A Formal Theory for the Discovery of Musical Boundaries in a Melodic Surface

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presented by
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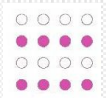
Purpose: find musical boundaries within a "melodic surface"

- "Melodic surface" = melody?
- Based on Gestalt principles of perception.
- Result is the Local Boundary Detection Model (LBDM).

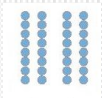
Gestalt – a quick intro

- Theory of human perception and understanding dating back to the late 19th century.
- We organize elements into a whole based on their surroundings and relation to each other (opposite of *Atomism)*
- Typically applied to visual perception

Types of conceptual grouping



SIMILARITY

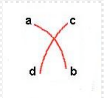


PROXIMITY

Images courtesy of Bonnie Skaalid ©1999
http://www.usask.ca/education/coursework/skaalid/theory/gestalt/gestalt.htm

And

Daniel Chandler
http://www.aber.ac.uk/media/Modules/MC10220/visper06.html



CONTINUITY

CLOSURE

Gestalt applied to music

- Cambouropoulos focuses on two of the principles:
  - Similarity
  - Proximity
  - Indirectly continuity (although he doesn't state it)

LBDM Algorithm

- Takes a sequence of notes as input
- Finds boundaries, organizing the notes into perceptual groups

LBDM Rules

- Identity-Change Rule (ICR)
  - There cannot be a boundary between two identical elements.
- Proximity Rule (PR)
  - Amongst different elements, those that are more similar will be grouped together.

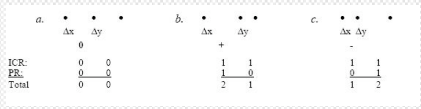
LBDM Rule Details

- "Interval": Difference in some property of successive - tone, volume, duration, etc.
- Always look at the absolute value of the difference.

LBDM Scoring

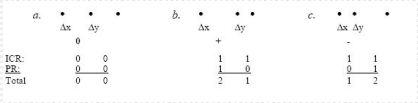
- ICR
  - Add 2 for each change (duration only?)
  - Add 1 for each interval change.
  - Add 0 for identity relation
- PR
  - Add 1 if boundary is suggested
  - Add 0 otherwise
- Places with highest score are likely boundaries

LBDM Example 1



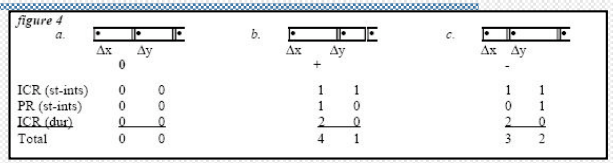
- Boundaries where the interval decreases are labeled "+"
- Boundaries where the interval increases are labeled "-"
- Otherwise label "0"

LBDM Example 1



- Result
  - A "+" gives you a 2 followed by a 1
  - A "-" gives you a 1 followed by a 2

LBDM Example 2



- Duration and start-time change
  - Why? Rests count as part of the note
  - Why no PR for duration
- A "+" gives you 4 followed by 1
- A "-" gives you 3 followed by 2

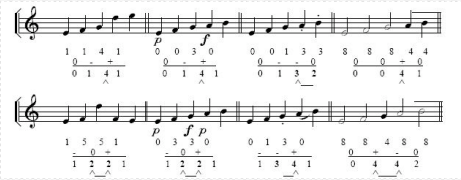
LBDM Summary

- In effect, taking a second order differential
  - Find differences applied to some property
  - Rectify (absolute value)
  - Find the sign of the resulting difference
  - Add scores according to the +/- rules

LBDM Summary (cont.)

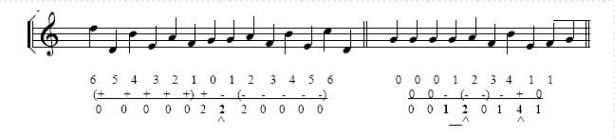
- When there is a long string of the same sign, only count the first and last
  - **+**(+++++++)**+**
  - **-**(---------)**-**
- In that sense, it's sort of a 3rd order differential!

Some Larger Examples



- Scores are assigned based on +/- rules.
- There can be ambiguity.

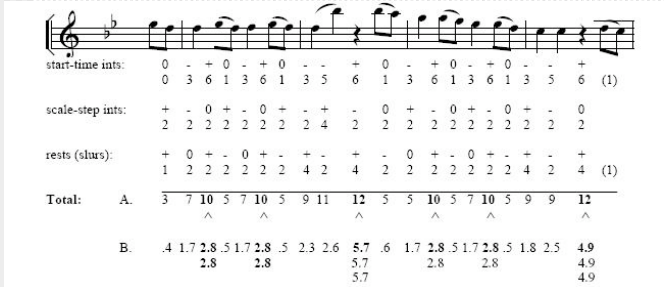
Some Larger Examples



Some Possible Refinements To LBDM

- Different properties can be given different weights
- Change the scoring rules – Cambouropoulos suggests giving PR a value of 2
- Multiply scores by a factor depending on the ratio of successive intervals: (x-y)/(x+y)
- Multiply scores by a factor depending on sum of successive intervals: (1- 1/(x+y))

Final Example: Mozart's Symphony in G-minor



Questions?