Symposium

Autour de la Théorie Générative de la Musique Tonale
de Fred Lerdahl et Ray Jackendoff

Ircam & ENS
11-12 janvier 2008

PROGRAMME et RESUMÉS

Vendredi 11 janvier (Ircam)

De 10h à 13h (Ircam, Salle Stravinsky) *Sur les rapports entre approches schenkériennes, grammaires chomskiennes et théories génératives de la musique*

- 10h00-10h30 Présentation de la double journée (Jean-Michel Bardez et Moreno Andreatta)
- 10h30-11h15 Nicolas Meeùs (PLM, Université Paris IV) - La théorie schenkérienne : une théorie sémiotique générative
- 11h15-12h00 Costas Tsougras (Aristotle University of Thessaloniki) - The application of GTTM on 20th century modal music: Theoretical issues, Modal Pitch Space and the analysis of Y. Constantinides's *44 Greek miniatures for piano*.
- Discussion

Pause

De 14h30 à 19h (Ircam, Salle Stravinsky) *Approches issues de la psychologie expérimentale et des neurosciences*

- 14h30-15h15 Ray Jackendoff (Tufts University) - GTTM: Its roots and its lessons for cognitive science
- 15h15-16h15 Fred Lerdahl (Columbia University) et Carol L. Krumhansl (Cornell University) - Testing the Theory of Tonal Tension

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- 16h30-17h15 Irène Deliège (ESCOM, Université de Liège) - La théorie des groupements et ses multiples conséquences
- 17h15-18h00 Michael J. Bruderer (Technical University of Eindhoven) - The perception and modeling of structural boundaries in Western popular music
- 18h15-19h00 Discussion (animée par Isabelle Viaud-Delmon, CNRS UMR 7593 et Ircam, équipe acoustique des salles)

Samedi 12 janvier (matinée à l'ENS et après midi à l'Ircam)

- 10h-13h Séminaire MaMuPhi (ENS, **amphi Rataud**). Thomas Noll (ESMuC, Barcellona) - Le Pli Diatonique : Algebraic Combinatorics on Words applied to the Study of the Diatonic Modes (séance animée par François Nicolas).

Pause

15h-19h Séminaire MaMuX (Ircam, Salle Stravinsky) Sur les rapports entre TGMT et modèles computationnels en analyse musicale

- 15h00-16h00 Fred Lerdahl (Columbia University) et Rob Seward (artist and programmer) Toward a Computer Implementation of the GTTM/TPS Analytic System
- 16h00-16h45 Emilios Cambouropoulos (Department of Music Studies Aristotle University of Thessaloniki) Musical Surface, Streaming and Grouping: Perceptual and Computational Perspectives.

- 17h00-18h00 Geraint A. Wiggins, Marcus Pearce et Daniel Mullensiefen (Centre for Cognition, Computation & Culture/Department of Computing, Goldsmiths' College, University of London) - Statistical Models of Music Cognition
- 18h15-19h00 Discussion finale (animée par Moreno Andreatta, Ircam/CNRS)

Résumés

La théorie schenkérienne : une théorie sémiotique générative (Nicolas Meeùs, PLM, Université Paris IV)

L'importance accordée à la pratique analytique dans les études schenkériennes récentes tend à voiler certains aspects essentiels de la théorie. Comme toute théorie générative, la théorie schenkérienne ne peut sans doute se dispenser de l'analyse, indispensable pour décrire le lien le niveau de surface et la structure profonde ; mais l'analyse, comme Schenker l'a souligné lui-même, n'est pas une fin en soi. Le concept fondamental de la théorie schenkérienne n'est pas la réduction (analytique), mais bien la prolongation (générative).
Contrairement aux méthodes traditionnelles de l'analyse musicale, la théorie schenkérienne ne décrit pas l'œuvre tonale par segmentation, mais bien par des opérations de prolongation, d'imbrication et d'intégration. Celles-ci, de surcroît, sont constitutives du sens de la musique : la théorie est donc proprement sémiotique.

Testing the Theory of Tonal Tension (Fred Lerdahl, Columbia University et Carol L. Krumhansl, Cornell University)

This study presents and tests the theory of tonal tension. The theory predicts tension patterns in diatonic and chromatic tonal music. In the experimental tasks, listeners record their experience of tension. Comparisons between predictions and data point to alternative analyses within the constraints of the theory. Tension in atonal music is also discussed.

La théorie des groupements et ses conséquences multiples (Irène Deliège, ESCOM, Université de Liège)

Au départ d'un premier travail empirique portant sur la perception des groupes rythmiques tels que décrits par les règles préférentielles de groupement de la GTTM de Lerdahl et Jackendoff, on postule que la portée de cette théorie peut offrir des perspectives plus vastes. Étant conçue comme une segmentation de la surface musicale sur la base de lois générales de la perception issues de la Gestalt, il n'est pas interdit de supposer que, non seulement, d'autres langages musicaux que la tonalité pourraient être analysés et perçus en fonction de cette théorie, mais que sa validité pourrait s'étendre à des pièces entières dont l'auditeur se formerait un *schéma* au cours de l'écoute, à la manière de ce qui se passe dans l'audition d'un discours.
À ce stade, il s'agissait de préciser les outils sous-jacents à un tel type d'organisation psychologique dans la mesure où, contrairement au langage, la musique n'offre pas de repères sémantiques directs. L'hypothèse d'une *extraction d'indices* pendant l'écoute attentive, articulée sur la base du principe du *même* et du *différent*, est ici posée, soit un ensemble de repères brefs, mais très remarquables, qui, par la force de leur répétition textuelle ou variée, sont susceptibles de donner à percevoir les grandes articulations d'une oeuvre musicale.
Les résultats de plusieurs recherches expérimentales corroborant cette hypothèse seront développés au cours de l'exposé.

The perception and modeling of structural boundaries in Western popular music (Michael J. Bruderer, Technical University of Eindhoven)

In the first part of my talk I present two perceptual experiments on the segmentation of music. In a first experiment subjects were asked to segment six complete songs taken from the popular music genre (duration of 3-5 min). The boundary indications were accumulated across subjects to obtain a perceptual boundary profile for each song. For the second experiment, several boundaries from the perceptual boundary profiles were selected and subjects were asked to rate the salience and to describe the cues of the selected boundaries. The correlation of the salience ratings with the number of boundary indications showed that the number of boundary indications can be taken as a salience measure. The second part of the talk discusses how the perceptual boundary profiles are correlated with the boundary profiles predicted by three formal musicological models. This analysis included four of the grouping rules of GTTM, quantified by Frankland & Cohen (in « Parsing of melody: Quantification and testing of the local grouping rules of Lerdahl and Jackendoff's *A Generative Theory of Tonal Music* », *Music Perception*, 21 (4), p. 499-543, 2004).

Le Pli Diatonique - Algebraic Combinatorics on Words applied to the Study of the Diatonic Modes (Thomas Noll, ESMuC, Barcellona)

The talk is dedicated to an investigation of the connection between tone neighborhood and tone kinship in the context of the diatonic modes. It is a report on ongoing research which is conducted collaboratively by David Clampitt (Yale University, New Haven) and myself. Aside from neutrally reporting on this work I intend to localize its subject with respect to the discourse of the MaMuPhi-series as well as with respect to the approaches by Ray Jackendoff and Fred Lerdahl in GTTM and TPS.

The mathematical background is provided by a subfield of "algebraic combinatorics on words", which is known as "Sturmian words" and "Sturmian morphisms". It is applied, for example, to computer graphics, where straight lines with a certain slope are discretized by a pixel-zigzag which can be interpreted as a two-letter word. In this application the theory helps to circumvent side-effects of the discretization to become noticeable. In our application to diatonic modes it is quite the contrary: The discretized lines are at the heart of our music-theorical interpretation and accordingly the "pixels" are rather large: They correspond to the meshes of the Pythagorean tone lattice, spanned by octaves and fifths. And the lines to be drawn are isotonic lines (corresponding to constant pitch height levels) and the zigzags become fifth/fourth foldings: modal refinements of the chain of fifths.

Two central and mutually connected components of the theory are (1) a strict duality between well-formed step-interval patterns and associated fifth/fourth-foldings (in terms of an extension of Christoffel duality), and (2) a generation principle for the Glarean modes in terms of special Sturmian morphisms. Both components suggest comparisons with the role of the diatonic in the constitution of the basic space in TPS.
Two main directions for a further music-theoretical interpretation shall be indicated.
One is concerned with the understanding of the diatonic system in general. Valuable anchors can be found in Jacques Handschin's book *Der Toncharakter: Eine Einführung in die Tonpsychologie* (1948). I show how two interesting objections by Carl Dahhaus in his *Untersuchungen zur Enstehung der harmonischen Tonalität* (1967) can be smoothened out in the light of our findings. The other direction is concerned with fundament progressions and the project of dualizing certain Schenkerian principles.

This concrete instance of a still ongoing application of a mathematical theory to a domain of music-theory shall serve as an example for a discussion about conditions of fulfillment for such a project.

Toward a Computer Implementation of the GTTM/TPS Analytic System (Fred Lerdahl, Columbia University et Rob Seward, artist and programmer)

The rules in *A Generative Theory of Tonal Music* and *Tonal Pitch Space* make possible the goal of a computer program that takes music as input and provides perceptually viable musical analyses as output. This paper presents research on this topic, using Bach chorales as input. The program currently specifies harmonic and non-harmonic tones, keys and modulations, Roman numeral analysis, time-span segmentation, and time-span reduction. Future developments include implementation of tonal tension.

Musical Surface, Streaming and Grouping: Perceptual and Computational Perspectives (Emilios Cambouropoulos, Department of Music Studies Aristotle University of Thessaloniki)

The musical surface is the lowest level of mental representation that has musical significance and is the first of five levels in the GTTM (Jackendoff 1987). The musical surface is commonly taken to be equivalent to the level of notes in the score (or in a piano-roll). It will be argued that, despite its convenience, the level of notes is often inadequate to act as a surface and higher-level events should be considered. Auditory streaming enables a listener to break the sound continuum into musical streams (e.g. melody and accompaniment); it will be maintained that the elementary events of the musical surface should include whole chords, clusters, trills and so on. Grouping models, such as the local GPRs in the GTTM or the author's LBDM, describe segmentation processes in *monophonic* sequences (melodies) – such models could be applied to polyphonic textures, if discrete independent voices are available. But, what happens in music that does not have independent monophonic voices? It will be suggested that the notion of 'voice' should be replaced with 'stream', that the musical surface consists of elementary musical stream events (notes and/or multitone complexes), and models should be developed to extract *musical streams* and/or *stream segments* (score extraction from audio should be abandoned and replaced by musical stream extraction, and voice separation in symbolic data should be replaced by musical stream separation/segmentation).

The application of GTTM on 20th century modal music: Theoretical issues, Modal Pitch Space and the analysis of Y. Constantinides's *44 Greek miniatures for piano* (Costas Tsougras, Aristotle University of Thessaloniki)

This paper examines the adaptation and expansion of Lerdahl's & Jackendoff's *Generative Theory of Tonal Music* in order to enable its application to the analysis of 20th century modal music. After an introductory discussion of the adaptation's theoretical background, the paper focuses on two topics:
a) The inductive formulation of special well-formedness and preference rules through the analysis of a representative 20th century modal compositional style (Yannis Constantinides's *44 Greek miniatures for piano*);
b) The *Modal Pitch Space* model, an expansion of Fred Lerdahl's *Tonal Pitch Space* model aiming at a more accurate description of the situations involved in the analysis of modal music. After the algebraic and geometrical representations of the chordal and regional modal space, two short GTTM analyses of 20th century modal music are carried out for the illustration of the model's analytical use.

Statistical Models of Music Cognition (Geraint A. Wiggins, Daniel Müllensiefen and Marcus T. Pearce, Centre for Cognition, Computation & Culture/Department of Computing, Goldsmiths' College, University of London)

We present our approach to the computational modelling of music cognition, and its applications to musicology and music analysis. First, we outline a research programme for the computer-based study of the musical mind, noting some methodological issues involved in cognitive modelling, and explain the programme's relationship with corpus-based musicology, a field of study which has only recently become possible, with the advent of large computer databases of music; our approach to both is primarily statistical. We then discuss the problem of musical similarity, comparing recent statistical models with other kinds. From these relatively simple, broad models, we progress to a more specific, detailed and complex model of melodic pitch expectation, which has been shown to account for up to 83% of variance in human expectation responses. We then show how the very same model provides an account for the cognitive process of melodic segmentation, and suggest that the measures used for this task are also suitable for more subtle music-analytical tasks. Following Honing, we suggest that a model becomes more convincing when it can reliably account for related phenomena other than those it was specifically intended to predict. Finally, we return to issues of methodology raised by the work, illustrating how the segmentation of melodies is an inherently ambiguous task when carried out by human experts and proposing a way to deal with this ambiguity in data analysis. We conclude by explaining the next steps to be taken.

Organisateurs : Irène Deliège (ESCOM) et Moreno Andreatta (Ircam/CNRS)

Le Symposium est organisé en collaboration avec l'équipe « Patrimoines et Langages Musicaux » (PLM) de l'Université de Paris IV-Sorbonne, le LEAD (CNRS UMR 5022) et avec le soutien de l'ESCOM (European Society for the Cognitive Sciences of Music), la SFAM et l'AFIM (groupe de travail « Mathématiques/Musique & Cognition »).

Adrèsses :

Ircam (salle Stravinsky) - 1, place I. Stravinsky, Paris 4e [séances de vendredi et samedi après-midi]
ENS (**amphi Rataud**) – 45, rue d'Ulm, Paris 5e [séance de samedi matin]

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Pour plus d'info sur le Séminaire MaMuX : http://recherche.ircam.fr/equipes/repmus/mamux/