The cognitive algorithm and its musical applications

Joséphine Calandra, PhD Student (3rd year) supervised by Jean-Marc Chouvel (IReMus) and Myriam Desainte Catherine (LaBRI)

Image&Son Day - August 31st 2021







- Modelise the music structure and the paradigmatic analysis, automate this modelisation
 - Proposition of a model that is submitted to the listening contraints
 - Parametrisation of the system





- Chouvel, J.-M. Analyse Musicale, sémiologie et cognition des formes temporelles, L'Harmattan, Paris, 2006.
- De Saussure, F. Cours de linguistique générale. Payot, Paris, 1906.
- Delalande, F. *La musique au-delà des notes*. Presse Universitaires de Rennes, 2019.

- Monitor the algorithm to understand :
 - The algorithm's computational load
 - The attention's phenomenons



• Laske, O.E. *Music, Memory and Thought, explorations in Cognitive Musicology*. University Microfilms, International, Ann Arbor (MI), 1977.

- Represent this modelisation
 - Difficulty as we produce a hierarchy of diagrams
- Propose an accessible pluggin for musicologists
 - Integration in ossia-score.

• J.-M. Celerier, P. Baltazar, C. Bossut, N. Vuaille, J.-M. Couturier, and al., *Ossia: Towards a unified interface for scoring time and interaction*, in Proc. Int. Conf. On Technologies for Music Notation and Representation - TENOR 2015, Paris, France, 2015.



Axioms

Which definition of music ?

We define music as a succession of objects, each object beeing an instance of materials.

For now, transitions between objects are considered as objects.



The Cognitive algorithm - Presentation





Material (material memory)



Formal diagram of a piece of music associated with the sequence of encoded materials « abacabacdeab »

Time (formal memory)



Formal diagram of a piece of music associated with the sequence of encoded materials « abacabacdeab »

Time (formal memory)



Formal diagram of a piece of music associated with the sequence of encoded materials « abacabacdeab »

Time (formal memory)



Formal diagram of a piece of music associated with the sequence of encoded materials « abacabacdeab » Time (formal memory) а b



Material (material memory)



Formal diagrams of a piece of music associated with the sequence of encoded materials « abacabacdeab » at level 0



Algorithm implementation





J. Calandra, J.-M. Chouvel, M. Desainte-Catherine, and al., *Génération automatique de diagrammes formels par un algorithme cognitif modulaire: étude preliminaire*, in Journées d'Informatique Musicales(JIM), Strasbourg, France, 2020.

From symbols to hierarchical formal diagrams



J. Calandra, J.-M. Chouvel et M. Desainte-Catherine, « Multi-Scale Oracle and automated representation of formal diagrams based on the cognitive algorithm » inProc. Int. Conf. On Technologies for Music Notation and Representation - TENOR 2021, Hamburg, Germany, 2021

From audio to hierarchical formal diagrams



Current results















From symbols to hierarchical formal diagrams





→ abacabacdeabfgabachijklmhinopqabacrsrsttu

Mozart K545- Rondo

3D representation



3D representation

- More readable representation :
 - Understandable for a musicologist
 - Make sens in every point of vew
 - Emphasis the relation between objects of differents levels
 - Internship with Erwan Michel, M2 student in cognitive ergonomy, Toulouse Jean-Jaurès University

3D representation





Interface



Interface



Perspectives

- Improve the system
- Develop a plug-in to integrate in ossia-score
- Analyse the algorithm behaviour
- Define a validation protocol for the obtained formal diagrams

Thanks for your attention !