Formalized (visual) Music

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Formalized Music (preface)

- "explorations in music composition"
- "to materialize movements of thought through sound…"
- "to make art while geometrizing"

Formalized Music (preface)

- "We are so convinced of the historical necessity of this step, that we should like to see the visual arts take an analogous path…"

arlequi

"All that you can *imagine* you already know."

—Stephen Spender

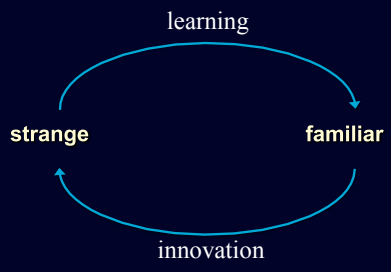
- Knowledge is built on prior knowledge
- A new idea is a new connection
  —a metaphor
- We create from what we already know.

Metaphors are connections—mappings across different conceptual domains.

See George Lakoff, Mark Johnson, et al.

values

- ***learning***
- ***innovation***



—William J. J. Gordon
Synectics

- maps are metaphors
- through potent metaphors we make connections, we learn, we create
- I make maps
- so did Xenakis

entropy

1. A measure of the *disorder* or randomness in a closed system.
2. A measure of the *loss of information* in a transmitted message.
3. The tendency for all matter and energy in the universe to evolve toward a state of *inert uniformity*.
4. Inevitable and *steady deterioration* of a system or society

entropy (in Western music)

- **Common practice tonality and equal tempered tuning is a closed system.**
- **After WWII entropy in that system was high.**
- **What did composers do?**

Structures for Piano

-Pierre Boulez (1951)

- **total serial composition**
- **total rational/systematic control**
- ***pure determinism***

Music of Changes

-John Cage (1951)

- **random/non-referential**
- ***pure chance***

and now for something completely different…

chance ⟷ control

chance

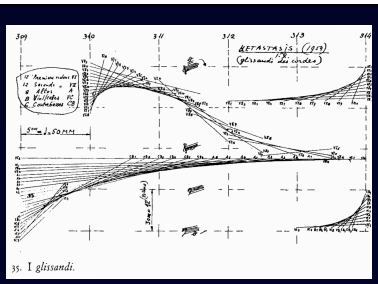
control

"Pure chance and pure determinism are only two facets of one entity."

—Xenakis

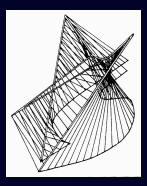
Xenakis *opened* the system

- the pitch continuum
- mapping numbers to music events
- mapping music events to architecture
- "Music and architecture found an intimate connection"

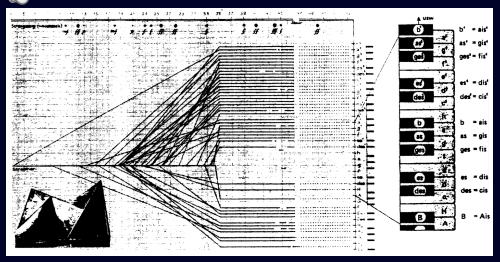


35. I *glissandi.*

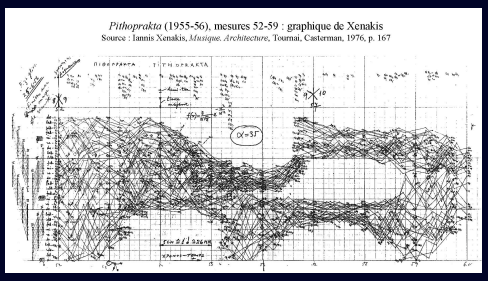
Xenakis, *Metastasis*
mathematics mapped to instruments



the modulor (Le Corbusier)



Xenakis, *Metastasis*
mathematics mapped to instruments

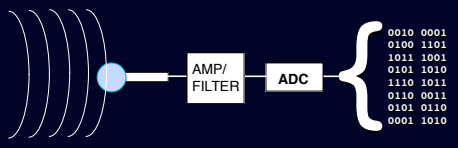


Xenakis, *Pithoprakta*
mathematics mapped to instruments

digital = discrete
digital = numeric

digital camellias

sampling sound



sound waves ➔ voltage ➔ digital data

"If music is from now on well and truly immersed in computer science, so too can be the art of light."

Iannis Xenakis
"The Diatope: music to be seen" (1982)

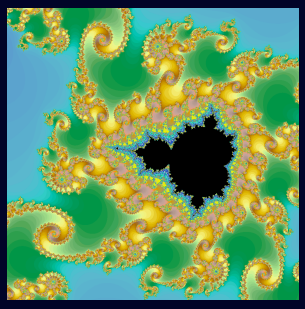
A = B digital image = number
C = B digital sound = number
then
A = C digital image = digital sound

It's all about the mapping!…

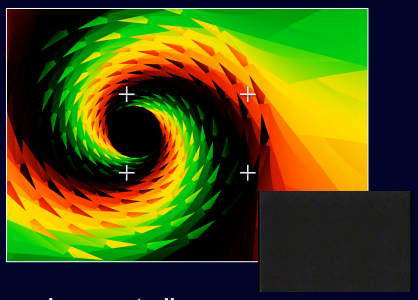
maps are metaphors!

$$z_n = z_{n-1}^2 + \lambda$$

```
z[REAL][0] = 0.0;
z[IMAG][0] = 0.0;
xSquared = 0.0;
ySquared = 0.0;

for (i=1; i < MaxIterationCount; ++i) {
        z[REAL][i] = xSquared-ySqared;
        z[IMAG][i] = 2 * z[REAL][i-1] * z[IMAG][i=1];
        xSquared = z[REAL][i] * z[REAL][i];
        ySquared = z[IMAG][i] * z[IMAG][i];
        zMag = sqrt(xSquared + ySquared);

        if (zMag >= 2){
              colorPixel(i);
              break;
        }
  }
```

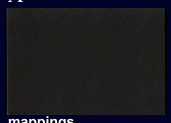


Ceci n'est pas une fractale



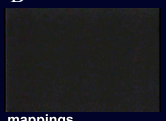
sonic map studies
ca. 1989

A



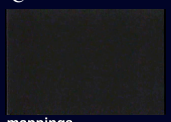
mappings
- quartertones (96 pitches)
- aperiodic (5:6:7:8)
- high event density

B



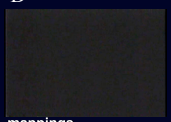
mappings
- chromatic (48 pitches)
- aperiodic (4:5:6)
- moderate event density

C

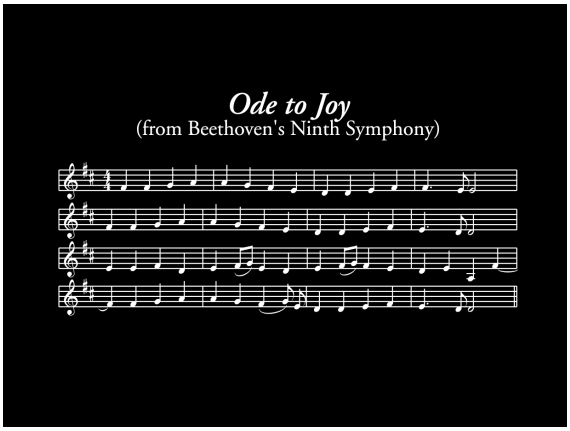


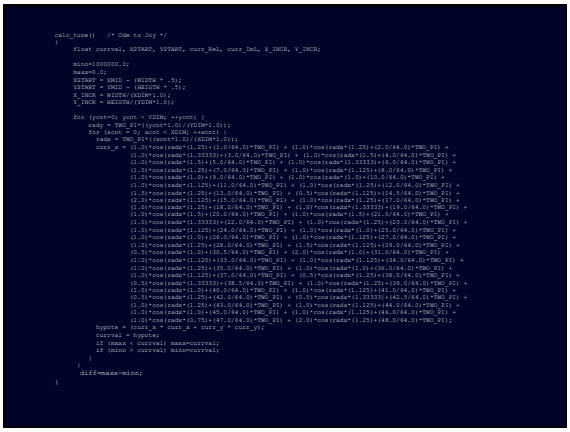
mappings
- diatonic (28 pitches)
- periodic (2:3)
- moderate / low event density

D

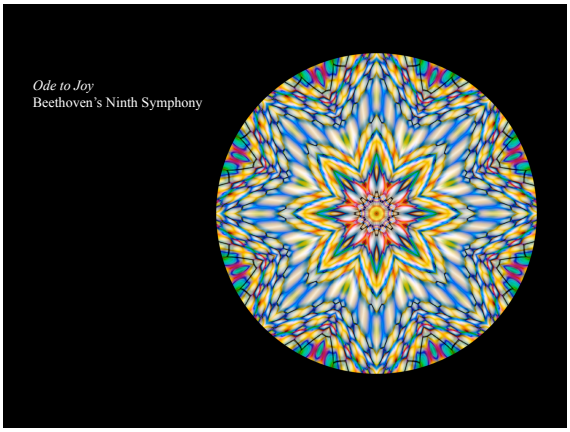


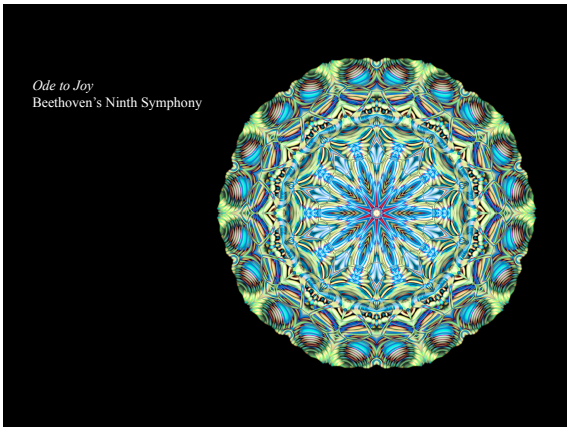
mappings
- pentatonic (24 pitches)
- periodic (all 16th notes)
- moderate event density

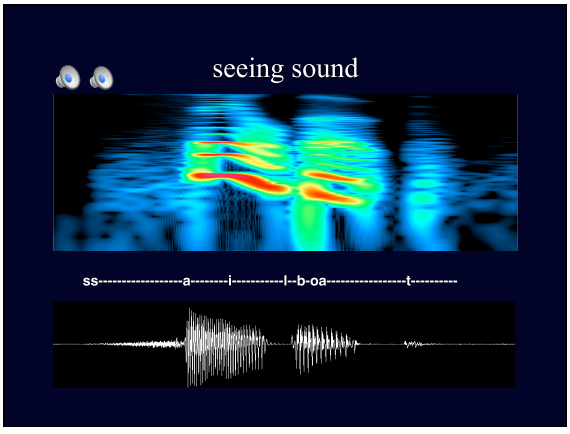


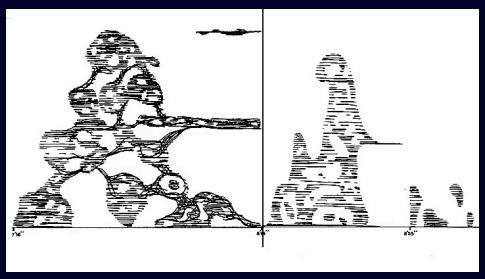


```
calc_tune()   /* Ode to Joy */
{
    float currval, XSTART, YSTART, curr_Re1, curr_Im1, X_INCR, Y_INCR;

    minn=1000000.0;
    maxx=0.0;
    XSTART = XMID - (WIDTH * .5);
    YSTART = YMID - (HEIGTH * .5);
    X_INCR = WIDTH/(XDIM*1.0);
    Y_INCR = HEIGTH/(YDIM*1.0);

    for (ycnt=0; ycnt < YDIM; ++ycnt) {
        rady = TWO_PI*((ycnt*1.0)/(YDIM*1.0));
        for (xcnt = 0; xcnt < XDIM; ++xcnt) {
            radx = TWO_PI*(xcnt*1.0)/(XDIM*1.0));
            curr_x = (1.0)*cos(radx*(1.25)+(1.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.25)+(2.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.33333)+(3.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.5)+(4.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.5)+(5.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.33333)+(6.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.25)+(7.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.125)+(8.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.0)+(9.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.0)+(10.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.125)+(11.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.25)+(12.0/64.0)*TWO_PI) +
                     (1.5)*cos(radx*(1.25)+(13.0/64.0)*TWO_PI) + (0.5)*cos(radx*(1.125)+(14.5/64.0)*TWO_PI) +
                     (2.0)*cos(radx*(1.125)+(15.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.25)+(17.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.25)+(18.5/64.0)*TWO_PI) + (1.0)*cos(radx*(1.33333)+(19.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.5)+(20.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.5)+(21.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.33333)+(22.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.25)+(23.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.125)+(24.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.0)+(25.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.0)+(26.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.125)+(27.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.25)+(28.0/64.0)*TWO_PI) + (1.5)*cos(radx*(1.125)+(29.0/64.0)*TWO_PI) +
                     (0.5)*cos(radx*(1.0)+(30.5/64.0)*TWO_PI) + (2.0)*cos(radx*(1.0)+(31.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.125)+(33.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.125)+(34.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.25)+(35.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.0)+(36.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.125)+(37.0/64.0)*TWO_PI) + (0.5)*cos(radx*(1.25)+(38.5/64.0)*TWO_PI) +
                     (0.5)*cos(radx*(1.33333)+(38.5/64.0)*TWO_PI) + (1.0)*cos(radx*(1.25)+(39.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.0)+(40.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.125)+(41.0/64.0)*TWO_PI) +
                     (0.5)*cos(radx*(1.25)+(42.0/64.0)*TWO_PI) + (0.5)*cos(radx*(1.33333)+(42.5/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.25)+(43.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.125)+(44.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(1.0)+(45.0/64.0)*TWO_PI) + (1.0)*cos(radx*(1.125)+(46.0/64.0)*TWO_PI) +
                     (1.0)*cos(radx*(0.75)+(47.0/64.0)*TWO_PI) + (2.0)*cos(radx*(1.25)+(48.0/64.0)*TWO_PI);
            hypote = (curr_x * curr_x + curr_y * curr_y);
            curval = hypote;
            if (maxx < curval) maxx=curval;
            if (minn > curval) minn=curval;
        }
    }
    diff=maxx-minn;
}
```

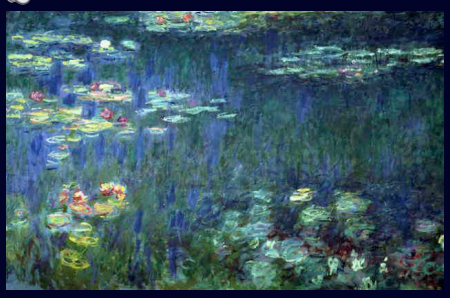




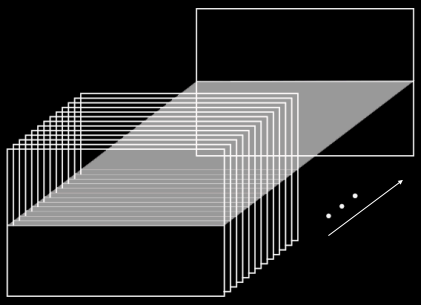


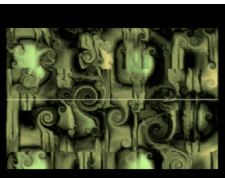


Xenakis, *Mycènes alpha*
image sonified digitally using the UPIC system

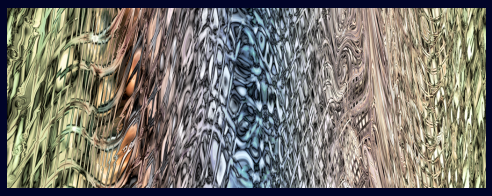


time slice

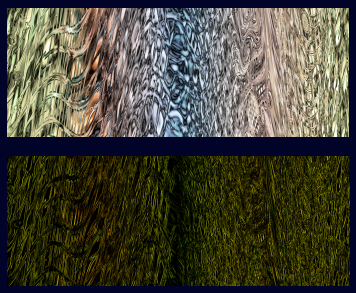




calidri time slice

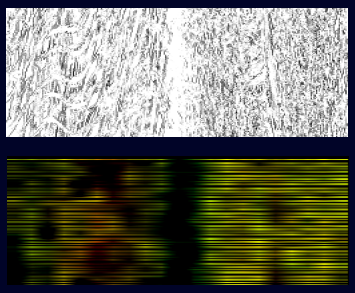


calidri time slice



guitar

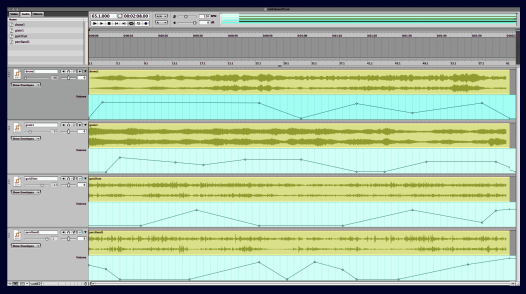
calidri time slice



percussion

drone

The heterophony of many maps—multi-track recording



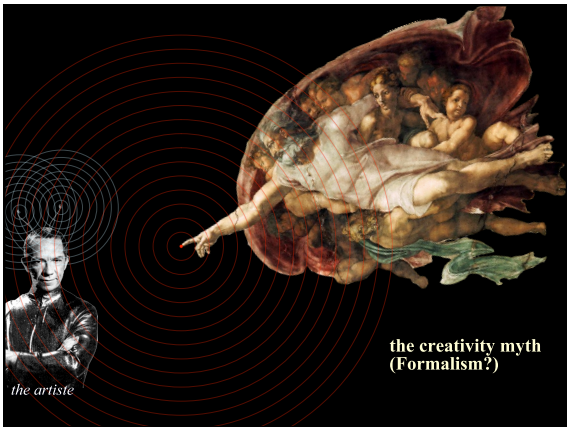
calidri

"Music means nothing outside itself."

Igor Stravinsky
The Poetics of Music

Art for art's sake

Formalism



#5 If a project consists in a mere mapping…*don't forget that every digital coding is arbitrary… Mapping is thus mere "found object"*. Wonder if the artist brings a shape, *a meaning,* a style or an approach to this arbitrary mapping, and which.

from *The Vademecum of Digital Art*
www.gratin.org

"Music means nothing in itself."

John Cage
Silence

"Marxism's mortal sin consists of believing that the day will come when society will be rid of all its contradictions."

Iannis Xenakis
Music and Architecture (preface)

"… knowledge is a secretion of the history of humanity…formed by the innumerable movements of its cultures"

Iannis Xenakis
Concerning Time, Space and Music

"…we face a frightening fundamental doubt as to the 'true objectivity' of our knowledge…"

Iannis Xenakis
"Concerning Time, Space and Music" (1991)

- Xenakis is a model of courage and optimism.
- He had faith in humanity's potential (not the same as destiny).
- We are evolving to the ability to recreate our universe.
- Music provides a model, a place to practice and prepare for the realization of that potential.

"Music is but a path among others for man, for his species, first to *imagine* and then, after many, many generations, to entail this existing universe into another one, one fully created by man."

Iannis Xenakis
"Concerning Time, Space and Music" (1991)

Xenakis and I, while maybe not on the same path, we are in the same forest, and our trails cross often…

as I imagine,
as I create.

I aspire to share his optimism.

Brian Evans
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www.brianevans.net