

Professor Dr. Guerino Mazzola

Spring 2018: Music 5950 Topics in 21th-Century Analysis: *The Mathematical Design of Future Music*

### **Course Description**

This course is a *propaedeutic* and *informal* introduction to the development and perspectives of mathematical music theory and its technology. We first motivate and unfold the conceptual framework upon the critical cases of Hugo Riemann's rhythm theory and Rudolf Reti's melody theory.—Music theory provides us with models of harmony, counterpoint, rhythm, or melody. What is the role of such models: a *posteriori* reconstruction of a historical development or construction of future directions in music? Core topics: Fux' *gradus ad parnassum* and Boulez' approach to creative analysis.—A theory and its computerized implementation are dramatically different topics. To understand the problem, we discuss the topic of programming abstract theory in the case of musical performance. The implementation of theories enables investigations with a variety of system parameters, and thereby an opening of such premises. But also a number compositional strategies, which extend the creative power and enable fictitious music worlds of the future, such as, for example, new contrapuntal paradigms. The latter is being implemented on my music software *Rubato Composer*, which I want to present as a perspective of future music creation.

### **Media and Collaboration**

I do not stick to a fixed media, the emphasis being rather on the collaboratory paradigm, using music audio examples, scores, music software, powerpoint, reading texts, blackboard discourses, or the piano. I also welcome critical perspectives in the course discussions, which will take 40% of the course time.

### **Prerequisites**

No specific prerequisites in mathematics (beyond high school education) are required. However, a basic interest for mathematical structures and information technology is advantageous.

### **Goals and Objectives**

This course will provide the students with a first overview of the new methods of mathematical music and performance theory, music informatics, and compositional strategies. It is *not* the course's goal to delve into mathematical formalism, but to give an idea of why and how these formalisms are being applied. The objective of the course is to let the students have enough specific knowledge to decide upon more specialized topics in this direction in order to shape their academic curriculum.

### **Grading**

I grade on a scale 0-10 with 0.1 steps: 9.5-10 = A, 9-9.4 = A-, 8.5-8.9 = B+, 7.6-8.4 = B, 7-7.5 = B-, 6.5-6.9 = C; 6-6.4 = C-, 5-5.9 = D, 0-4.9 = F.

Final grade: Class participation 1/3, first paper 1/3, second paper 1/3; no final exam.

First paper due March 19, length = 6 –10 pages (double spaced),

Second paper due April 30, length = 6 –10 pages (double spaced).

Plagiarism will not be tolerated and will lead to failure.

### **Contact**

My office hours are by appointment (room 164).

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Web = <http://www.encyclospace.org>

## Schedule of Classes

### I. INTRODUCTION

- I.1 (W Jan 17) General Organization and Syllabus  
I.2 (F Jan 19) A historic-systematic introduction
- I.3 (M Jan 22) The dynamic ontology of music I: Presentation  
I.4 (W Jan 24) Discussion  
I.5 (F Jan 26) Creative collaboratories in the information age
- I.6 (M Jan 29) Creativity by ontological switches between mathematics and music

### II. CONCEPT SPACES

- II.1 (W Jan 31) Case study I (rhythm): Riemann, Jackendoff-Lerdahl  
II.2 (F Feb 02) Concepts and software for a theory of rhythm: The MetroRubette
- II.3 (M Feb 05) The MetroRubette: Examples  
II.4 (W Feb 07) Discussion  
II.5 (F Feb 09) Case study II (motifs): Reti
- II.6 (M Feb 12) Concepts and software for a theory of motifs: The MeloRubette  
II.7 (W Feb 14) Discussion  
II.8 (F Feb 16) Why encyclopedic concept spaces in music?
- II.9 (M Feb 19) Denotators I—definition of a universal concept space and notations  
II.10 (W Feb 21) Denotators II—examples  
II.11 (F Feb 23) Building forms and denotators on Rubato Composer

### III. MODELS

- III.1 (M Feb 26) The role of models in music theory  
III.2 (W Feb 28) Counterpoint models I: consonances and dissonances  
III.3 (F Mar 02) Counterpoint models II: deduction of the basic rules
- III.4 (M Mar 05) Exotic counterpoint worlds—introduction  
III.5 (W Mar 07) Boulez' creative analysis  
III.6 (F Mar 09) The Rubato software for Boulez' *structures pour piano*

Spring Break 3/12-3/16

### *First paper due March 19*

The first paper should present a critical discussion of the topic «Is precise conceptualization of music objects and modeling in music theory only of academic interest or also useful for musical creation?» This discussion must be based upon Parts I, II, III of the course. Make appropriate references for citations.

### IV. OPERATIONALIZATION

- IV.1 (M Mar 19) Playing abstract symbols: the challenge of performance theory  
IV.2 (W Mar 21) Critical differences between symbols and reality—levels or creativity  
IV.3 (F Mar 23) What is an instrument?

## V. EXPERIMENTS

- V.1 (M Mar 26) What is an experiment in music?  
V.2 (W Mar 28) The sonata experiment (an example of Boulez' approach)  
V.3 (F Mar 30) Modeling tonal modulation
- V.4 (M Apr 02) The modulation landscape in Beethoven's op. 106  
V.5 (W Apr 04) Reconstruction of a sonata by creative analysis  
V.6 (F Apr 06) How would you construct a composition with such a modulation geography?
- V.7 (M Apr 09) Think about modulation in other parameter spaces, e.g. time, sound color, etc.  
V.8 (W Apr 11) How to compose with a computer?  
V.9 (F Apr 13) The composition software presto
- V.10 (M Apr 16) Synthesis—a computer-aided jazz composition—I: principles  
V.11 (W Apr 18) Synthesis II: symmetries and morphing  
V.12 (F Apr 20) Synthesis III: Rhythmic modulation
- V.13 (M Apr 23) Synthesis IV: the 2nd movement and comments  
V.14 (W Apr 25) Synthesis V: the 3rd movement: text and music  
V.15 (F Apr 27) Discussion of the interaction of a performer and a computer

### *Second paper due April 30*

Discuss the topic «What is the difference between the experiment realized by my musical creation/composition and an experiment in the sciences?». This discussion must be based upon Parts I through V of the course. Make appropriate references for citations.

- V.10 (M Apr 30) Presentation of students' works I  
V.10 (W May 02) Presentation of students' works II  
V.10 (F May 04) Presentation of students' works III

### **Selected Original References**

- Beethoven L van: Grosse Sonate für das Hammerklavier op.106 (1817-1818). Ed. Peters, Leipzig 1975
- Boulez P: Jalons (dix ans d'enseignement au Collège de France). Bourgeois, Paris 1989
- Buteau Ch and Mazzola G: From Contour Similarity to Motivic Topologies. *Musicae Scientiae*, Vol. IV, No. 2, 125-149, 2000
- Eco U: *Art and Beauty in the Middle Ages*. Yale U Press 1986
- Fux J J: *Gradus ad Parnassum* (1725). Dt. und kommentiert von L. Mitzler, Leipzig 1742
- Mazzola G: *Semiotic Aspects of Musicology: Semiotics of Music*. In: Posner R et al. (Eds.): *A Handbook on the Sign-Theoretic Foundations of Nature and Culture*. Walter de Gruyter, Berlin and New York 1998
- Mazzola G: *presto Software Manual*. SToA music, Zürich 1989-1994
- Mazzola et al.: [www.rubato.org](http://www.rubato.org)
- Mazzola G and Zahorka O: *Tempo Curves Revisited: Hierarchies of Performance Fields*. *Computer Music Journal* 18, No. 1, 1994
- Mazzola G: *Synthesis*. SToA 1001.90, Zürich 1990
- Mazzola G: *L'essence du bleu*. Acanthus, Rütönen 2002

Mazzola G: *La vérité du beau dans la musique*. DelaTour/IRCAM, Paris 2007

Mazzola G, C Losada, F Thalmann, S Tsuda: *Topos Theory for a Creative Analysis of Boulez's Structures*. In: Somashekhar Naimpally, Giuseppe Di Maio (eds.): *Quaderni di Matematica, Theory And Applications of Proximity, Nearness and Uniformity*, Vol 23, 2009

Mazzola G and F Thalmann: *Musical Composition and Gestural Diagrams*. In: C. Agon et al (eds.): *Mathematics and Computation in Music - MCM 2011*. Springer, Heidelberg 2011.

Mazzola G, J Park, F Thalmann: *Musical Creativity*. Springer 2011

Mazzola G, M Mannone, Y Pang: *Cool Math for Hot Music*. Springer 2016

Mazzola G, M Mannone, M O'Brien, Y Pang, N Torunski: *All About Music*. Springer 2016

Mazzola G: *The Topos of Music I, II, III, IV*. Springer 2018

Milmeister G: *The Rubato Composer Music software*. Springer, Berlin-Heidelberg 2009

Reti R: *The Thematic Process in Music (1951)*. Greenwood Press, Westport 2nd ed. 1978

Riemann H: *System der musikalischen Rhythmik und Metrik*. Breitkopf und Härtel, Leipzig 1903

Sachs K-J: *Der Contrapunctus im 14. und 15. Jahrhundert*. AMW, Franz Steiner, Wiesbaden 1974