Computational Analysis Workshop:
Comparing Four Approaches to Melodic Analysis

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We compare four computational approaches of melodic analysis according to diverse approach aspects: input type (monophonic or polyphonic), pattern identication type (strict or similiar), analysis segmentation, aim of approach, motivic pattern representation, and type of result representations. The considered four computational approaches are the following: a similarity neighbourhood approach by Adiloglu (Adiloglu and Obermayer 2006), a multiple viewpoint representation and discovery approach by Anagnostopoulou (Anagnostopoulou, Share and Conklin 2006), a topological approach by Buteau (2005), and an approach based on multidimensional closed pattern mining by Lartillot (Lartillot and Toiviainen 2007).

Comparing Four Approaches to Melodic Analysis

We briefly describe the comparison of four computational approaches of motivic analysis according to diverse approach aspects. The four computational approaches considered for the comparison are the following: (1) a similarity neighbourhood approach by Adiloglu [ADI] (Adiloglu and Obermayer 2006; Adiloglu and Obermayer 2008), (2) a multiple viewpoint representation and discovery approach by Anagnostopoulou [ANA] (Anagnostopoulou, Share and Conklin 2006; Conklin and Anagnostopoulou 2006), (3) a topological approach by Buteau [BUT] (2004 and 2005), and (4) an approach based on multidimensional closed pattern mining by Lartillot [LAR] (2008; Lartillot and Toiviainen 2007).

For the following description, we refer the reader to the table below summarizing our comparison. We start our comparison with the music that can be analyzed by the different approaches. [ADI and LAR] currently restrict their method to monophonic music, whereas [ANA and BUT] can also consider polyphonic music. Alternative approaches have been considered for the detection of motivic variations, either based on numerical similarity threshold along different successive musical parameters [ADI and BUT], or on identification within the multidimensional parametric space using statistical learning [ANA] or logical generalization inferences [LAR]. Another significant difference between the approaches is the collection of motives in the score that is analyzed: [ADI and LAR] only consider motives with consecutive notes, [ANA] also admits motives with some specific holes, and [BUT] in addition considers non-contiguous motives. Furthermore, the method can make use of a score segmentation [ADI, ANA, and BUT], whether this is manual or dictated by the score, or may produce a type of segmentation along with the analysis by discovering patterns [ANA and LAR]. The four approaches are based on different theoretical background from formal music analysis, e.g. Ruwet (1987) or Réti (1951), and result in different purposes: the method may aim at identifying the *shortest* significant motives (for [ANA, BUT, and LAR]) and/or the *largest* significant motives (for [ADI, ANA, and LAR]). There is a significant aspect that differs in the approaches: an approach yields either *one* analysis considering *multi*-dimensional motivic pattern representations [LAR and ANA], or yields *several* analyses each considering *one*-dimensional pattern representation [ADI and BUT]. We mention that [LAR] uses a linear reduction strategy to deal with combinatorial issues. Finally, most of the implemented approaches [ADI, ANA, and LAR] yield numerical results, except for [BUT] which offers a diversity of result representations (*Motivic Evolution Trees*, weight graphs, dynamic clustering tables, and other spatial representations implemented in the software environment *OpenMusic*).

Table of Comparison of Four Computational Approaches of Melodic Analysis

Approach Aspects	Adiloglu [ADI]	Anagnostopoulou [ANA]	Buteau [BUT]	Lartillot [LAR]
monophonic music	X			X
polyphonic music		X	X	
multi-dimensional pattern identity		X		X
similarity of patterns	X		X	
contiguous motives only	X			X
using specific holes in motives		X		
non contiguous motives			X	
predetermined segmentation	X (rest)	X	X	
no segmentation		X		X
aim: shortest significant motives		X	X	X
aim: largest significant pattern	X	X		X
multi-dimensional pattern representation in *one* analysis		X		X
one-dimensional pattern representation in *several* analyses	X		X	
linear reduction strategy (combinatorial issues)				X
type of result representations	numerical	numerical	several (2D and 3D)-graphic and other representations in *OpenMusic*	numerical

References

Adiloglu, Kamil, and Klaus Obermayer. 2006. A paradigmatic approach to extract the melodic structure of a musical piece. *Journal of New Music Research* 35(3): 221-236.

Adiloglu, Kamil, and Klaus Obermayer. 2008. Melodic topologies. In *this Volume*.

Anagnostopoulou, Christina, Chris Share, and Darrel Conklin. 2006. Xenakis' Keren (1986): A computational semiotic analysis. In *Denitive Proceedings of the International Symposium Iannis Xenakis*. Athens.

Buteau, Chantal. 2004. Motivic Spaces of Scores through RUBATO's MeloTopRUBETTE. In *Perspectives in Mathematical and Computational Music Theory*, ed. Emilio Lluis-Puebla, Guerino Mazzola, and Thomas Noll, 330-342. Osnabrück. epOs-Music.

Buteau, Chantal. 2005. Topological Motive Spaces, and Mappings of Scores Motivic Evolution Trees. In *Grazer Mathematische Berichte*, Proceedings of the Colloqium on Mathematical Music Theory, Graz (Austria), May 6 May 9, 2004, ed. Harald Fripertinger and Ludwig Reich, 27-54.

Conklin, Darrel, and Christina Anagnostopoulou. 2006. Discovery of segmental patterns in music. *INFORMS Journal on Computing* 18(3):285-293.

Lartillot, Olivier and Petri Toiviainen. 2007. Motivic matching strategies for automated pattern extraction. *Musicae Scientiae*, Discussion Forum 4A, 281-314.

Lartillot, Olivier. 2008. Automated extraction of motivic patterns and application to the analysis of Debussys Syrinx. In *this Volume*.

Réti, Rudolph. 1951. *The Thematic Process in Music*. Greenwood Press, Connecticut, USA.

Ruwet, Nicolas. 1987. Methods of Analysis in Musicology. *Music Analysis* 6(1-2): 4-39.