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A process of interactive computational creation of musical notation

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The erudite music is based on the existence of a formal musical notation, that defines the compositional structure and allows the musician to execute it, intermediating this “musical algorithm” that translates the graphic objects of the notation, in sonorous objects, of the musical performance. The traditional order of events that constitute the musical creative process initiates in the composition and extends to the performance. Nonetheless, in computational music, it is currently possible the generational order of the composition of formal music to be inverted, initiating it through a free musical process as an improvisation and culminating in the self-organization of a formal structure: the musical notation. This short article presents the study and development of a possible computational model of this category. It is about the creation of an algorithmic system of computational music for the self-organization of musical notation from the collected data in real time, during the performance. Through the trio interaction: composer-computer-interpreter, the improvisation begins the computation process of the automatic composition of musical notation. Such process may be executed through the utilization of two data acquisition methods: Musical descriptor – computational models that preview musical aspects; and Bio-signals - involuntary biological signals, associated to variations of the emotional state, in this case, of the musician or listener. The computational model mentioned here was developed in PD (www.puredata.info) and graphically presented by INScore (<http://inscore.sourceforge.net/>). The system generates dynamic notation structures, representing emerging musical works that occur from the informational flow generated by descriptors/bio-signals. In the model exemplified here, data is dynamically collected through the musical descriptors. The final structure generated by this dynamic process of musical creation can be published subsequently online or printed in paper, resulting in a musical score that as such can be once again played, as a traditional piece of

music. However, instead of being created by only one composer, this piece is the result of an emerging creative process; self-organized by the interaction between human being and machine, expressed in the dynamic interaction between composer, computer and interpreter.

Contrasting with the musical notation forms (traditional and graphic) the interactive notation presents itself as a dynamically structured and adapted notation. The development of the computational model responsible for interactive notation considers as much the aspects of the noted music as the gestural data related to the improvisational performance. Music is frequently defined by its creation material; According to Edgard Varèse, as "organized sound". The creative process that creates such organization is identified by the human mind in three levels: 1) the sonorous perception, 2) the musical cognition and 3) the evoked emotion. The sonorous perception deals with related aspects to the human hearing of the limits of its reception and of the processing of the acoustic information (Helmholtz, 1912); studied by the psychoacoustic. The musical cognition deals with related processes related to the understanding, identification and memory of musical information. Part of these studies involve the implementation of the descriptors, that are computational models for the prediction of non-contextual (psychoacoustic ones) or contextual (cognitive ones) of the musical listening. Despite musical cognition usually handling with the analytic understanding of the music, a study area derived from it, which is becoming more popular, is the study of evoked emotion by the music (Meyer, 1957). The musical emotion can be of two categories: verified or evoked emotion. Verified emotion deals with the category of the primarily cognitive nature, where the listener easily understands the emotive meaning of a work, yet does not have his/her emotional state altered by it. The evoked emotion, on the other hand, deals with the category of the affective nature, where the emotional state of the listener is altered by the music, even if he/she is not conscious of this process. The evocative emotion can be associated to appreciation, through the listening of a musical piece. It is also related to the creation process of a musical piece by the computer through its actual structuring, or to the performance of a musical piece through or improvisational recreation.

In terms of musical cognition, bio-signals can describe either the evocative emotional states; of short (*affects*), or long (*moods*) (Blechman, 1990). *Affects* deals with short musical extracts (3-5 seconds of duration) considered by some experts as related to the present sensation, or the "now" of the musical listening. *Moods* are emotional states longer, usually caused by extensive exposure to music, like listening to a full symphony or musical show. Such emotional effects persist for long periods of time and can be seen in the variations of biological rhythms such as circadian rhythms (Moore, et al., 1982).

The informational content, given by the evoked emotion through the listening or musical performance, permeates three interdependent musical areas: The Structuring (composition), the Appreciation (listening) and the Performance (interpretation). From this systemic interconnection the music derived of the trio interaction composer-computer-interpreter, it is

described here as a self-organized process that emerges from the regularities of an open system, whose informational flow from the musical aspects is detected by the mind, where from (according Charles S. Peirce, 1931) derive habits which point to a musical significance.

Traditionally, the notational structure remains unchanged while the performance dynamics is processed and its consequent appreciation, through its hearing. This occurs because the structure happens through the self-organization of the open system, compounded by the psychological universe of the composer. Such medium, is presented as a complex and open system, undergoing the intervention of external gestural agents, here referred as inspirational ones, which delineate the final shape of the composition structuring. Also it is possible the existence of musical processes where the structure is not static, but dynamically variable, modifying itself throughout the performance. Examples of such processes are found in the improvisations of pop music and jazz, in happenings and even in the algorithm composition, such as the dice game of Mozart (Chuang, 1995). The computational model of interactive notation here presented comes from a similarity with such styles, having the extension that the musical creative process is refueled, closing a circuit between performance and dynamic composition of musical notation. A video, presenting an initial test with such model, may be watched in the link: http://youtu.be/p0_A93QIUk4

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