Ziffers - Numbered Notation for Algorithmic Composition

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ABSTRACT

Ziffers is an algorithmic number based musical notation system offering a terse syntax for the improvisation and composition of complex melodies and rhythms. Ziffers gradually evolved from empirical experiments aiming at closing the gap between several number-based notational practices spanning from numerical and staff notation to pitch class set and post-tonal theories. Ziffers places a special emphasis on providing support for live algorithmic and generative composition, embedding a toolset of algorithmic processes directly in its syntax model. The system also tries to accommodate these fixed media types of notation to the liveness experienced when using live coding environments. Ziffers has been influenced by TidalCycles (McLean and Wiggins 2010) and Ixi Lang (Magnusson 2011), two popular live coding libraries designed around the use of a custom domain specific language, called mininotation, allowing the live manipulation and transformation of musical patterns. In this article, we propose an environment agnostic presentation of the Ziffers musical notation system. As a proof of concept, this article also introduces two implementations running in different environments: Sonic Pi (Aaron 2016), a live coding platform designed for education and music performance and Musescore, a general purpose scorewriter and score playback software. In doing so, we are hoping to highlight the versatility of our approach, which seems to allow the use of a unified syntax for different contexts of execution and interpretation.

1 INTRODUCTION: ZIFFERS, QUICKLY EDITABLE NUMBER BASED NOTATION

Ziffers — named and inspired by the older *Ziffersystem* (Warkentin 2022) — proposes a system focused on the conciseness and expressiveness of musical notation. Ziffers is designed to enable generation and transformation of musical patterns (McCormack et al. 1996; McLean 2020) in minimal amounts of time and typing. To do so, Ziffers uses a text-based syntax for representing various short-hand symbolic notations used in music theory and concepts in programming languages. The need for concise and succinct notation in the context of live coding performance is a well-known constraint (Roberts and Wakefield 2018) that gave rise to many practices and techniques aiming to reduce frictions in the conversational feedback loop between the musician and its programming interface (REFERENCE). Domain specific languages (DSLs) and the use of terse mini notations have become an important design pattern in the conception of live coding interfaces (Hoogland 2019; ADD OTHER), and can also be noted to be a key concept in the larger realm of exploratory or conversational open-ended programming where reactivity and fast decision-making is of prime importance to achieve a creative state of flow (Nash 2015; Kery and Myers 2017).

Ziffers is designed as a terse and platform independent syntax capable of embedding algorithmic and generative processes at the notational level. Basic notation tokens denoting pitch, rhythm or expression marks form the base notation, enriched by a set of generative operators and tokens denoting algorithmic transformations of that first layer of notation. Implementation of the Ziffers system is specific to each targeted platform, in conformity with the notation described in this article and the documentation for the prototype implementation. The first prototype of Ziffers has been created in 2018 (Alonen 2018) as an inline parser for Sonic Pi. It was thought as an attempt to speed up the process of writing melodic lines on-the-fly, taking advantage of the large number of predefined methods and compositional helpers offered by Sonic Pi's rich internal library. Its design aimed at resolving the dissociation between pitch and rhythm imposed by Sonic Pi data structure and imperative-oriented programming model. After a few years of evolutionary prototyping, Ziffers 2.0 was released in 2022 (Alonen 2022), including a new parser aiming at extending Ziffers capabilities with new operators, nested structures and better support for stochastic and aleatoric composition.

2 METHOD: DESIGNING BY DRAWING FROM MUSIC NOTATION HISTORY

The Ziffers music notation project initially started as an experiment to confront historical numeric pitch-based music notation practices with the kairotic notations (Cocker 2013) typically found in live coding and algorithmic music performance systems (Blackwell et al. 2022). Therefore, the system has been designed iteratively in conversation with the diverse and complex historical legacy of said practices. Documents pertaining to the systems of numeric pitch notation in common practice can be traced back as early as the European baroque up to the contemporan era through examples as varied as the American Nashville system, the Chinese Jianpu simplified notation (Kaminski 2022; MNMA 2022) or the theoretical pitch-class set numbering of musical structures and chords used in post-tonal music theory (Forte 1973).

Numerical systems for score, harmonic or melodic writing – less commonly encountered than their staff-based counterparts – have historically served as compositional tools for polyphonic contrapuntal notation (Davantès 1560), early theoretical endeavours in algorithmic composition (Kircher 1650) or in pedagogy and teaching (Rousseau 1781). Finding a new breath during the late nineteenth-century through the Galin-Paris-Chevré notation (Dauphin 2012), the practice spread to Asia where it is widely used, known and practiced, sometimes concurrently with standard staff notation. Some specialized applications of numbered notation can also be found in the toolset of contemporary ethnomusicologists and ethnomathematicians that often take advantage of the versatility of symbolic cipher notation to devise notation systems capable of formalizing musical systems or previously non-written musical practices (Chemillier 2002).

We perceive – as a thought experiment – the use of mininotations (Magnusson and McLean 2018) as modern live coding analogues to previously mentioned numerical music notation systems. In that regard, with their conciseness and economy of expression, we observe that older non-computer based numerical notations systems are adequate fits for the domain but have never been fully transposed and applied to the realm of live coding performance. Strikingly, we see them being used by musicians and music theorists alike as pragmatic and practical tools for draft notation and information sharing. In our opinion, the versatility of pitch-based number notations as well as their adequacy to the traditional way of inputting complex data structures (as lists, arrays or ordered data) in the most music programming languages (Roads 1996; Dannenberg 2018) make this type of notation a fruitful exploration domain for live coding and computer-based music notation alike. Generative numeric notation can also mitigate the separation between static and dynamic music notation languages as defined by Dannenberg's typology of the domain. Examples such as Adagio (Dannenberg 1986), ABC (Walshaw 2011), Guido (Hoos et al. 1998), MusicXML (Good 2001), Lilypond (Nienhuys and Nieuwenhuizen 2003) or MusicTXT (Li and Li 2021), as static languages, focus on the encoding of musical information on fixed medium while other dynamic languages such as Nyquist (Dannenberg 1997), SuperCollider (McCartney 2002), Sonic Pi (Aaron 2016), TidalCycles (McLean and Wiggins 2010), Open Music (Bresson et al. 2017), OpusModus [opusmodus2022], often extends musical notation by blending it with computational models of control flow, sound processing capabilities or binding different means of sonic writing: "The instrument incorporates notational elements, but conversely the notational is becoming increasingly instrumental and systematic" (Magnusson 2019).

Conclusion

3 Acknowledgment

Raphaël would like to thank Laurent Pottier and Alain Bonardi for their support, as well as the doctoral school *3LA* from the University of Lyon for the funding it provided to this research.

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