Musical Performance: a Composition of Monads (in Workshop: Logic and Music)

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Much work has been done on computer representations of music at the physical level. Developments such as K-nets by Klumpenhouwer and Lewin provide a way for representing transformations from one pitch-class to another. Category theory should facilitate the development of a logical approach to music, which can be mapped into one of the physical approaches for implementation. Towards this aim Mazzola and Andreatta developed the idea of a category of directed graphs (objects = notes or chords, edges = music operations such as transposition), as a topos-based approach for a description of the music, ultimately delivering the generalised PK-net with the concepts of form and support. PK-nets enable heterogeneous collections of musical objects to be naturally compared and manipulated as described by Popoff, Andreatta and Ehresmann [1].

The work to be presented builds on that developed for information systems, taking up the challenge of a testing application for the Cartesian monad approach to universal design [2]. A principal aim is to capture the performance of music as a communication between the musicians and the audience using the categorial construction of a monad. In this respect the monad, a term originally used by Leibniz, presents a musical performance as a composition over time signatures, with adjointness between each step: the monad looking backwards and then forwards and its associated comonad looking forwards and then backwards. The physical characteristics of the notes in each time-frame are complex, so it is necessary to use a strong Cartesian monad, facilitating the representation of each time-frame as a product. The monad is process, handling dynamic aspects. The category upon which the monad operates is a topos holding relatively static information such as the players, the score and the venue, together with the relationships between them. The topos is far from totally static with its arrows facilitating flexibility in all information held, including relationships; the topos is also searchable through the subobject classifier. There is no assumption of any particular musical genre. Such a categorial framework could be implemented in a functional programming language such as Haskell, under the control of a scripting language such as Forth, as employed in the Blockchain method.

References

1. A. Popoff, M. Andreatta & A. Ehresmann, “A Categorical Generalization of Klumpenhouwer Networks", in Mathematics and Computation in Music: 5th International Conference, 2015, pp. 303-314.

2. N. Rossiter, M. Heather & M. Brockway, “Monadic Design for Universal Systems", ANPA* Proceedings 37 & 38, edited by A.L. Vrba, 2018, pp. 369-399, https://goo.gl/YXxy43.

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