Towards describing perceived complexity of songs

Growing digital music file collections, on the private and the commercial site, raise new demands for visualization, search and automated recommendation. Computable descriptors, that capture relevant attributes of human music perception (semantic descriptors), hence become very desirable. We consider musical complexity being such a descriptor and therefore further explore this concept.

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Definition

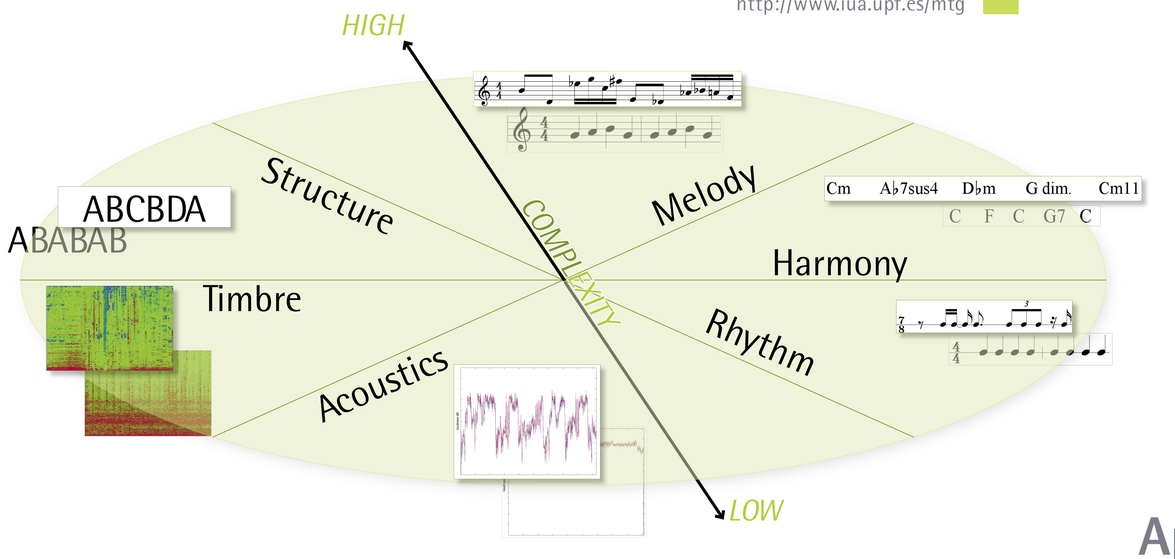
"Unusual harmonies and timbres, irregular tempi and rhythms, unexpected tone sequences and variations in volume" raise the level of perceived musical complexity (after Finnäs, 1989). This statement is in concordance with common sense, but lacks of precision to form an exact definition.
We can list the following six characteristics of musical complexity:

1. Musical complexity possesses many different aspects.
2. These aspects can be independent of each other.
3. These aspects can be linked to high-level as well as to low-level features of the music.
4. The richness of mutations is linked to musical complexity.
5. The rate at which events have to be processed is linked to musical complexity.
6. Expectation and surprise play also a role in complexity perception of music.

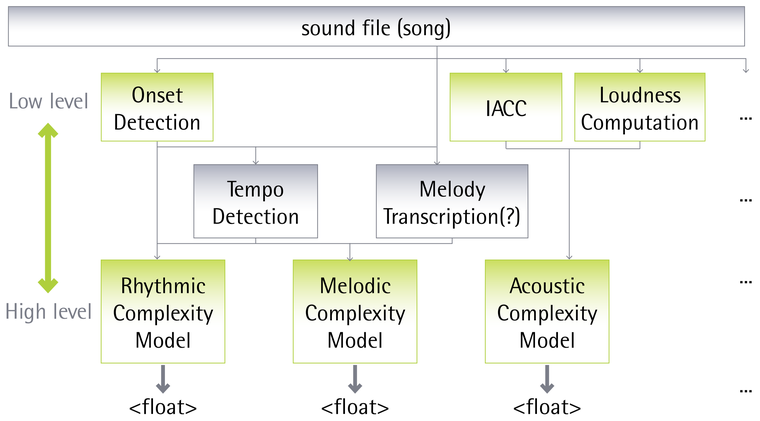
It seems straightforward to split musical complexity into six dimensions according to the following table:

Dimension	Parameters
Melody	Predictability; Polyphony; Tempo
Harmony	Number of chords; Predictability
Rhythm	Regularity; Induction strength; Tempo
Acoustics	Loudness variation; Spaciousness
Timbre	Variation; Density
Structure	Number of sections; Regularity

References:
· *L. Finnäs, "How can musical preference be modified? A research review," Bulletin of the Council for Research in Music Education no. 102 (1989).*
· *R. M. Parry, "Musical Complexity and Top 40 Chart Performance", Technical Report, College of Computing, Georgia Institute of Technology (2004).*
· *D. K. Simonton, "Drawing inferences from symphonic programs: Musical attributes versus listener attributions," Music Perception no. 12 (1995).*
· *D. E. Berlyne, Aesthetics and psychobiology, Appleton-Century-Crofts (1971).*



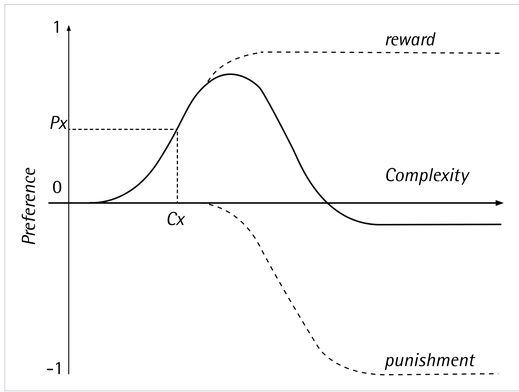
Implementation



The goal is to represent a song's complexity by only one value for each complexity dimension. We therefore need to find models for computing these values based on low-, mid- and high-level features of the song.
Such models exist already for melody (Narmour's Implication-Realization Model; based on archetypal interval patterns) and rhythm (Povel/Shmulevich PS-measure; based on clock induction and coding of segments). However, they have only been used on symbolic level music representations, so a transcription of the music would be needed as a preprocessing step. On the other hand, since humans can judge melodic complexity without knowing notation, other ways of measuring should be explored, too.
For the other dimensions of complexity no acknowledged models exist in the literature. Here, implementations can be based on related findings, like the measure for spaciousness from room acoustics.

Application

As many studies have shown, there is a relationship between musical complexity and popularity of or individual preference for songs (Perry, Simonton).
Following Berlyne's theory of arousal potential, we can relate musical complexity to the preference for a certain piece of music by the inverted U-shape curve.



This has direct implications for automated music recommendation. For the individual listener a preferred complexity profile can be estimated and the songs with maximum preference are selected. The listener might give more weight only to certain dimensions of complexity. He can actively search for songs with special complexity characteristics (e.g. "easy-listening" with low rhythmic, melodic and harmonic complexity).
Complexity of single dimensions can be easily visualized, because it comprises only one number per song. Ordering and distance computation are straightforward.

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