



# *Music Informatics*

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- ▶ Paradigmatic analysis
- ▶ Analysing outside WTM

- ▶ Received some submissions for first coursework; will accept for a couple days more.
- ▶ Assessed coursework will be available Thursday, due in 3 weeks (17th March).

Automated music analysis enables in principle various forms of manipulation of musical structures:

- ▶ variation;
- ▶ coordination between performers;
- ▶ structuring machine improvisation;
- ▶ within algorithmic composition.

Paradigmatic analysis is a method that lends itself to implementation.

For a quick overview of computational aspects:

`http://quod.lib.umich.edu/cgi/p/pod/dod-idx/classification-in-music-a-computational-model-for.pdf`

Levi-Strauss did a comparative analysis of various myths, and found it useful to give an analysis in the form of a table that indicated:

- ▶ succession of events in time
  - by a reading in normal top/bottom (left/right) order
- ▶ and similarity of events, by ordering them in columns

This was a way to bring out internal structure and relationships between myths.

(C. Lévi-Strauss, *Structural Anthropology*, 1963)

## Example

C seeks sister

C kills dragon

S kill each other

Limping L

O kills father

left-handed L

O swollen foot

O marries mother

E kills brother

where O = Oedipus

C = Cadmos

E = Eteocles

S = Spartans

L = Laius

Ruwet used this as a model for analysis;  
on-line discussion describing the background and a soft-ware tool is  
at

<http://tinyurl.com/yzfqso5>

Nicolas Donin and Jonathan Goldman,  
Charting the Score in a Multimedia Context:  
the Case of Paradigmatic Analysis,  
at Music Theory On-line.

# Ruwet example



A musical score for a piece titled 'Ruwet'. The score is written on six staves, arranged in three pairs. The first pair of staves (top two) is labeled 'A' and contains measures 'a' and 'b'. The second pair of staves (middle two) is labeled 'A'' and contains measures 'c' and 'b'. The third pair of staves (bottom two) is labeled 'B' and contains measures 'd' and 'b'. The notation includes various rhythmic values and accidentals, such as flats and naturals. The piece appears to be in a common time signature.



As before, there is a lot to do in order to make sense of this sort of analysis to the point where it can be carried out automatically.

The two main questions are:

- ▶ what are the units that are being compared?
- ▶ what counts as musical similarity here?

The questions are *not* independent;  
in looking for similarity, some bits of segmentation can be suggested. (We already saw this role of similarity in GTTM.)

The interaction between segmentation and similarity can be organised in different ways, eg

1. note segments  $A, A', B, B$  at large granularity;
2. alternatively, use  $a, b, b', c, d$  at medium granularity
3. or finer grained, with  $d_1$  etc

This has an assumption that the segments are roughly similar size, in terms of duration. This is different from the case of myths, where time spent on a given episode is less relevant.

Compare the toy analysis of the British national anthem in this way, depending on the size of the units compared.  
Handout is from *Music as Discourse*, Agawu, Oxford University Press, 2009, pp 168–173.

We can also see a version of hierarchy in terms of patterns of bunches of the segments:

- ▶ immediate repetition from same class will bunch together;
- ▶ immediate repetition of this bunch will bunch together.

This is fairly crude, but will work for popular music in recognise melodic echos and 8-bar structure, without minimal rhythmic or harmonic analysis.

The algorithm depends on parameters  $N, M$ , suitable small integers.

Work by following the temporal structure of music in first instance:

- \* Identity: repeat:
  - \* Look for repetition of N notes
    - \* If found, extend as far as possible
    - \* now look for other instances in the rest of the piece
    - \* tag as a class & remove from input
- \* Similarity: repeat
  - \* Look for similar passages of M notes
    - \* If found, extend as far as possible
    - \* now look for other instances in the rest of the piece
    - \* tag as class & remove from input
- \* Anything left will be isolated segments

The procedure obviously depends on what notion of **similarity** is used. Some metric is needed, and this will make some use of the organisation involved in the style.

The claim is that similarity based on general cognitively salient aspects of musical sound can get us a long way, without eg notions of key:

- ▶ similarity in duration patterns
- ▶ similarity in melodic shape (rising, falling, stationary)

On the other hand, the analysis is **not** a plausible cognitive model of listening to the music in real time: segments far apart in time are related to each other, and the analysis is not incremental through time.

Look at first piece from Charles Ives' "Three Quarter Tone Pieces".  
On-line performance can be found on you-tube.  
This is for two pianos, tuned a quarter tone apart.  
The harmonies used are not from WTM, yet some patterns are clear to listeners (I think).

This sort of music can be successfully given paradigmatic analysis using a simple algorithm and notion of similarity as described above.

- ▶ Paradigmatic analysis from myth
- ▶ Applied to music
- ▶ Relatively independent from stylistic assumptions