

Abstract Notes

Richard Hoadley, University of Exeter
 10th June 2014

Quantum Geodesics and the Quantum
 Riemann Hypothesis

Abstract: The Riemann Hypothesis is one of the most important unsolved problems in mathematics. In this talk, we will discuss the connection between the Riemann Hypothesis and quantum mechanics, and how the theory of quantum geodesics can be used to study the distribution of the zeros of the Riemann zeta function.

Keywords: Riemann Hypothesis, Quantum Geodesics, Riemann zeta function, Quantum mechanics.



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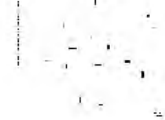
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Earle Brown

Earle Brown (1913-2013) was an American composer and pianist. He is best known for his work in the field of experimental music, and for his collaboration with John Cage and Merce Cunningham. Brown's music is characterized by its complex, non-linear structures, and its use of chance operations. He was a pioneer of the "open form" approach to composition, in which the performer has a significant role in determining the final structure of the piece. Brown's work has had a profound influence on contemporary music, and he is widely regarded as one of the most important composers of the 20th century.

Issues and translations

The study of issues and translations is a complex and multi-disciplinary field. It involves the analysis of various issues, such as social, economic, and environmental, and the translation of these issues into different contexts and languages. This process is essential for understanding the global impact of local issues, and for developing effective strategies for addressing them. The field of issues and translations is constantly evolving, as new issues emerge and existing ones change. It is a field that requires a deep understanding of both the issues themselves and the cultural and linguistic contexts in which they are being studied.

Demonstration

A demonstration is a public display or performance of a skill, product, or service. It is often used to showcase the capabilities of a new technology or to educate the public about a particular issue. Demonstrations can take many forms, from simple product demonstrations to complex theatrical performances. They are an important part of many marketing and educational campaigns, and they can be a powerful way to engage with an audience.

Next steps

- implement rotation and live interpretation
- shapes and colours
- local and global structures
- live performance
- suggestions?

Thank you

any questions?

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 richard.hoadley@ex.ac.uk
 or
 research@r.hoadley.net

this presentation is available at
<https://hoadley.net/presentations>

Forthcoming Events

Quantum Geodesics and the Quantum
 Riemann Hypothesis of Richard Hoadley
 7th June 2014

Richard Hoadley, University of Exeter
 10th June 2014



Variations on a Theme by Earle Brown

Histories, Theories and Practices of
Sound Art, Goldsmiths, May 2014

Richard Hoadley
Digital Performance Laboratory
Anglia Ruskin University

Three research streams

- algorithms (patterns)
- physical computing (microprocessors, etc.)
- notation/representation

(+ cross-domain mapping, interdisciplinarity...)

Performances

Gaggle, HCI conference, Cambridge 2009



Gaggle v2



The Fluxus Tree, LIPAM, Leeds, September 2011



Quantum Centricum, Festival, Engage, Long, Waterloo
Planning, Design and Interface, 2012 (September 19th - 20th)



Quantum Centricum, Mumberg Theatre, Cambridge,
Friday 4th April 2014



Triggered, Kings Place, London, 2011



Public interactions with the Fluxus Tree at the
Cambridge Festival of Ideas, October 2012



Quantum Centricum, Dapford Town Hall, London,
Friday 18th October 2011



Gaggle, Museums, interfaces, spaces, technologies, 2010



[to display, or not to display, the notation?]

Gaggle, HCI conference, Cambridge 2009



www.youtube.com/watch?v=_h98CGIG9Qw

Gaggle, Museums, interfaces, spaces, technologies, 2010



www.youtube.com/watch?v=FroFT1vHU0

The Fluxus Tree, LIPAM, Leeds, September 2012



www.youtube.com/watch?v=wH0mjb-jf8Q

*Quantum*², Sensations Festival, Empty Shop, Meadows
Shopping Centre, Chelmsford, Saturday September 28th 2013



Quantum Canticorum, Mumford Theatre, Cambridge,
Friday 4th April 2014



Why?

- Musical instruments
- Music performance
- Music scores

Musical instruments are **finite** pieces of **technology**. Those who are skilled at playing have something solid to push against (compare computers); this physicality implies a physical form, the style and functionality of which has an aesthetic, sculptural perspective.



Musical performance is highly visual: musical instruments are physical, visual entities; these and other references to music have been commonly used in visual and graphic arts (Picasso, Matisse, Klee, Mondrian, Marclay, Maclaren)

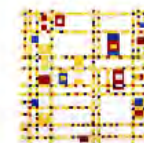
Picasso, Matisse



Elser

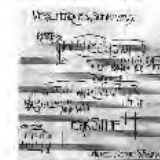


Mondrian



Music scores are intriguing graphically (or intriguingly graphic); many musicians (Satie) and artists (Kandinsky) have exploited this

Erik Satie



Kandinsky



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Christian Marclay

Band, 2002; including "Virtuoso" (2000), "Drumkit" (1999) and "Lip Lock" (1992)

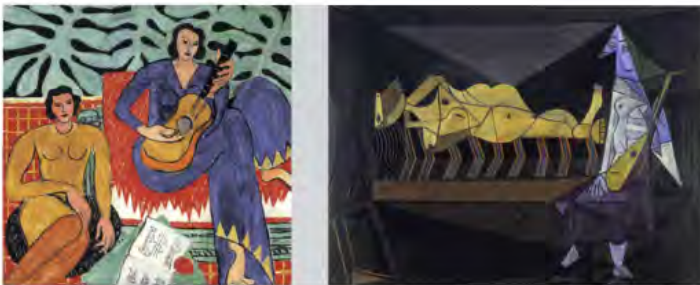


<http://prezi.com/kw1zidlk0-b7/christian-marclay-presentation/>

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Picasso, Matisse

Matisse 'Music' (1939) & Picasso 'Serenade' (1942)



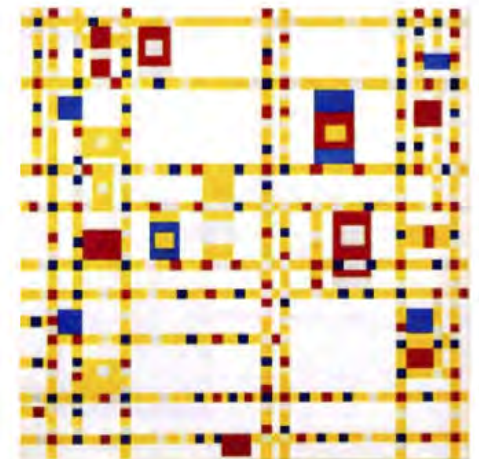
Klee

polyphon gefasstes Weiss (1930)



Mondrian

Broadway Boogie Woogie (1942-43)



Music scores are intriguing graphically (or intriguingly graphic); many musicians (Satie) and artists (Kandinsky) have exploited this

Eric Satie

Verset laïque & somptueux (Sumptuous lay verse), 1900



Kandinsky

Composition 7 (1913)



Notation/representation

- complex semantic and graphic 'language'
- not really suited to non-specialised environments
- many challenges in electronic implementation and display



Richard Hoadley

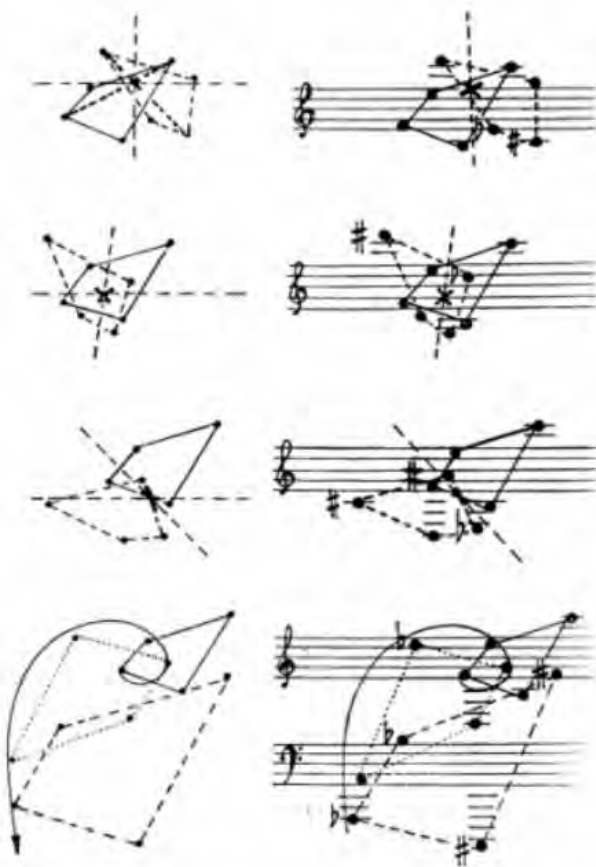
Four Archetypes, 1995

$\text{♩} = 110$

Handwritten musical score for "Four Archetypes" by Richard Hoadley, 1995. The score is written on three systems of staves. The first system has three staves (1, 2, 3) with dynamics *mf*, *p sotto*, and *p sotto*. The second system has three empty staves. The third system has three staves (1, 2, 3) with dynamics *mf sopra*, *p sotto*, and *p sotto*. The score includes various musical notations such as notes, rests, and dynamic markings.

Kagel

From Kagel's essay 'Translation-Rotation', Die Reihe - 7 (1960)



<http://www.softsynth.com/jsyn/examples/pinwheel.php>

Cornelius Cardew

Octet 61

Musical notation for Octet 61, measures 27-50. The notation is arranged in three rows of four measures each. Each measure is numbered in a circle at the beginning. The notation includes various rhythmic values, accidentals, and dynamic markings such as *pp*.

- Measure 27: Treble clef, one note on the second line, *pp*.
- Measure 28: Bass clef, one note on the second line, *pp*.
- Measure 29: Treble clef, eighth notes on the second and third lines.
- Measure 30: Treble clef, eighth notes on the second and third lines.
- Measure 37: Treble clef, one note on the second line.
- Measure 38: Bass clef, eighth notes on the second and third lines.
- Measure 39: Treble clef, eighth notes on the second and third lines.
- Measure 40: Treble clef, eighth notes on the second and third lines.
- Measure 47: Treble clef, eighth notes on the second and third lines.
- Measure 48: Bass clef, eighth notes on the second and third lines.
- Measure 49: Treble clef, eighth notes on the second and third lines.
- Measure 50: Treble clef, eighth notes on the second and third lines.

Cornelius Cardew Octet 61 'translations'

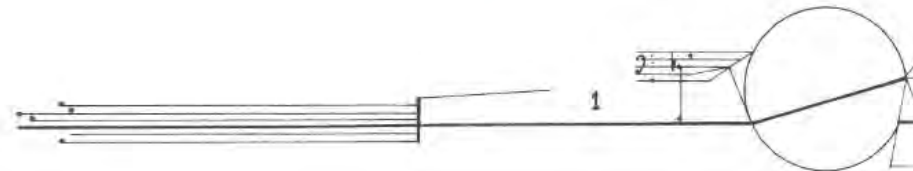
Cornelius Cardew: Octet '61

The image shows a handwritten musical score for Octet 61 'translations' by Cornelius Cardew. The score is divided into two main sections. The upper section contains six circled numbers (1-6) with corresponding musical notations: 1) a treble clef with a single note, 2) a treble clef with a single note, 3) a treble clef with a complex, overlapping notation, 4) a bass clef with a single note, 5) a bass clef with a single note, and 6) a treble clef with a complex, overlapping notation. The lower section is a complex musical score with various notes, rests, and markings, including circled numbers 1-6 at the bottom. A '3P' marking is visible at the end of the bottom staff.

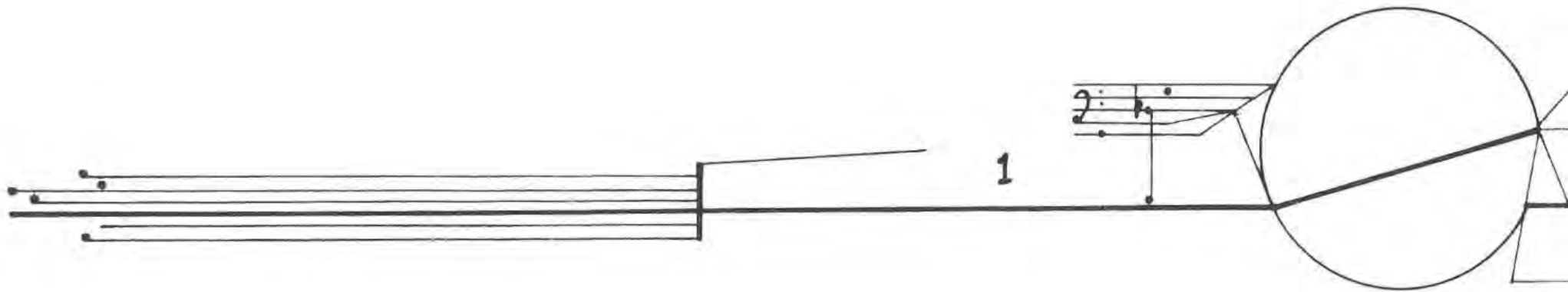
Cornelius Cardew

Treatise p45 (1963) and Bun No. 2 (1964)

"With the exception of [two passages] [Bun No 2] is based on pp 45-51 of Treatise. In a way it represents an **analysis** of that passage of *Treatise*."



...the exception of [two passages] [Bun No 2] is based on pp 45
...e. In a way it represents an **analysis** of that passage of *Treatise*



FL
Pic
Ob
Cl
Bsn

SD

RICHTIG (1)

Pno

Vln I desk 1
desk 2
desk 3
Vln II desk 1
desk 2
desk 3
Vla

Related forms

Spectral composition: audio > notation

Grisey, *Partiel*, 1975 - stimulated by an analysis of a pedal low E1 (41.2 Hz) on the trombone

Harvey, *Mortuous Plango Vivos Voco*, 1980
Spectral analysis of bell, 'orchestrated' for boy's voice

Sonification/audification ("thing" > audio)

Bob Sturm *Ocean Buoy Sonification*, 2003
"Pacific Pulse is sculpted from sonifications of spectral data from fourteen buoys that extend along the entire Pacific coast of the United States."
<http://www.mat.ucsb.edu/~b.sturm/music/PacificPulse.htm>


John Eacott *Floodtide*, 2009
<http://www.floodtide.eu/play>

Partial

43	
38	
34	Violins
30	
26	
22	Piccolo
18	Viola
14	Viola
10	Cello
6	Clarinet
4	Cb(*)
2	Trombone
1	Cb



Flute 16:8 50 bpm



These are a tiny part of an extremely active area of creativity and research. See *The Sonification Handbook*, 2011, ed. Herman et al., for more information.

The tools...

- provide a structure for the generation of music and/or common practice notation as well as many arbitrary graphical elements
- facilitate communication between SuperCollider and INScore
- <http://supercollider.sourceforge.net/>
- <http://inscore.sourceforge.net/>
- <http://rhoadley.net/inscore> (from summer 2014?)
- offer the beginnings of a more standard interface for physical mapping



Related work: live or real-time notation

[definition]

- MaxScore (Didkovsky, Hadju)
- Bach Project (Agostini, Ghisi)
- eScore (McClelland, Alcorn)
- Lilypond with extensions
- Live Notation (Eacott, Collins)

The functional emphases are different: quality, speed, variety of rendering, etc.

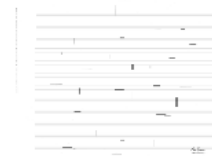
definition:

'live notation' is...

music notation that is generated as the performance progresses and where this process is itself considered to be of central importance in the composition. In this case I am referring to **common practice music notation**, generally understood to be the notation that, like common law, has become commonly used over the last 800 or so years

Leslie Brown
December 1952

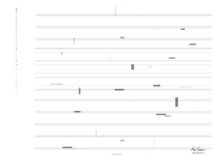
Earle Brown



- version of *December 1952* in which the notation was created by superimposing the objects onto staves. This system does the same (sort of), but without so much effort each time
- I'm neither a musicologist, nor an Earle Brown scholar; this project is an interesting opportunity to investigate use of these ideas in a musicological setting;
- elicits (contradictory) opinions on cross-domain links, the nature of the score and its relationship to performance;
- the work provides insights into **notation**, **performance** and **performers**: how does **detailed notation** effect the performance? How is it different from fully **improvised** performances? How might it aid **coordination** of many musicians?
- Earle Brown himself provides a highly ambivalent opinion

Leah Brown
December 1952

Earle Brown



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Earle Brown 'On December 1952'

Brown, E., On December 1952, American Music Vol 26 No 1, Spring 2008

“

Under the influence of Calder, I considered this ... a score that was **mobile** ... that had **more than one potential of form and performance realization**
(page 1)

...this was an attempt at correlating my own conception with **an extremely rapid way of "composing"**, which was, I have said, **almost like improvising** myself - in other words, **realizing a graphic drawing**... (page 2)

the notebook has ... sketches of ... scores I thought of that would allow for **multiple realizations of a sonic image** and ... deal with new notational possibilities ... as well as [more] spontaneity in the performance.
(page 2)

”

“

In my notebooks at this time I have a sketch for a physical object, a three-dimensional box in which there would be motorized elements - horizontal and vertical, as the elements in *December* are on the paper. ... It would be a box which would sit on top of the piano and these things would be motorized ... so that the vertical and horizontal elements would ... be moving in front of elements as they approached each other, crossed in front of and behind each other, and obscured each other. ... There would be a possibility of **the performer playing very spontaneously, but still very closely connected to the physical movement of these objects** [I] hoped that I could construct a motorized box of **elements that also would continually change their relationships**... I never did realize this idea, not being able to get motors and **not really being all that interested in constructing it.** (page 3)

this sphere would float in water and the performer, by gently blowing on it, would make it revolve and turn. ...[E]ach thing that appeared on the face of the sphere directly in front of the performer would be what he played at that moment. There would be completely composed material on those strips that made up the sphere. But each time, **each performance, different elements would appear.** (page 4)

”

Issues and translations

- The importance of automation in enabling more complex behaviour at higher levels, as in performance.
- Is this a software system, (a tool) or a composition?
- What about interpretation?
- Improvisation vs. notation: is there a difference?
- Live notation: is it too difficult to play?
- x, y and z maps to pitch, duration, amplitude, chordal complexity, timbre? Is this all too simplistic?
- technicalities: how best to implement notation and display the resulting 'live' notation.

Demonstration

- (INScore/SC)
- Variations
- Improvising variations
- (Rotations)

Next steps

- implement rotation and 'live' interpretation
- shapes and colours
- local and global structures
- live performance
- suggestions?

Forthcoming Events

Quantum Canticorum, a part of *Quantum²*
Barcelona Museum of Modern Art
7th June 2014

*Workshop on Interactive Notation and
Representation*
NIME, Goldsmiths
30th June 2014

Thank you

any questions?

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this presentation is available at

<http://rheadley.net/presentations>