7	Hypercosine	0.1	0.5000763	-1	1	-10	-10
12	0		X	A6	1755.000	-28.200	1760.000	5.000	0.285	Cauchy	1	1	0	2	5	7	Hypercosine	0.1	0.5000763	-1	1	-10	-10
11	0		X	A#6	1847.000	-29.600	1864.655	17.655	0.956	Cauchy	1	1	0	2	6	7	Hypercosine	0.1	0.5000763	-1	1	-10	-10
10	0		X	B6	2032.000	-37.700	1975.533	56.467	2.779	Cauchy	1	1	0	2	6	7	Hypercosine	0.1	0.5000763	-1	1	-10	-10

Quantifying and Representing

					Track Architecture									Waveform							
					Local			Global			Track Ranges			Breakpoints		Filter Selection					
Samplitude VIP or Cluster Name	Clusters Reference #	Legacy Gendyn WAV File	Track #	Note	# Fields	Density	Activity (Prb)	# Fields	Density	Activity (Prb)	Group #	# Tracks	Track Range	Wave Seg.	Wave Repeat	Time	Ampl	Pitch Frequency (Actual) (Hz)	Peak Level of Fund. Freq. (dB)	Pitch Frequency (Reference) (Hz)	Freq. Deviation
	Clusters_54	CAUHYP04	1	D#4	100	1.00	0.01	100	100	100	1	4	1-4	16	0	X	X	306.000	-27.600	311.130	5.13
	Clusters_54	CAUHYP04	2		100	1.00	0.01	100	100	100	1										
	Clusters_54	CAUHYP04	3		100	1.00	0.01	100	100	100	1										
	Clusters_54	CAUHYP04	4		100	1.00	0.01	100	100	100	1										
	Clusters_54	CAUHYP04	5	F4	100	1.00	0.01	100	100	100	2	4	5-8	17	0	X	X	351.000	-25.500	349.230	1.77
	Clusters_54	CAUHYP04	6		100	1.00	0.01	100	100	100	2										
	Clusters_54	CAUHYP04	7		100	1.00	0.01	100	100	100	2										
	Clusters_54	CAUHYP04	8		100	1.00	0.01	100	100	100	2										
	Clusters_54	CAUHYP04	9	A4	100	1.00	0.01	100	100	100	3	4	9-12	15	0	X	X	445.000	-30.000	440.000	5.00
	Clusters_54	CAUHYP04	10		100	1.00	0.01	100	100	100	3										
	Clusters_54	CAUHYP04	11		100	1.00	0.01	100	100	100	3										
	Clusters_54	CAUHYP04	12		100	1.00	0.01	100	100	100	3										
	Clusters_54	CAUHYP04	13	A#4	100	1.00	0.01	100	100	100	4	4	13-16	12	0	X	X	460.000	-28.300	466.160	6.16
	Clusters_54	CAUHYP04	14		100	1.00	0.01	100	100	100	4										
	Clusters_54	CAUHYP04	15		100	1.00	0.01	100	100	100	4										
	Clusters_54	CAUHYP04	16		100	1.00	0.01	100	100	100	4										
	Clusters_54	CAUHYP04	17	A4	100	1.00	0.01	100	100	100	5	4	17-20	15	0	X	X	445.000	-30.000	440.000	5.00
	Clusters_54	CAUHYP04	18		100	1.00	0.01	100	100	100	5										
	Clusters_54	CAUHYP04	19		100	1.00	0.01	100	100	100	5										
	Clusters_54	CAUHYP04	20		100	1.00	0.01	100	100	100	5										
	Clusters_54	CAUHYP04	21	F4	100	1.00	0.01	100	100	100	6	4	21-24	17	0	X	X	351.000	-25.500	349.230	1.77
	Clusters_54	CAUHYP04	22		100	1.00	0.01	100	100	100	6										
	Clusters_54	CAUHYP04	23		100	1.00	0.01	100	100	100	6										
	Clusters_54	CAUHYP04	24		100	1.00	0.01	100	100	100	6										
Clusters_67.1.VIP Deen Todi	Clusters_54	CAUHYP04	25	D#4	100	1.00	0.01	100	100	100	7	4	25-28	19	0	X	X	306.000	-27.600	311.130	5.13
	Clusters_54	CAUHYP04	26		100	1.00	0.01	100	100	100	7										
	Clusters_54	CAUHYP04	27		100	1.00	0.01	100	100	100	7										
	Clusters_54	CAUHYP04	28		100	1.00	0.01	100	100	100	7										
	Clusters_54	CAUHYP04	29	C#4	100	1.00	0.01	100	100	100	8	4	29-32	18	0	X	X	272.000	-26.500	277.180	5.18
	Clusters_54	CAUHYP04	30		100	1.00	0.01	100	100	100	8										
	Clusters_54	CAUHYP04	31		100	1.00	0.01	100	100	100	8										
	Clusters_54	CAUHYP04	32		100	1.00	0.01	100	100	100	8										
	Clusters_54	CAUHYP04	33	D#4	100	1.00	0.01	100	100	100	9	4	33-36	16	0	X	X	306.000	-27.600	311.130	5.13
	Clusters_54	CAUHYP04	34		100	1.00	0.01	100	100	100	9										
	Clusters_54	CAUHYP04	35		100	1.00	0.01	100	100	100	9										
	Clusters_54	CAUHYP04	36		100	1.00	0.01	100	100	100	9										
	Clusters_54	CAUHYP04	37	C4	100	1.00	0.01	100	100	100	10	4	37-40	19	0	X	X	257.000	-30.700	261.630	4.63
	Clusters_54	CAUHYP04	38		100	1.00	0.01	100	100	100	10										
	Clusters_54	CAUHYP04	39		100	1.00	0.01	100	100	100	10										
	Clusters_54	CAUHYP04	40		100	1.00	0.01	100	100	100	10										
	Clusters_54	CAUHYP04	41	D#4	100	1.00	0.01	100	100	100	11	4	41-44	16	0	X	X	306.000	-27.600	311.130	5.13
	Clusters_54	CAUHYP04	42		100	1.00	0.01	100	100	100	11										
	Clusters_54	CAUHYP04	43		100	1.00	0.01	100	100	100	11										
	Clusters_54	CAUHYP04	44		100	1.00	0.01	100	100	100	11										
	Clusters_54	CAUHYP04	45	F4	100	1.00	0.01	100	100	100	12	4	45-48	17	0	X	X	351.000	-25.500	349.230	1.77
	Clusters_54	CAUHYP04	46		100	1.00	0.01	100	100	100	12										
	Clusters_54	CAUHYP04	47		100	1.00	0.01	100	100	100	12										
	Clusters_54	CAUHYP04	48		100	1.00	0.01	100	100	100	12										
	Clusters_54	CAUHYP04	49	A4	100	1.00	0.01	100	100	100	13	2	49-50	15	0	X	X	445.000	-30.000	440.000	5.00
	Clusters_54	CAUHYP04	50		100	1.00	0.01	100	100	100	13										

Quantifying and Representing

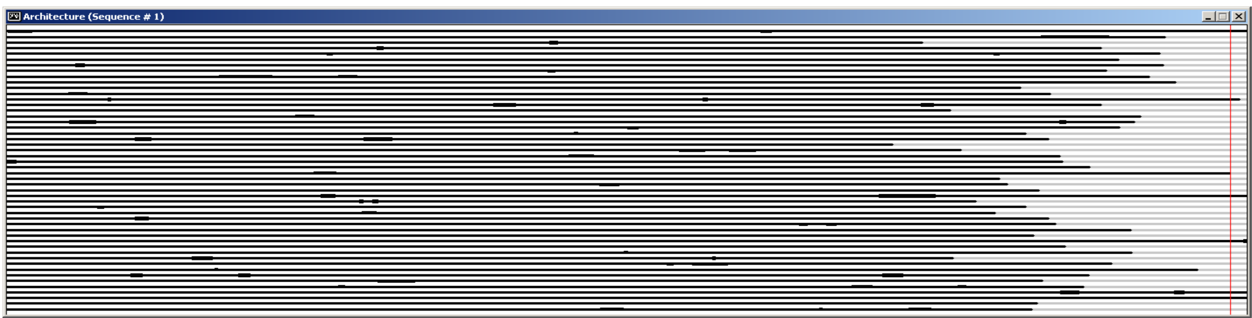


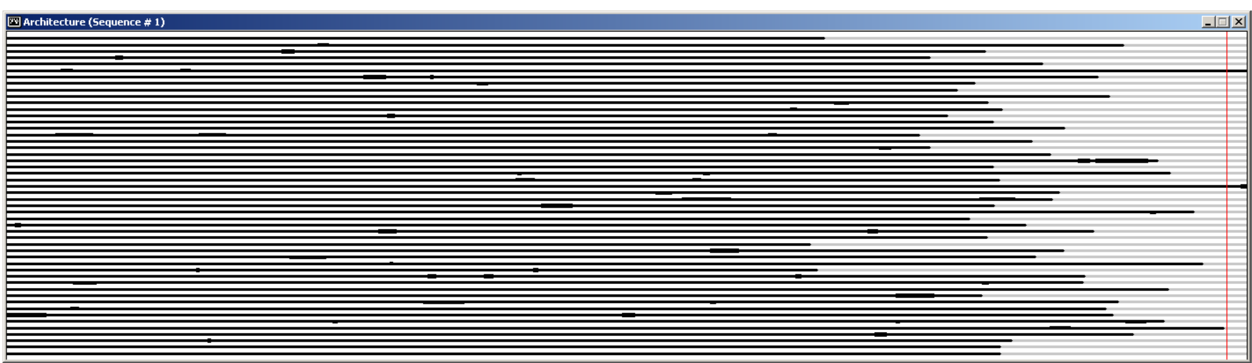
Track Architecture						Local Activity Value Variable															
Local			Global			0.01				0.10				0.50				1.00			
# Fields	Density	Activity (Prb)	# Fields	Density	Activity (Prb)	Samples	Secs.	Mins.	Log(Secs.)	Samples	Secs.	Mins.	Log(Secs.)	Samples	Secs.	Mins.	Log(Secs.)	Samples	Secs.	Mins.	Log(Secs.)
100	0.1	Variable	10	100	100	608,562	**13.80**	0.23	1.14	3,599,862	**81.63**	1.36	1.91	6,055,422	**137.31**	2.29	2.14	6,733,474	**152.69**	2.54	2.18
100	0.1		20	100	100	4,822,727	**109.36**	1.82	2.04	13,164,483	**298.51**	4.98	2.47	10,986,369	**249.12**	4.15	2.40	13,355,884	**302.85**	5.05	2.48
100	0.1		30	100	100	9,675,902	**219.41**	3.66	2.34	17,174,826	**389.45**	6.49	2.59	19,764,222	**448.17**	7.47	2.65	18,643,288	**422.75**	7.05	2.63
100	0.1		40	100	100	19,117,415	**433.50**	7.23	2.64	20,189,961	**457.82**	7.63	2.66	20,635,178	**467.92**	7.80	2.67	24,008,043	**544.40**	9.07	2.74
100	0.1		50	100	100	22,951,725	**520.45**	8.67	2.72	21,709,349	**492.28**	8.20	2.69	26,444,498	**599.65**	9.99	2.78	26,436,994	**599.48**	9.99	2.78
100	0.1		60	100	100	26,783,334	**607.33**	10.12	2.78	30,684,428	**695.79**	11.60	2.84	29,997,452	**680.21**	11.34	2.83	31,138,016	**706.08**	11.77	2.85
100	0.1		70	100	100	38,820,996	**880.29**	14.67	2.94	36,152,394	**819.78**	13.66	2.91	34,313,954	**778.09**	12.97	2.89	36,737,961	**833.06**	13.88	2.92
100	0.1		80	100	100	37,585,963	**852.29**	14.20	2.93	38,242,317	**867.17**	14.45	2.94	42,628,281	**966.63**	16.11	2.99	30,020,838	**680.74**	11.35	2.83
100	0.1		90	100	100	38,304,362	**868.58**	14.48	2.94	40,113,804	**909.61**	15.16	2.96	45,724,067	**1036.83**	17.28	3.02	49,298,765	**1117.89**	18.63	3.05
100	0.1		100	100	100	41,083,209	**931.59**	15.53	2.97	48,645,500	**1103.07**	18.38	3.04	46,437,474	**1053.00**	17.55	3.02	50,627,396	**1148.01**	19.13	3.06
10	0.1	Variable	10	100	100	337,559	**7.65**	0.13	0.88	156,598	**3.55**	0.06	0.55	578,673	**13.12**	0.22	1.12	1,471,278	**33.36**	0.56	1.52
10	0.1		20	100	100	1,033,875	**23.44**	0.39	1.37	307,988	**6.98**	0.12	0.84	999,036	**22.65**	0.38	1.36	3,770,890	**85.51**	1.43	1.93
10	0.1		30	100	100	1,601,429	**36.31**	0.61	1.56	1,485,901	**33.69**	0.56	1.53	1,318,470	**29.90**	0.50	1.48	4,108,880	**93.17**	1.55	1.97
10	0.1		40	100	100	1,294,822	**29.36**	0.49	1.47	1,573,016	**35.67**	0.59	1.55	2,113,432	**47.92**	0.80	1.68	4,940,170	**112.02**	1.87	2.05
10	0.1		50	100	100	2,649,495	**60.08**	1.00	1.78	2,369,101	**53.72**	0.90	1.73	2,870,783	**65.10**	1.08	1.81	4,790,319	**108.62**	1.81	2.04
10	0.1		60	100	100	2,256,045	**51.16**	0.85	1.71	3,321,625	**75.32**	1.26	1.88	4,173,386	**94.63**	1.58	1.98	5,356,503	**121.46**	2.02	2.08
10	0.1		70	100	100	3,485,509	**79.04**	1.32	1.90	4,078,105	**92.47**	1.54	1.97	4,509,816	**102.26**	1.70	2.01	5,949,984	**134.92**	2.25	2.13
10	0.1		80	100	100	4,582,749	**103.92**	1.73	2.02	4,926,903	**111.72**	1.86	2.05	5,116,642	**116.02**	1.93	2.06	6,285,143	**142.52**	2.38	2.15
10	0.1		90	100	100	5,554,923	**125.96**	2.10	2.10	6,156,711	**139.61**	2.33	2.14	6,352,264	**144.04**	2.40	2.16	7,607,744	**172.51**	2.88	2.24
10	0.1		100	100	100	5,715,282	**129.60**	2.16	2.11	7,498,277	**170.03**	2.83	2.23	7,832,592	**177.61**	2.96	2.25	7,987,121	**181.11**	3.02	2.26

Quantifying and Representing

- **GENDYN sound is comprised of events that occur at multiple simultaneous scales, defined by stochastic processes in the form of probability distributions.**

Example: Clusters_73.03_no_01 + 02

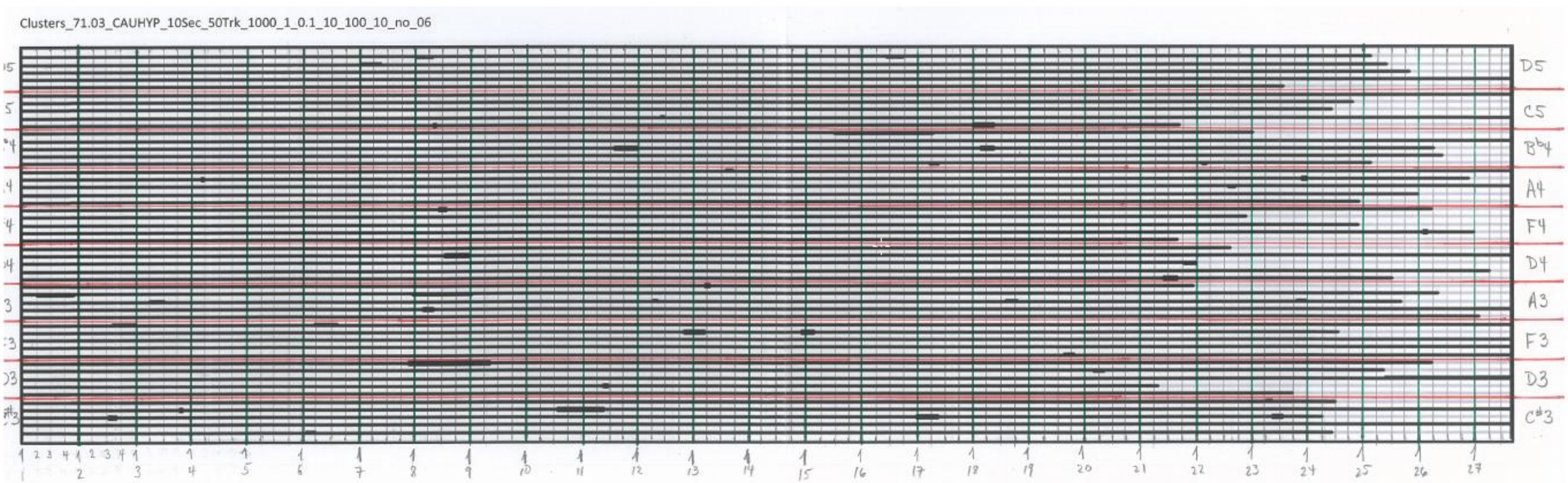




Quantifying and Representing

- **GENDYN sound is comprised of events that occur at multiple simultaneous scales, defined by stochastic processes in the form of probability distributions.**

Example: Clusters_71.03_no_05



Quantifying and Representing