

Modern Music, Shapes and Persistence

Séminaire MaMuX

Mathématiques, Musique et relations avec d'autres disciplines

Vendredi 03 avril 2015, 14h30

IRCAM, Salle Stravinsky

1, place Igor Stravinsky 75004 Paris

Avec la participation de Massimo Ferri (Bologna University), Barbara Di Fabio (Bologna University), et Mattia Bergomi (IRCAM).

Page Web de la séance:

<http://repmus.ircam.fr/mamux/saisons/saison14-2014-2015/2015-04-03>

PROGRAMME

14h30-15h15: From geometry to topology in shape description
Massimo Ferri

Is shape just geometric similarity? Surely not; on the other hand, the main topological type of equivalence, i.e., homeomorphism, is much too far from the human idea of "having the same shape". Still, this does not mean that we have to avoid mathematical tools in shape description, analysis, comparison, classification, retrieval... We start from the work of Jan Koenderink, seeing how differential topology yields important cues for understanding shape, and we end up with ideas and applications of persistent homology.

15h15-16h00 : Persistent homology for shape description
Barbara Di Fabio

Interpreting and comparing shapes are challenging issues in computer vision, computer graphics and pattern recognition. Persistent homology allows us to describe shapes by means of suitable shape descriptors, the persistence diagrams. They capture both geometrical and topological features of an object by recording the homological changes and their longevity in the lower level sets of a real valued function (called a filtering function) defined on a topological space associated with the object. This seminar provides an overview of some of the most relevant results in persistent homology, the main properties of persistence diagrams and the principal aspects in the generalization to multivalued filtering functions that allow the description of shape properties with an intrinsically multidimensional nature.

16h00-16h45 :

A musical Application of Persistent Homology

Mattia Bergomi

Musicians use notes and chords as words of their personal dictionary to create musical phrases. Quite often, these phrases are shaped as tension patterns over time, drawing the attention of the listener to particular moments thanks to specific choices, frustrating its intuition through unexpected changes, or confirming its expectation with, for instance, a well-known cadence leading to resolution. The notion of tension has often been related to that of consonance, for which recent models developed in the XXth century have allowed one to provide explicit calculations and a quantitative method to compute it for n-notes chords. Traditionally, the geometric-oriented analysis of Music is based on isotropic spaces, we suggest a topological model belonging to the domain of symbolic-signal interaction aimed at the introduction of preferred directions in those spaces. In particular, the Tonnetz interpreted as a 2-dimensional simplicial complex is deformed via an height function computed as the consonance value of a fixed triad and the note associated to each element of its 0-skeleton. We observe how the geometric analysis of the different states of this variable geometry space leads to intuitive and interesting representations on either a melodic and harmonic superposition point of view. A direct way to achieve this information is given by the comparison, in terms of Wasserstein distance, among 0-dimensional persistent homology corner points diagrams associated to each shape generated by the action of the height function on the Tonnetz's vertices.*

***This research is a join work with Alexandre Popoff.**

I4ème saison du séminaire MaMuX (2014-2015)

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- | | |
|----------------------|---|
| - 26 et 27/09/2014 : | Séance hors-les-murs à Montpellier : Journées sur les pavages en mathématiques, informatique et musique |
| - 05/12/2014 : | Mathématiques et musiques du Monde Arabe |
| - 23/01/2015 : | Bande dessinée |
| - 06/02/2015 : | Tempéraments et visualisations |
| - 06/03/2015 : | Other Harmony |
| - 03/04/2015 : | Modern Music, Shapes and Persistence |

Prochaine séance :

vendredi 08/05/2014 : TBA

Le Séminaire MaMuX est organisé par L'Equipe Représentations Musicales de l'**IRCAM** / UMR STMS – Sciences et technologies de la musique et du son, avec le soutien du Réseau National des Systèmes Complexes (**RNSC**).

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