David Cope: Experiments in Musical Intelligence

Part I of 2
David Cope
Intellectual models adapted by Cope for algorithmic composition

- Components from sound synthesis c. 1990
- Components from algorithmic activities in 1980s
- Components from music pedagogy
  - *New Music Composition* (1977)
  - *Experiments in Musical Intelligence* (1996, included code and exs.)
  - *Techniques of the Contemporary Composer* (RE 1945-1975)
  - Paperbacks containing 371 Chorales, Books I and II of Well-Programmed Clavier (2015) and many more—all produced by Emmy
Historical models of composition

- Celestial
- Empirical
- Dialectic
- Algorithmic/Aleatoric

Boethius (6th cent.): tonal relations

Zarlino (1559): correspondences of planets, muses, modes
Music = science of moving tones

• Seven liberal arts
  • Grammar – Rhetoric – Logic

• Role of music in the quadrivium [sciences]
  • Astronomy – astrology – geometry – music
  • Music = science of moving tones
Empirical models of music (c1750)

• Empower composers to master rules
• Give listeners access to moral precepts
• Rise of computational theories
  • Harmony: J.D. Heinichen (1711, 1728)
  • Counterpoint: J. J. Fux (1725)
  • Melody, mechanical rules of: H. C. Koch (1793)
Probability theory: Musical dice games (c1800)

- Games of chance
- Games of skill
Experiments in Musical Intelligence (EMI)

• UC Santa Cruz, 1980-2008
• David Cope, professor emeritus
• Sought tool to make recommendations for own compositions
• Programming in Common Lisp on Mac (several Op Sys prior to OSX)
• Nickname changed from EMI to Emmy (at request of EMI)
Experiments in Musical Intelligence (EMI): Components
Main components

1. Style: **Human** separation of composers, genres, performance media
2. Consideration of **grammars** for each
3. Recursive identification of “**signatures**”
4. Creation of feature **lexicons**
5. **Generation** of new works
1. Musical style

• Cope: Features in common between two or more works by the same composer
1a. What is a musical signature?

• A short passage occurring in two or more works by the same composer with the same intervallic content.
1b. From signatures to lexicons

• Lexicons store **signatures** by composer and genre
• Signatures have associated **approach/departure information**
• Signatures stored by **grammatical function**

Brest overview: Patricio da Silva (Greece)
https://eclass.uoa.gr/modules/document/file.php/MUSIC124/%CE%94%CE%B9%CE%B1%CE%BB%CE%AD%CE%BE%CE%B5%CE%B9%CF%82/da-silva-david-cope-and-emi.pdf
2. Musical grammar as an Augmented Transition Network (ATM)

- Musical grammar as an augmented transition network:

- Variables defined by grammatical function
2. Musical grammar as an ATM

SPEAC grammar

[parts of speech]
• Statements
• Preparations
• Extensions
• Antecedents
• Consequents
Musical generation overview

- Work 1 (e.g. sonata)
  - Movement 1 (e.g. Allegro)
    - Recursively identify signatures
    - Store signatures with contextual information
    - Sort signatures by grammatical function
    - Process another work in same genre, style, grammar
Recombination: Synthesize features of two or more works in same style

- Recursively identify signatures
- Sort signatures with contextual information
- Sort signatures by grammatical function
- Generate a new work, mixing signatures from both

Work 2 (e.g. sonata)

Movement 1 (e.g. Allegro)
Emmy’s genetic results

• **Signatures** = composer’s (or genre’s) “genes”

• Genes can be coupled in myriad ways (“combinatoriality”)

• Combinations governed by **rules**

*Recombinant music*
Emmy’s interactive apparatus

Experiments in Musical Intelligence=Emmy
Original software in Franz Lisp
User-governed features:

• genre
• composer
• key, mode
• many more

Music-theoretic rules can be implemented in pertinent genres
Cope’s overview of Emmy
(2015, Computer History Museum)

https://youtu.be/yFlmmDsNGdE
Extra examples....

• [https://www.youtube.com/watch?v=PczDLl92vlc](https://www.youtube.com/watch?v=PczDLl92vlc)
  • Bach chorale

• [https://www.youtube.com/watch?v=CgG1HipAayU](https://www.youtube.com/watch?v=CgG1HipAayU)
  • Beethoven symphony

• [https://www.youtube.com/watch?v=2kuY3BrmTfQ](https://www.youtube.com/watch?v=2kuY3BrmTfQ)
  • Vivaldi: 12 short pieces