

# A GENERATIVE ENVIRONMENT FOR PERFORMING CONTEMPORARY ELECTRONIC MUSIC

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## ABSTRACT

Performing contemporary popular electronic music commonly incorporates audio playback, either from digital audio files or vinyl records. A software environment (*Deviate*) has been constructed, which employs generative methods for performance and control and allows new note-level musical material to be created in real-time. This discussion focuses on the contextual issues of using and designing this system, with regard to contemporary methods for computer-based and laptop performance, and critiques of these approaches. Standards for performance environment design and practice are introduced, which outline primary areas to be addressed in the construction of a performance environment such as *Deviate*. Audio examples of *Deviate* are located online, at <http://www.cetenbaath.com/cb/about-deviate/>.

## 1. INTRODUCTION

Contemporary electronic music, as it will be called in this paper, refers not to contemporary electro-acoustic music but to a diverse genre of music including and derived from popular electronic music styles of the 1980s to present, such as techno, industrial, and house. The performance of this music has historically taken several forms, ranging from turntable-based DJ sets to live programming and playing of sequencers and synthesisers. In recent years, music production and performance software programs have digitised DJ practice. The most prominent of these programs is Ableton Live, which allows users to cue loops and samples for selection and playback in real-time. The author's research concerns the incorporation of generative compositional methods to the performance of contemporary electronic music, where musical material is generated 'live' at the note-level according to stochastic processes and user-determined control parameters. This approach permits the creation of new musical material in performance and affords greater flexibility and scope for improvisation.

This performance model used in this research is that of a single performer with laptop computer, with no acoustic or instrumental input. A software performance environment (named *Deviate*) has been developed using Max 5 [1] and includes systems for percussive and melodic

generation, synchronisation, and control of musical features. This paper focuses on the context surrounding this project, and will discuss its relation to other methods of generative performance, programmatic and stylistic formalism, and improvisation. Functional and lower-level aspects of *Deviate* are not covered here; see Keith [2] for a discussion of practical features.

This research is innately practical, and investigates possible solutions to a perceived issue, namely, the separation of the methods for production and performance in contemporary electronic music. To redress this, *Deviate* provides a means for producing note-level musical output in real-time, placing it closer to the role of a performable musical instrument rather than a storage and playback mechanism. The motivations for this project are therefore firstly founded on a musical and cultural basis, and secondarily on the fields of computer music, algorithmic composition, rule-based logic, and programming. This style-first, result-oriented approach aims to situate this research within a musical context, and develop generative techniques and performance practices to suit that practice. To date, *Deviate* has been used for numerous live recordings in various sub-styles of contemporary electronic music. For examples of these, see <http://www.cetenbaath.com/cb/about-deviate/>.

## 2. CURRENT APPROACHES

The motives for generative music composition and inquiry encompass music and information analysis [3], perception research and cognitive science [5], an exercise in programming [6], and the development of compositional tools [9]. The motivation underlying *Deviate* is comparatively prosaic in that it employs generative techniques as a practical method for augmenting live performance of contemporary electronic music. This endeavor is a response to the author's own perception that popular methods for laptop-based contemporary electronic music performance, such as Ableton Live [10], do not allow the user to extemporize or create new note-level material in performance.

### 2.1. Performing contemporary electronic music

As a production-based rather than performance-based musical form, contemporary electronic music has limited conventions for live performance. Turntable-based DJ

mixing practice is perhaps the most well-known approach, where a volume crossfader is used to blend separate audio sources, merging the output of two vinyl records while maintaining a steady beat. In this scenario, the DJ exerts little input regarding the compositional structure of the sonic result. Virtuoso turntablism practices have evolved in hip-hop and other popular music forms, however, where sound sources are adeptly manipulated and recombined in order to generate an original work during performance [11], but for the most part performance constitutes playback of existing works. Other approaches may incorporate technologies of music production, including various configurations of software, sequencers, and synthesisers, but there is no unified method that exists across practitioners and sub-genres. In recent years, Ableton Live has come to the fore as a software package that merges live performance and production capabilities, and is widely used by DJs as well as music practitioners in other genres. This research project is, however, examining only the model of single performer and laptop computer, and does not consider collaboration with other musicians, audio input, or additional musical instruments.

## 2.2. Non-linear and improvisatory approaches

An element that is underdeveloped in performance programs such as Ableton Live is the facility for improvisation, although it is patently successful in its approach to live music-making as a whole. The ‘Session View’ performance mode allows for real-time decisions to be made over phrase-level musical output and compositional form, by recombining pre-composed loops or via real-time control over audio effects and processing. Ableton Live’s ethos focuses on this notion, as demonstrated by their “Defy the Timeline” slogan [12]). This concept is more accurately described as non-linear playback rather than improvisation, as output is wholly deterministic. Adding a measure of indeterminacy places the performer in an improvisatory and *interactive* rather than *reactive* role, as s/he is obliged to react and adapt to sonic output. Furthermore, the production of new material in performance is constrained by Ableton Live’s approach. Although sections and loops can be selected, layered, recombined, and processed in real-time, creating new note-level material without recourse to external instruments is problematic.

## 3. MOTIVES FOR CHANGE

Given that the performance approach engendered by Ableton Live is acceptable to many DJs and performers of contemporary electronic music, the question might be raised: why improvise at all? There exist many concerns [13] raised in both academic and wider contexts that suggest that it may be useful to rethink current approaches to laptop performance. These concerns relate, in several forms, to the development and perception of skill. The areas discussed below highlight how *Deviate*’s approach and function in performance aim to address these issues.

### 3.1. Skill and effort

With the advent of the laptop as an instrument of performance came the decline of motoric skill. The performance template outlaid by turntable DJs has been implanted in a digital setting, retaining the fundamental practices of recombination and beat-matching while replacing the physical expertise necessary to achieve this with the “office-style user interface” [14] of mouse and keyboard. The ideal of skill in performance is crucial, and technology has had an undeniably complicating effect. Godlovitch, in his study of musical performance, cites both musical skill and “appropriately creditworthy physical skill” as pre-requisites for model performance [15]. Regarding technology, he states, “It gives anyone with minimal effort and skill the power to create the very results for which the musician has spent years in training...if society values musicians largely for their results, the value of musicians declines” [16].

This fatalistic view may not be universal, but nonetheless shows how value is tied to notions of physical and practical skill, and how skill differs within acoustic and technologised performance. Addressing this by attempting to develop physical skill on mouse, keyboard, or other control devices to a level beyond that of any standard computer user is unlikely to yield satisfactory results, although Collins [7] does suggest incorporating typing practice into a live coding exercise regimen. An alternative approach is proposed by d’Escriv an, where effort and physical skill are circumvented by reducing the value of performance to intentionality [17]. The following question is therefore how intentionality can best be expressed in musical performance. To achieve this, the performer must demonstrate the capacity to make skilled, rather than routine or perfunctory, musical decisions, and also be able to realise new and original directives rather than be constrained by limited options. *Deviate* aims to address this by incorporating indeterminate and generative processes, formulating skill as the ability to interact with and improvise with new and complex material.

### 3.2. Grain and performance

An issue related to the perception of skill is the possibility for error and the notion of *grain*. This uncodifiable quality is defined by Barthes with reference to Kristeva’s notions of pheno-text and geno-text [18], and constitutes “the body in the voice as it sings, the hand as it writes, the limb as it performs” [19]. Grain thus represents the elusive qualities that are created through the performance of a work [20], generated materially and resistant to systematisation. As digital audio files present a flawless representation of themselves in each instance of playback (speaker and mechanical error notwithstanding), there is minimal space for grain in this type of performance. Notions of effort and virtuosity can be framed in terms of grain, where surmounting the inherent difficulties and idiosyncrasies of a musical instrument translates to the perception of skill, and thus to appreciation by an audience. The cultural

antipathy towards technology in musical performance can be expressed as a tension between the desired and elusive grain (the “human element” of performance) and the perfection of the machine. By incorporating generative processes resulting in output that cannot be wholly foreseen, *Deviate* aims to introduce grain by creating music that is unique to each instance of performance.

### 3.3. The significance of spectacle

The effectiveness of any approach is additionally contingent on the performer’s actions being understandable to the audience. Croft [21] suggests that developing scrutable relationships between performer action and sonic response is essential to instrumental laptop performance. Cascone [22] introduces the notion of “counterfeit”, a term which refers to the audience perception of falseness that occurs “when a performer generates music by a process unknown to the audience; using technology more at home in an office cubicle than a musical performance”. This concern is echoed by Davis [23], who declares that most laptop musicians are “boring to watch” and “often there isn’t even a visible link between a keypunch and a specific change in sound. Is it live or is it Memorex?” Given that the majority of home computers contain pre-installed music playback and music-making software, and that the laptop screen enforces a physical (acoustic) barrier between performer and audience, it is understandable that audiences would assume the use of pre-recorded samples or sequences in laptop performance. This perceived use of playback devalues laptop performance to audiences. Incorporating perceivable improvisatory practices to performance is one method for reducing “counterfeit” and the perceived externality of the performer to laptop performance; this project serves as an exploration of this possibility.

## 4. STYLE SYNTHESIS AND MODELLING

The discussions above cover the wider cultural and contextual reasons for incorporating generative and improvisatory practices into laptop performance. Adapting these practices to musical constraints and goals is another issue, but one that which needs concerted attention to ensure this project’s success.

Situating *Deviate* within a specific musical genre implies that style modelling is a concern, though its intended use in performance environment adds further constraints. A well-known example of musical style modelling is Cope’s Experiments in Musical Intelligence (EMI) project, started in 1981 [24]. The data-driven programming techniques used in this project involved “analyzing a database of musical works, and then, using this analysis, replicating new music in some manner appropriate to the user’s wishes.” [4]. EMI has resulted in the development of compositional programs capable of composing new works in the style of composers including Bach and Mozart. Other style modelling methods have been similarly based on analysis of large bodies of musical

data, parsing existing musical texts into a lexicon of phrases or patterns, and selecting progressive musical objects according to context [25]. Modelling using analysis of musical input, rather than a pre-built corpus, has been undertaken by Kippen and Bel [26] in their exploration of improvisations of north Indian tabla players. Each of these data-driven approaches requires analysis of existing works within an established musical tradition. The analysed works must be of a distinct style to ensure consistent results, thus limiting the variety of possible output. As a result, data-driven modelling is more attuned to creating new works according to specific conventions, or replicating the style of individual composers, rather than composing within a broader stylistic framework.

Data-driven style modelling is not immediately suitable for this project, as a core aim of the project at hand is to build a performance environment capable of sustaining a range of musical results. A more informal analytical approach is demonstrated by generative music programs geared more towards popular styles, including Collins’ BBCut [27] sample-cutting breakbeat library. Collins describes this approach as “‘active style synthesis’ rather than ‘empirical style modelling’.” [27]. Similarly, programs such as Koan (now succeeded by Noatikl) incorporate more general musical rules within a user-defined modular structure to generate note and control data [28]. An approach based on listening analysis and heuristic tests thus focuses more on creative input (either from the developer of the program or the eventual user) in developing new works, rather than rigorous stylistic analysis and recreation. Further examples of generative programs for contemporary or popular music forms include LEMu [29], Bloom [30], and Infno [31].

### 4.1. From modelling to generative creativity

The link between music-making and generative processes, in a psychological sense, is well established and underlies music performance, improvisation, and composition [32]. The word ‘generative’, in this context, refers to Chomsky’s linguistic theory of grammars and syntactical structures [33] rather than computational music production. Generative frameworks are applicable to musical structures including tonality [34] and form [35]. Given that musical structures can be analysed in generative terms, it follows that such structures may be actively used in the generation of musical material. These generative principles describe broad musical processes, rules and conventions, providing leeway for variation while constraining output within acceptable parameters.

Musical rules and conventions exist at an absolute and empirical level (as used in data-driven style modelling) as well as in a more informal and descriptive capacity. Culturally based concepts such as genre, style, and subculture describe musical and performative practices defined by rules, although these rules may be mutable and not formally set out. A high degree of stylistic formalism exists in contemporary electronic music; Bogdanov identifies 63 varieties of electronica [37], 14 within

Jungle/Drum'N'Bass alone [38]. His description of ragga reads:

*Ragga jungle is characterized primarily by fast, complex beat patterns, deep, tight bass, and the use of sound system-type MC chanting sampled from old reggae, ragga, and dancehall records. Ragga also makes jungle's connection to African and Caribbean traditional and popular musics most evident, with rhythms recognizably descendent from nyabinghi and calypso-style drumming.* [39].

The above description is naturally based on a categorisation of existing musics rather than an attempt at compositional or computable formalism, but nonetheless demonstrates how existing musical conventions can inform generative structures. The translation from stylistic formalism to strict programmatic formalism in the case of *Deviate* has been undertaken heuristically, based on listening analyses of existing artists and works, as well as analyses of the resulting output.

A more weighty concern relating to algorithmic and generative music performance in general is raised by Lerdahl, who proposes that all artificial compositional grammars, including music composed using algorithmic and generative methods, must be based on a 'listening' grammar in order to contain meaning. Lerdahl suggests a set of 17 constraints relating to musical events, structures, and pitches, and uses them to demonstrate how serialism subverts these constraints and is thus difficult or impossible for a listener to comprehend musically [36]. From this perspective, incorporating generative models derived from existing musics reinforces the aesthetic success of any musical system. Generative musical models based on analysis are thus not confined to instances where modelling and close style synthesis are the goal, but relate to all instances of algorithmic and generative composition.

## 5. LIVE CODING

Live coding is the foremost approach to laptop performance that addresses the contextual and practical issues cited above, particularly the lack of transparency and the inflexibility of conventional approaches to digital performance. Building algorithmic and generative musical structures from scratch in performance and modifying them in real-time places the performer in an incontrovertible position of responsibility. The projection of the coding screen likewise makes performance practice more transparent. Some drawbacks to the medium of code as an integral part of performance are highlighted by Collins, including "obscurantism and intellectualism" [8], while the complexity of composing code live implies that "in practice most composers would content themselves with modifying pre-tested snippets" [40]. Though live coding laudably addresses many problematic aspects of laptop performance, the intensive process of writing code live impedes the creation of complex musics that adhere to the stylistic characteristics of existing musical genres. The analytical processes and data structures required to output

generative music within the constraints of contemporary electronic music are too burdensome to realistically build from scratch in a live performance. Furthermore, coding, live or otherwise, is not a practice that is indigenous to contemporary electronic music production (Aphex Twin and Autechre's occasional use of Supercollider and MaxMSP notwithstanding), and therefore does not logically present itself as a medium for composition, let alone performance. Live coding thus attends admirably to problematic aspects of laptop performance, while introducing new concerns regarding the complexities of using the medium of code for live music creation.

## 6. STANDARDS FOR DESIGN AND PRACTICE

The issues raised above are the primary matters that need to be answered by *Deviate*'s function in practice. Firstly, the performer must be able to exert sufficient control to direct musical output, but not be obliged to input more control than is feasible. Likewise, the performer needs to fulfill a transparently performative role, rather than a role that is either perfunctory or obscure to the audience. Finally, the system needs to provide a navigable space between the consistency of style modelling and potential for the generation of original works. The following section expands on these assertions, proposing a number of criteria that must be met by *Deviate* and similar systems, and how these criteria may be tested.

**Directability:** Given that the aim is to construct a performance-oriented environment, there must be sufficient scope for interaction with and influence over output in real-time. The user must be able to direct musical processes to realise his/her own aesthetic goals within broad constraints of musical genre. Any analysis, while necessary to create works conforming to a particular style, must therefore be sufficient to place generated works within genre constraints. Conversely, they should be indefinite enough to allow the creation of new works that are not apparent recreations of a specific style or composer. Directability may be ascertained by composing and performing within diverse musical forms and styles, and according to predetermined aesthetic and musical parameters.

**Responsiveness:** Aside from the ability to direct musical processes, the environment must be capable of generating material and responding to input with low enough latency to cement the relation between action and result for both performer and audience. The importance of feedback and immediacy in musical performance, and improvisation in particular, is highlighted by Pressing [41], who asserts, "feedback is a vital component in improvisation for it enables error correction and adaptation". A low response time is also a valuable musical criterion and aids in developing skill. Determining responsiveness is a more subjective process, dependent on the performer's impressions and the quality of musical output.

**Comprehensibility:** The generative structures and processes used, and the controls designed for real-time

interaction, need to be intelligible to the performer. This criteria is additionally important given the possible complexity of musical output, and given that the environment is to be used in a performance situation. Developing comprehensibility is handled through interface design, system design, and practice, and through continued refinement of each of these areas in relation to the others. Comprehensibility is, again, a subjective issue dependent on the performer and his/her exposure to and practice with the environment at hand.

**Suitability:** Musical output needs to be evaluated to ensure that it falls within the constraints of the chosen context and genre. This aspect is contingent on the above criteria of directability, responsiveness, and comprehensibility, and includes aesthetic judgement as well. Apart from being able to produce suitable output, all generated material must be provably consistent to allow its use in performance. This can be objectively informed by formal or informal comparison with existing musical works, as well as by the performer's own judgement.

**Reusability:** *Deviate* must be sustainable across a range of musical tasks and capable of producing varied output, as it is a genre-based performance environment rather than a tool for realising a specific musical work. A related concern is the ability to extend and expand the environment's abilities. This criterion is dependent on meeting each of the previous criteria, and requires long-term evaluation.

This list is an attempt to objectively determine the standards that must be met for *Deviate* to successfully achieve its goals, and it is constantly reviewed in light of these criteria. Evaluation takes place in terms of both machine functioning and judgements that are aesthetic and subjective in nature, and its function is evolved through a combination of practice, experience, and continual refinement.

## 7. CONCLUSION

*Deviate* aims to provide a performance environment for electronic music incorporating note-level improvisation and generative methods. This environment is situated not only within the context of generative music systems, but also within the existing practices of contemporary electronic music. The approach presented here outlines the motivations underlying this research project, as well the contextual issues informing its construction. Given that this undertaking is practical in nature, and has a specific stated outcome, it is essential that the benchmarks for success are clearly elaborated. The criteria above have been devised with regard to current practices in contemporary electronic music and laptop performance, and attend to aesthetic critiques and technical limitations of these practices. These criteria have been useful in designing and refining *Deviate* while attending to larger contextual, musical, and cultural concerns, and it is hoped that future projects bridging generative music and existing musical forms likewise benefit from this approach.

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