

# Live digital notations for collaborative music performance

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## ABSTRACT

This paper considers a software environment centred around digital notations for music performance. Implemented in SuperCollider, the PitchCircle3D software is discussed within the context of affinities with the aims of the live coding movement and sharing music notations with an audience. Use of the software in collaboration with other performers is also discussed, in which the notations function as digital score. A case study is presented, a collaborative project in which PitchCircle3D functions as a partially-indeterminate score. This score was used as a basis to structure musical improvisation, and a model of interactions within this project is presented.

## KEYWORDS

Digital notation, music performance, improvisation, collaboration, live coding, PitchCircle3D, SuperCollider

## INTRODUCTION

The performance of music for millennia has been grounded in collaborative practices, the centrality of 'liveness' and for the last thousand years or so – and for some musics – its visual representation as notation (Rastall, 1983). In recent years, attention has been given to these areas within software engineering and design communities, as development processes have become faster due to technological advances, and more consideration has been given to the cultural, collaborative and cooperative aspects of programming (See for example Schmidt & Bannon, 2013). These themes can also be found in developments in computer music, from the move to real-time synthesis, live algorithms and live coding. Indeed, it has been argued that live coding for example, 'offers new insights with regard to software engineering processes' (Biddle et al., 2013, p. 131). This paper considers an example of how such perspectives, generally from disciplines within computer science can be married to the longstanding traditions of their equivalents within the domain of musical performance.

## SHARING NOTATIONS

One of the usual outcomes of live coding is a shift of emphasis from software, to the programmer as performer on stage, in line with traditional music performance. The programmer's code is commonly shown to the audience through its projection onto a screen. This move towards *sharing* is in sympathy with a post-war desire towards transparency of communication in art (Hall, 2013). Although sharing code with an audience can help shift emphasis to the act of programming, code itself is usually a highly abstracted representation of heard music. Thus as a form of notation of music, code offers many communication barriers to the non-programmer. This issue has been the motivation for a number of artist-programmers to create forms of graphic music notations that offer more low-level representations of musical processes. In this respect my software, PitchCircle3D, introduced below, appears to share an aim of Magnusson's 'Threnoscope' (Magnusson, 2013), to broaden the accessibility of and maximise communication of musical processes to non-specialist audiences.

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## PITCHCIRCLE3D

The following gives a brief overview of PitchCircle3D, before contextualising its use in a collaborative performance project. PitchCircle3D<sup>2</sup> is a series of custom classes, written using live coding techniques of interactive programming in the SuperCollider programming language (See Rohrhuber, de Campo and Wieser, 2005). Implementation in SuperCollider allows tight integration with the software's realtime audio synthesis engine for use in electronic music performance. PitchCircle3D animates live music notation in the form of notes and chords in 12-tone equal temperament (12-TET). Figure 1 shows two of the three current notational views available, including a 'pitch clock' (pitch-classes only, i.e. omitting registral information) and a spiral helix (illustrating relative register, in this case, over three octaves).

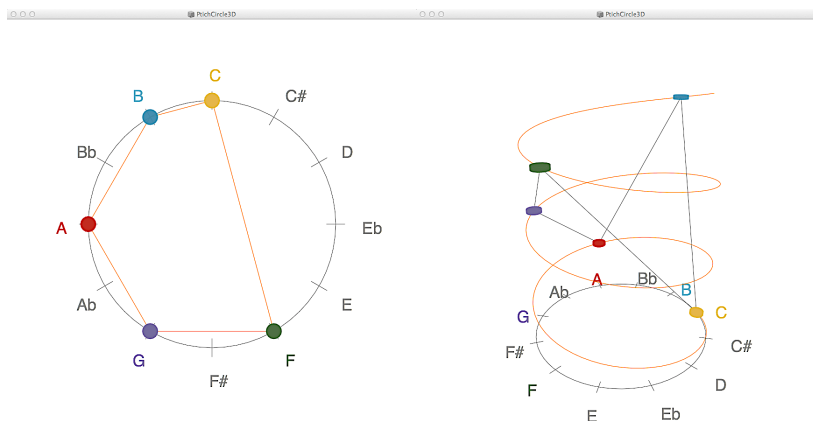


Figure 1. PitchCircle3D views

PitchCircle3D's notational representations are in themselves not novel, although the implementation and its performative context offers affordances not hitherto available. Software offering similarities to PitchCircle3D's pitch clocks view include Pierre Couprie's iPhone apps *Music Set Theory*.<sup>3</sup> Software animating series of notes over time on pitch clocks is less common, but includes Zalman Kelber's real-time visualisation of a recording of Milton Babbitt's *Semi-Simple Variations*.<sup>4</sup> Like the spiral helix view available in PitchCircle3D, Chew and François' MuSA.RT Opus 2 software also displays pitches around a spiral helix, and can do so based in real time using MIDI input (Chew and François, 2005). Whilst MuSA.RT can also be used as music notation to be shared with an audience, its scope is narrower than PitchCircle3D, as it is intended to illustrate a specific theory of the analysis of tonal music, arguably requiring specialist knowledge to be fully appreciated. MuSA.RT is primarily a tool for music analysis, whereas PitchCircle3D is intended for broader use, including as a digital musical score.

## COMPUTER MUSIC SCORES & COLLABORATION

There is a long tradition of 'static' computer music scores, with some intended for realisation in computer music, others as notation of existing music already created. However there has also been a sense that the medium produced mixed results in its early decades (Zinovieff, 1969). Digital scores, however, able to be updated in real-time, offer more scope for interactive notation. Whilst PitchCircle3D can be used as a simple visualisation of note music, its implementation is intended also to act as musical notation in the sense of a live digital musical score for collaboration in performance. Collaboration in music, as in most domains,

<sup>2</sup> See <http://www.ludions.com/notation/>

<sup>3</sup> [http://logiciels.pierrecouprie.fr/?page\\_id=34](http://logiciels.pierrecouprie.fr/?page_id=34)

<sup>4</sup> <http://www.youtube.com/watch?v=L3VpOD2Rtw4>

requires a form of shared communication, representation, or notations. In the broader sense, the ongoing software development of PitchCircle3D is collaborative, subject to informal 'alignment work' as defined by Biddle, operating between the software's author and other performers who use PitchCircle3D (Biddle, 2013, p.137). The emphasis on collaboration for the present purpose, however, is narrower: the use of PitchCircle3D as a form of computer-assisted-performance, acting as the shared notational space between performer–collaborators.

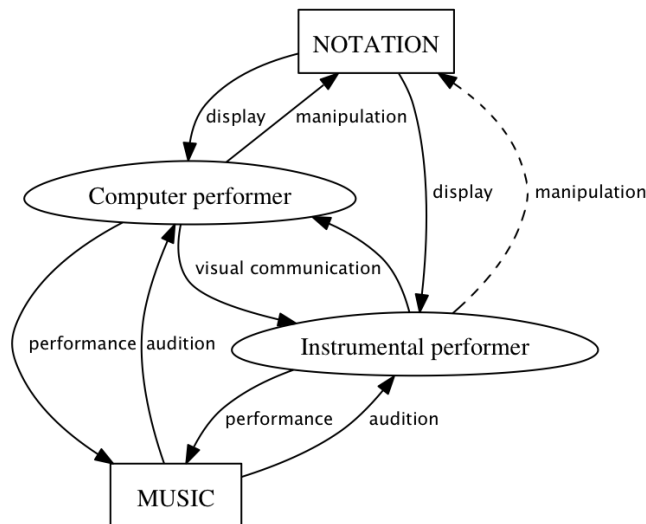
As the basis of a musical score, PitchCircle3D is by default fully determinate in terms of pitch, but indeterminate with regards to low-level rhythm. This project thus sits between other recent approaches in digital notation that are more indeterminate (graphic notation), or fully determinate, employing common western musical notation (CWN) (e.g. Hoadley, 2012). This design decision offers clear constraints for performance (what notes to play), but leaves others relatively open (when and how to play) (See Behrman, 1965).

### **INDETERMINACY & IMPROVISATION**

The notational indeterminacy of PitchCircle3D leaves considerable room for collaborative musical improvisation. It might be argued that musical improvisation (indeed like live coding), exists along a continuum that may have at one end materials seemingly free, spontaneous and unprepared, at the other, mosaics or sequences of carefully controlled and rehearsed materials whose appearance is as equally predicted by an audience as by the performer. Pressing's theories of musical improvisation serve to explain how PitchCircle3D can be used in collaborative improvisation (Pressing, 1988). The following brief summary introduces the key ideas: the model divides improvised music into sequential 'event clusters' divided by time points, usually demarcated by 'local musical boundary criteria' including pauses and other phrase junctures (Pressing, 1988, p.153). Musical continuation within and between clusters is determined by 'associative' or 'interrupt' generation across musical parameters (Pressing, 1988, p.155). Using PitchCircle3D in improvised performance, the notes and chords shown in sequence on the screen can be understood as the impetus for improvised event clusters, or as partial clusters indicating musical continuation. In a recent performance using the software, this was partially determined by the duration over which each note/chord was displayed. The duration was in turn determined either algorithmically, or through mediation by the computer musician (further discussion of this aspect is outside the scope of this paper). Likewise, timings of musically noted material and the relationships between this material thus influenced whether continuations were associative or interrupt-driven. These musical decisions and outcomes were the result of the collaborative nature of the musical improvisation, which functioned according to a specific set of interactions next outlined.

### **INTERACTIONS**

A recent collaborative performance using PitchCircle3D involved the present author as computer performer, and an instrumental performer (Kevin Flanagan, soprano saxophone). Figure 2 illustrates the feedback of interactions between the two performers, digital notation, and the sounding musical performance (influenced by Nash & Blackwell's 2012 approach to diagramming user interaction within music software). Note that the majority of these interactions function as iterative feedback loops which may operate on multiple timescales. The exception in this case is that the instrumental performer did not manipulate the digital notation (and sounding electronic part), except indirectly through visual cues to the computer performer. It is also helpful to understand that the notation and music are in a sense at any moment types of abstract representations of the other, whose relationship is determined by the type of improvisation occurring. Thus paths through these iterations occur in a layered fashion, in which the notation is realised through improvisation by the performers.



**Figure 2. Interactions around PitchCircle3D in collaborative performance**

## CONCLUSION

PitchCircle3D is a flexible tool for displaying live notation of note music in the form of pitch clocks, spirals and spiral helix. Its implementation in SuperCollider allows tight integration with audio synthesis, and is aimed towards both visually complementing (sharing) and notationally structuring (as score) music performance. The software has flexibility to allow for performance that is solo or collaborative, improvised or pre-defined. The real-time nature of the implementation affords applications in live algorithmic computer music, including live coding.

Future work will involve investigating the effectiveness of the environment for both flexible and specialist means of communication and sharing between performers and audience of live and improvised music. The extent to which the system can meaningfully be integrated into a live coding environment is a part of this research context. Collaboration between performers in the form of musical interaction is intended to be extended to include the ability of the acoustic performer to manipulate the notation and electronic music. The notation may also be made more flexible through allowing representations of other n-TET tunings. Perhaps the highest constraint of the system is that the notation currently provides no rhythmic information, except through the real-time temporality of time points in the performance. Whilst this appears to be an in-built friction of the system as a performance notation, it does not follow that such information is then lacking in the resulting musical performance, just that it is indeterminate. However, future research will likely leverage further representations of musical parameters, including rhythm, into the notation.

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