Enhancing the experience of contemporary classical music through dynamic, interactive visualisation

1. Motivation

We address the topic of music visualisation—specifically, exploring the possibilities and challenges associated with dynamic and interactive representations of musical content, displayed on a screen while a piece is being performed live or played back on a device. We address this topic in the context of our aim to develop more effective, engaging, and appealing ways to communicate contemporary classical music (CCM) to a modern audience, whose exposure to this repertoire is often limited to media such as film, videos and games, rather than in traditional concert settings.

Art Music Denmark[1] recently highlighted in a newsletter that classical and contemporary music often receive only minimal media attention and lack prominent dissemination in mainstream culture. This observation aligns with Emerson's (2020) large-scale study (N = 1428) involving twelve CCM concerts across ten different European countries, which emphasized the importance of innovative approaches to engaging audiences. From her analysis, Emerson concluded that significant extra-musical features could enhance and intensify the audience experience. One of her four key recommendations to institutions organising CCM concerts was to "take risks with format" (Emerson, 2020, p. 256) and involve audiovisual pieces, installations and participatory formats to attract newcomers to CCM. Such results and considerations provide motivation for developing better methods for conveying the aesthetic potential of CCM, fostering immersive and interactive experiences that sustain and promote art music culture.

We explore the potential and the challenges of providing dynamic, interactive visualisations, designed to engage audiences during music-listening experiences. Two core principles guide

[1] https://mailchi.mp/ea9d6b5015d9/nyhedsbrev-workshop-om-diversitet-i-musikbranchen-musikere-hjemvendt-fra-residency-dansk-elektronisk-musikshistorie-ny-neustart-pulje-13633199?e=5b4a299e9a

our discussion: (1) the visualisations should ideally be self-explanatory, allowing intuitive understanding; and (2) they must captivate the audience's interest, while also enhancing the listening experience. We propose that these two goals can be achieved by drawing on empirical and theoretical research in information and data visualisation aesthetics, principles of design aesthetics, and formal models of creativity and aesthetic value.

2. Background

Insights from the fields of information aesthetics and data visualisation offer valuable principles for designing effective music visualisations, emphasizing the balance between visual appeal and functional clarity. Foundational concepts from the emerging field of informational aesthetics, as noted by Pawłowski (1976), highlight key principles such as *Auffälligkeit* (salience) and *Gestalthöhe* (structural complexity), underscoring the need for visualisations to capture attention while maintaining a coherent and meaningful organization of complex content.

Contemporary approaches expand on these early ideas. Manovich (2008) and Sack (2011) emphasize that effective visualisations must simplify complexity without diminishing informational depth, thereby fostering intuitive understanding. The principle of achieving maximum effect for minimal means, as articulated by Hekkert and Leder (2008), highlights the value of elegance and efficiency in design. Lau and Vande Moere (2007) further assert that information aesthetic visualisation techniques should enable both intrinsic insight—such as pattern recognition—and extrinsic understanding, revealing deeper contextual meaning. Additionally, interactivity is increasingly recognised as a core component of modern visualisation design, allowing users to explore and interpret data on their own terms (Stoll et al., 2024).

These evolving perspectives resonate strongly with the challenges of music visualisation, where dynamic, interactive representations must balance clarity, engagement, and opportunities for user-driven exploration. At the heart of the problem is the question of what types of visualisation most enhance the experience of a *listener*—and, in particular, a listener who may be unfamiliar with the music. This presents different challenges from those addressed by, for example, Isaacson (2023), who focuses on the problem of effectively visualising musical structure for *analytical* purposes. Moreover, in the listening setting, animated (and even interactive) three-dimensional effects may be employed to represent more aspects of the music, whereas in the analytical setting, visualisations are typically static and focus on representing relationships between different structural constituents in the music. A set of different challenges and affordances emerge, therefore, when one attempts to design dynamic, interactive visualisations that enhance the experience of audiences who may be new to contemporary classical music (or even new to classical music in general).

3. The space of challenges

One significant challenge lies in balancing audience attention between the music and the visualisation itself. How can supportive visual elements enhance the musical experience without drawing attention away from the music? On one hand, the visualisation should deepen the audience's engagement and understanding; on the other, if it attracts too much attention, it risks detracting from the music itself. This necessitates a delicate balance to ensure that visualisations genuinely support and enrich the listener's immersion in the *musical* experience.

A second challenge to be overcome is that of guiding listeners through what they might perceive to be "difficult" music, whilst simultaneously setting as few constraints as possible on how they actively and creatively construct their own interpretations of what they are hearing. The visualisation should ideally encourage listeners to take ownership of the music by developing their own interpretations rather than constrain them into understanding the music in particular ways. Listeners should feel that they maintain control over how they experience the music.

In the playback setting (as opposed to the live performance setting), one way to activate users might be to provide a visualisation along with controls that support non-linear listening—e.g., selecting particular passages or parts to listen to, changing the playback tempo, or changing the relative loudness of different parts or patterns. The user may also be provided with the means to customise the visualisation itself, controlling, for example, which aspects of the music are represented (pitch, timbre, time, instrumentation) and how these aspects are mapped onto graphical elements. The visualisation then becomes more like a user-interface of an application. However, this gives rise to a third challenge, since providing such extra affordances for control and interaction may come at the price of making the visualisation more complex and difficult to use—recall that the first of our "core principles" was that the visualisation should be self-explanatory, so that a listener does not need to spend a significant amount of time learning how to control the visualisation system before starting to listen to the music. This is particularly important in the live performance setting, where such a learning phase would need to be an integral part of the whole participatory experience. Moreover, if the listener is required or encouraged to make choices about how and what to represent in the visualisation, this could take cognitive resources away from experiencing and interpreting the music itself. While such interactive features can enhance engagement and allow for a more personalised experience, they therefore also present a dilemma: the choice-making involved in interactivity may reduce immersion in the music itself and thus reduce the effectiveness with which the aesthetic and semantic aspects of the music are communicated.

A fourth challenge in the design of a music visualisation is that of providing some idea of where one is located, globally, within a piece of music, whilst not giving away too much

about what is to come later on in the piece. Music is inherently temporal, unfolding in time with a sense of linear progression and development. Informing users of where they are in a full and detailed "road map" of a piece therefore risks disclosing the music's development prematurely, potentially undermining one of the most vital aesthetic qualities of music—the "sweet anticipation" (Huron, 2006) that arises from the tension between what the listener expects and what actually occurs. On the other hand, the end result of having listened to a piece of music should typically be a coherent, unitary conception of the piece as a whole. Also, having some idea of where one is within a piece (e.g., whether one is close to the end, in an exposition or development section) allows a listener to interpret what they are hearing within a broader context, which can enrich the listener's experience.

4. Concluding remarks

In this paper, we consider the problem of designing dynamic, possibly interactive, visualisations, to be presented synchronously with performances of pieces of contemporary classical music. The goal of such visualisations is to enrich listeners' experiences of the music, so as to support them in achieving more rewarding and deeper interpretations. Drawing insights from previous work on aesthetics, creativity and information theory, we identify the following four particular challenges or dilemmas that emerge when attempting to design such visualisations:

1. A visualisation should enhance the experience of the music without distracting listeners from what they hear.
2. A visualisation should guide the listener through the music without constraining the listener's interpretation of the music.
3. Providing listeners with the means to interact with the music and customize their experience can enhance engagement. However, this must be done without making the visualisation/interface too complex—the visualisation should, ideally, be self-explanatory. Also, the interface should not distract attention away from the music itself.
4. Providing listeners with a means to locate themselves within the music can enrich their experience by providing context. However, this must be done without disclosing the music's development prematurely.

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