Composing with Sequences: ...but is it art?

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Overview

- Algorithmic Composition – Very brief history
- PGA-1 – A two-part invention
  - The Sequence (Fibonacci partition fractal)
  - The Tool (Dow program)
  - The Score (not what you think…)
  - The Tune (a hopefully flawless performance)

Algorithmic Composition – History

- Guido d'Arezzo (1026) – vowel -> pitch
- Guillaume Dufay (1400's) – golden mean
- W. A. Mozart – Musikalisches Würfelspiele (dice music)
- Xenakis, Cage – "chance" music
- Fractal Music
  - Music is fractal (Voss, etc.)
  - so maybe fractals are musical?

Algorithmic Composition: Categories and Issues

- Timbres vs. Notes (Notes)
- Deterministic vs. Stochastic (Deterministic)
- Natural vs. Artificial (Artificial)
- Surface vs. Deep Structure (Relatively Deep)
- Composed vs. Sonified (Composed hopefully!)
- Expectation vs. Surprise

The Sequence – Definition

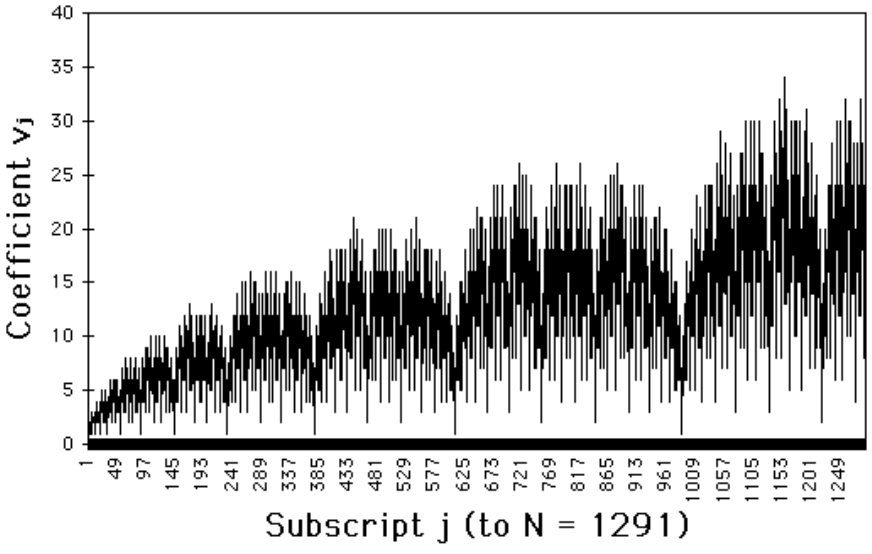
- Fibonacci Partition Fractal – Peter G. Anderson (PGA-1)
- Counts how many ways j is the sum of distinct Fibonacci numbers
- Sequence of v_j coefficients such that

$$\sum_{j=0}^{F_{N+2}-2} v_j x^j = \prod_{k=2}^{N} (1 + x^{F_k})$$

where $F_{N+2} - 2 = F_2 + F_3 + \cdots + F_N$

- Fractal dimension = log 2 / log 1.618 ≈ 1.44

The Sequence – Picture



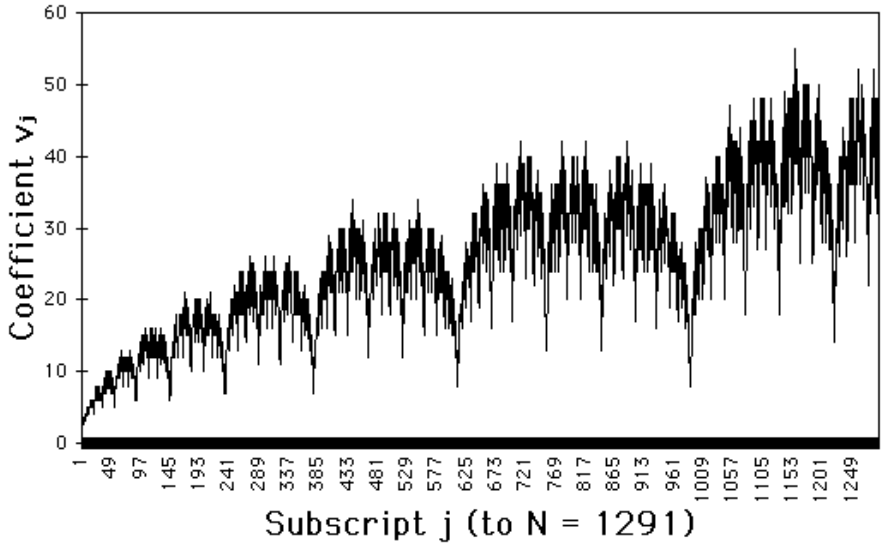
The Sequence – Properties

- Self-similarity – repeated elaborations (theme & variation)
- Each elaboration contains all its predecessors
- New detail is always "higher" than its predecessors
- Elaboration lengths are Fibonacci numbers
- Sub-structures of every elaboration are Fibonacci length
- Use first 1291 elements (middle of the 14th elaboration)

A Secondary Sequence

- Slight variation – start k at 1 instead of 2 (use both 1's)
- Closely related to the primary sequence, but subtly different
- Used to provide a second voice (counterpoint)
- Also used to provide velocities (loudness) for primary sequence
- Use primary for velocities of secondary

Secondary Sequence



The Tool – Dow Program

- Sonifies sequences of numbers (sonification tool)
- Originally developed for “stock arrangements”
- Each sequence maps to a separate voice (MIDI channel)
- Elements in a sequence map to events (pitch and velocity)
- Successive events that map to the same pitch are held (rhythm)
- Composer sets tempo, tonality, timbre, etc.
  - Can (re)set any parameters at any time
  - These are the primary compositional decisions

Tonality – Musical Scales

- Map pitch data to actual notes through scales (western 12-tone music)
- Scales set expectations
  - Changing scales introduces surprise
- Standard modes, chromatic, progressive scales
- Progressive – Key signature progresses
  - Overlapping scales share notes
  - Progressive Major – Hexatonic major (avoid 4th)
- C D E G A B D E F# A B C# E F# G# B C# D# F# G# A#

  |<---- C ---->|<----- D ------>|<-------- E ------->|

  |<---- G ----->|<------ A ------->|<-------- B -------->|

Tempo and Rhythm

- Events conceptualized as eighth notes
- Tempo units are in beats per minute (2 eighth notes per beat)
- Perception of different tempo ranges

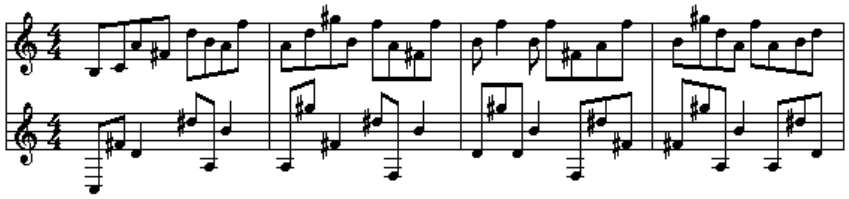
  < 15 BPM (30 events per minute, 2 seconds per event)
  - Perceived as isolated tones

  30 BPM to 300 BPM (musical sweet spot)
  - Perceived as musical phrases (traditional “music”)

  > 300 BPM (10 events per second, 100 ms per event)
  - Perceived as textures (can’t perceive individual notes)

Greatest Hit

- Several nice moments, but this one stood out
- Elements 897-928 from elaboration 13b
- 32 events => four 4/4 measures, 170 BPM
- Mapped to pitches with chromatic scale
- Lower stave primary sequence, upper secondary



Timbre (Instruments)

- Origin – acoustic vs. electronic
- Complexity – single vs. multiple layers
- Envelope
  - percussive vs. sustained
  - simple vs. complex
- Mutual blending characteristics – solo vs. ensemble
- Useful pitch range – broad vs. narrow

PGA-1 – The Concept

- Highlight the structure (elaborations) in the sequence
- Each elaboration is a section with different parameter settings
- Gradual changes vs. abrupt shifts (minimalist?)
- Mostly tonal vs. atonal or anti-tonal
- Rhythmic vs. arrhythmic
- Unifying high-level form – more than sum of its sections

PGA-1 – The Story

- Begins with a single voice in the distance
- Gradually approaches and speeds up
- Divides into two voices (counterpoint)
- Continues to accelerate, get more complex and energetic
- Tonality and timbres change for variety
- Returns to original timbre for last two elaborations

PGA-1 – The Score

Elab	Leng	Tempo	Time	Scale	Pan	Reverb	Instruments
1	1	10	3	Chromatic	0	120	HarpVox
2	2	20	3	Chromatic	0	120	HarpVox
3	3	25	3.6	Chromatic	6	110	HarpVox
4	5	30	5	Chromatic	12	100	HarpVox
5	8	40	6	Chromatic	18	90	HarpVox
6	13	50	7.8	Chromatic	24	80	HarpVox
7	21	65	9.7	Chromatic	32	70	HarpVox
8	34	80	12.8	Chromatic	40	60	HarpVox
9	55	105	15.7	Prog Major	56	40	HarpVox
10	89	115	23.2	Prog Major	40, 80	30, 30	HarpVox, Harp
11	144	130	33.2	Prog Minor	32, 96	20, 20	Harp, NylonHarp
12a	144	140	30.9	Prog Penta	8, 120	10, 10	WrmAtmos, Harp
12b	89	150	17.8	Prog Major	8, 120	10, 10	PizzacatoStrings
13a	144	160	27	Prog Minor	8, 120	10, 10	Kalimba, Harp
13b	233	170	41.1	Chromatic	8, 120	10, 10	HarpVox
14	306	180	51	Prog Major	8, 120	10, 10	HarpVox