«EMBODIED NAVIGATION OF COMPLEX PIANO NOTATION: RETHINKING MUSICAL INTERACTION FROM A PERFORMER'S PERSPECTIVE»

ABSTRACT

This thesis proposes a

a) *performer-specific paradigm* of
b) *embodied interaction with complex piano notation* from
c) an *expert user perspective*.

This paradigm, which I term *embodied navigation,* complements, extends and confronts the traditional composer-oriented paradigm of piano interpretation. At a second stage, the proposed paradigm serves as the basis for the development of methodologies and customized tools, dedicated to a range of applications for piano performance. Those applications include performance analysis, embodied interactive learning, contemporary composition, free improvisation, piano pedagogy and score-following.

The central dichotomy of a "performer-specific" in lieu of a "composer-oriented" paradigm; the notion of "embodied interaction" instead of "interpretation"; the term "complex notation" and the term "expert user", will be defined at length in the first part of this dissertation, in relation to developments in music composition and musicology after 1945.

In what follows, we provide some provisional opening definitions of the above-mentioned terms, to be developed later at length:

The PARADIGM is summarized under the rubric *embodied navigation of complex notation* and is informed by developments in Contemporary Performance Practice, Embodied Cognition, Human-Computer Interaction (HCI) and New Interfaces for Musical Expression (NIMEs, *nouvelles lutheries*).

The TOOLS include gesture capture, gesture analysis & gesture following tools, as well as interactive notation platforms, combined in the customized system called *GesTCom (Gesture Cutting through Textual Complexity).*

The PERFORMANCE ANALYSIS refers crucially to the whole learning trajectory, ranging from the first approach to a new piano work up to learning strategies and varied interpretations of the piece in future performances.

COMPLEX NOTATION is viewed in both historical and systematic ways, including not only intrinsic notational complexity, but also its opening-up to the electronic medium and to digitally extended notations and interactions: *intra-notational* and *interactive complexity*.

PERFORMER-SPECIFICITY refers crucially to methods of performative self-reflexivity. In the Anglo-Saxon world, those methods are often referred to as *practice-led* or *artistic* or *auto-ethnographic* research[1]. In the field of embodied music cognition, they would be identified with the notion of *first-person descriptions.* In the field of interaction they would correspond to *expert-user* studies. The subjective character of this research is counter-balanced by the use of OBJECTIVE DATA and EMPIRICAL METHODS in the form of *third-person descriptions*[2].

Let us now elaborate a bit more on the notions above.

PARADIGM: Interaction versus Interpretation; TUI versus UTI

This thesis proposes a performer-specific paradigm of embodied interaction with complex piano notation. This paradigm, which I term *embodied navigation,* extends and even confronts the traditional paradigm of textual interpretation. The latter assumes a linear and hierarchical process, whereby internalized understanding of the musical text is considered a prerequisite of instrumental technique towards personal interpretation. I call this classical paradigm *UTI: Understanding-Technique-*

[1] Term by Nicholas Cook to describe what in the Anglo-Saxon world is often termed "performance-led research" and in continental Europe "artistic research".

[2] After Marc Leman's definition in his *Embodied Music Cognition and Mediation Technology*, the MIT Press, Cambridge Massachusetts, 2008, p. 79.

Interpretation. In lieu of that, I advocate for a dynamic, non-linear, embodied and external processing of music notation, even without the need for mental representations on the part of the performer, in the radical version of the model[3]. Music notation is theorized as a *state-space*[4] of *affordances*[5], to be navigated by the performer during a diachronic learning trajectory, ranging from the moment of first contact until on-stage interpretation. The pianist manipulates and processes notation through physical movement, as if it were an extension of her instrument. To take the metaphor even further, the pianist *touches notation* as much as she touches the instrument, and this action constitutes cognition. I term this conception of notation *TUI*: *a Tangible User Interface*[6], which is integral part of the instrument, enabling a composer-performer-listener communication based on *corporeal articulations*[7].

TOOLS: Gesture capture, Interactive notation

At a second stage, the proposed paradigm serves as the basis for the development of methodologies and customized tools for a range of applications, including: performance analysis, embodied interactive learning, contemporary composition, free improvisation, piano pedagogy and score-following. The tools in question include gesture capture, gesture analysis, gesture following and gesture interaction systems developed at IRCAM by the team *Interaction-Son-Musique-Mouvement*[8] (*MuBu for MAX*[9], *motionfollower*); the system of capacitive sensing *TouchKeys*[10] developed at Queen Mary University*;* as well as interactive notation platforms developed at

[3] As will be several times underlined, such definition does not do away with mental representations altogether (for example, in softer versions of the model), but does consider them as *contingent* rather than *necessary* to the performance of complex music.

[4] Term in dynamic systems theory, indicating all the possible states of a dynamic system, that is a system changing in time.

[5] Term introduced by James Jerome Gibson in his ecological theory of visual perception, indicating the possibilities for action given the abilities of an organism in a given environment.

[6] The use of the term *Tangible User Interface* here is metaphorical. The original term, referring to real interfaces which enable tangible interactions, is employed in the field of Human Computer Interaction.

[7] Similarly, term by Marc Leman, Embodied Music Cognition, p. 77

[8] http://ismm.ircam.fr/ accessed 30.03.2018

[9] http://forumnet.ircam.fr/product/mubu-en/ accessed 13.04.2018

[10] http://www.eecs.qmul.ac.uk/~andrewm/touchkeys.html accessed 13.04.2018

GRAME, Lyon (*INScore*[11]). These systems are combined in a sensor-based environment for the processing of complex music called *GesTCom (Gesture Cutting through Textual Complexity).*

METHODOLOGY

The methodology consists in practice-led research, theoretical and empirical, informed by the performative and embodied turns in both composition and musicology, by the general field of embodied cognition, by Human-Computer Interaction (HCI) and by research around New Interfaces for Musical Expression (NIMEs, nouvelles lutheries[12]) and other related communities (MOCO[13], TENOR[14] and others).

The concept of *embodied navigation* emerges out of my personal, expert-user perspective and practice as a professional pianist for new music. Thus, it falls into the category of practice-led research and often features subjective, first-person descriptions. At the same time, this research is interdisciplinary. It is informed by a variety of theoretical tools, empirical methodologies and objective data, captured during my praxis at the custom-built studio for gesture capture of LabEx GREAM and at IRCAM. In that way, it reaches towards third-person descriptions.

STRUCTURE: Why, what, how and case studies

The thesis is articulated in four parts.

The **first part** addresses the following research question: *If and why does complex piano music necessitate an embodied interactive paradigm, which is different from the traditional interpretation paradigm.* I attempt to answer the question by looking at developments in both music creation and musicology. As far as music creation is concerned, I explore a wide range of postwar repertoire along three overlapping axes of complexity: intrinsic notational complexity; complex interactions with electronic

[11] http://inscore.sourceforge.net/ accessed 13.04.2018

[12] after the homonymous conferences and community: http://www.nime.org/ accessed 31.03.2018

[13] MOvement and COmputing: http://moco.ircam.fr/videos/ accessed 31.03.2018

[14] TEchnologies for music NOtation and Representation: http://tenor-conference.org/ accessed 31.03.2018

media; and the theatrical investment of the performative body in intermedia constellations[15]. I examine discourses by composers and performers under the light of theories and works by (indicatively): Martin Zenck ("corporeal subtext"), Harry Lehmann (*The digital revolution of new music*), Erika Fischer-Lichte (*Aesthetics of the performative*) and Stefan Drees (*Body-Media-Music*). In this way, notational complexity is defined as *intra-* and *inter-complexity*, pointing at different types of notational interactions with the body and the media. As far as musicology is concerned, I am looking at the performative turn in the English- (Cook/*Beyond the Score*), French- (Lalitte/*Analysis of 20th century music interpretation*) and German-speaking (Hiekel/*Musical embodiments*) academia. I identify a central aporia, namely the problematic ontological status of the musical score in performance-oriented methodologies. I am also looking at the embodied cognitive turn in systematic musicology, as epitomized by Marc Leman. I eventually suggest that the UTI ("Understanding-Technique-Interpretation") model is inadequate for these repertoires and results in the aporias witnessed in the performative turn.

The **second part** addresses the research question: *What could be the alternative to the UTI paradigm.* I show how developments in cognitive psychology resonate with the unseating of the UTI paradigm and I introduce my embodied and technology-mediated alternative under the name "embodied navigation of complex notation". This alternative is featuring a TUI (*Tangible User Interface*) conception of notation. I am drawing from both the general field of embodied cognition (Gibson's *ecological psychology*, Rowlands' *4E cognition*, Chemero's *radical embodied cognitive science* and Lakoff's *metaphor theory*), tending towards a radical anti-representationalist dynamic stance; as well as from the field of music embodied cognition, notably Leman's *mediation theory* and Godøy's notions of *co-articulation* and *sound-action*

[15] We prefer the mid-1960s term "intermedia", introduced by the Fluxus artist Dick Higgins to describe various interdisciplinary art activities and convergence of genres, in lieu of the most commonly used "multimedia" and "mixed media". The reason is, that the latter is indissolubly associated today with technologically advanced media, while our research adopts a wider definition of technology, considering for example ancient forms of paper music notation as an equal interactive part of ancient media constellations (such as instruments and human bodies), while remaining obviously open to the highest degree of technological advancement of the media in question. Dick Higgins, Hannah Higgins, *Leonardo*, Volume 34, Number 1, February 2001, MIT Press, pp. 49-54

chunks, as well as other studies on musical gesture (for example, Guerino Mazzola's notion of *hypergestures*).

The **third part** addresses the research question: *How could the embodied navigation paradigm contribute to the development of interactive tools for the recording, analysis and integration of physical movement in augmented dynamic notational representations.* I introduce technological implementations of notation as gesturally controlled interface, by investigating: gesture modeling conducted at IRCAM by the ISMM (*Interaction-Son-Musique-Mouvement*) team; as well as the predecessor of the current *GesTCom* (*Gesture Cutting through Textual Complexity*) project, the *augmented violin project* (Kimura & Bevilacqua); interactive notations featured in the TENOR (*Technologies for Music Notation and Representation*) communities; new interfaces as presented by the NIME (*New Interfaces for Musical Expression*) community; and wider perspectives on movement modeling from the MOCO (*Movement and Computing*) community. Ideas and concepts from the history of HCI (*Human Computer Interaction*) will further frame the argument for a radical revision of the role of notation as extension of the instrument.

Eventually, the **fourth part** will put at work the concept of embodied navigation and the corresponding tools, in the form of case studies. A wide range of complex piano music, pertaining to all three axes of embodied interactive complexity will be examined: works by Iannis Xenakis and Brian Ferneyhough, which encapsulate the usual meaning of intra-notational complexity; post-complexity in the work of the French-German composer Mark Andre; action notation with theatrical consequences, in the work of the German-British composer Wieland Hoban; mixed music and live electronics, with a case study by the Greek composer Nicolas Tzortzis. This chapter will show hands-on examples of how the theoretical framework of embodied navigation and the prototype system called *GesTCom* (*Gesture Cutting through Textual Complexity*) may be used for the performance analysis, embodied interactive learning and composition of complex piano scores.