Technologies in Live Performance of Classical Music as Resource of Music Mediation

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Abstract

This paper presents an overview of contemporary practices that incorporate technological tools into live classical music performances. These tools serve various functions, including enhancing sound transformation in the musical process and augmenting the aesthetic experience of performances through audiovisual elements. Drawing on international examples from large institutions and independent projects, the study highlights the evolving role of technology in classical music, particularly in fostering new forms of audience engagement and reshaping concert experiences. The analysis touches on key issues such as the declining interest in classical music, the aging audience base, and the role of non-traditional venues in broadening appeal. It also addresses how these new practices contribute to breaking away from the "rituals" of traditional concert formats, providing a fresh perspective on how classical music performances can connect with modern audiences.

Cet article présente une vue d'ensemble des pratiques contemporaines qui intègrent des outils technologiques dans les concerts de musique classique en direct. Ces dispositifs remplissent diverses fonctions, notamment l'amélioration de la transformation du son en temps réel et l'augmentation de l'expérience esthétique des représentations grâce à des éléments audiovisuels. S'appuyant sur des exemples internationaux de grandes institutions et de projets indépendants, l'étude met en lumière l'évolution du rôle de la technologie dans la musique classique, notamment en favorisant de nouvelles formes d'engagement du public et en remodelant l'expérience des concerts. L'analyse aborde des questions clés telles que le déclin de l'intérêt pour la musique classique, le vieillissement des publics et le rôle des lieux non traditionnels dans l'attrait croissant pour la musique. Elle examine également la manière dont ces nouvelles pratiques contribuent à rompre avec les « rituels » des concerts traditionnels, offrant une nouvelle perspective sur la manière dont les spectacles de musique classique peuvent s'adresser aux publics d'aujourd'hui.

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Dieser Artikel bietet einen Überblick über zeitgenössische Praktiken, die technologische Werkzeuge in Live-Aufführungen klassischer Musik integrieren. Diese Werkzeuge erfüllen verschiedene Funktionen, darunter die Verbesserung der Klangtransformation im musikalischen Prozess und die Bereicherung der ästhetischen Erfahrung von Aufführungen durch audiovisuelle Elemente. Anhand internationaler Beispiele aus großen Institutionen und individuellen Projekten wird die sich wandelnde Rolle der Technologie in der klassischen Musik hervorgehoben, insbesondere in der Förderung neuer Formen der Publikumsansprache und der Neugestaltung von Konzerterlebnissen. Die Analyse beleuchtet zentrale Themen wie das nachlassende Interesse an klassischer Musik, die alternde Zuhörerschaft und die Rolle unkonventioneller Veranstaltungsorte bei der Erweiterung der Attraktivität. Außerdem wird untersucht, wie diese neuen Praktiken dazu beitragen, sich von den "Ritualen" traditioneller Konzertformate zu lösen und eine neue Perspektive darauf zu bieten, wie klassische Musikaufführungen eine Verbindung zum modernen Publikum herstellen können.

Keywords

Music Mediation, Arts Technology, Concert Studies, Music Performance, Classical Music

INTRODUCTION

This article aims to contribute to the mapping of the main contemporary practices using technology in live classical music performances. Among other possibilities, these resources can be introduced both as tools for sound transformation in the musical process itself and as elements that enhance the conceptual or aesthetic experience of a live performance. The incorporation of these technologies by musical institutions, independent orchestras, chamber groups, and individual initiatives may be driven by various factors, such as innovation strategies, audience development, purely experimental practices, or as an adaptation of musical performance in response to recent social and technological transformations.

Many of the resources I will present here are currently more widely explored within the context of opera, popular music, experimental contemporary music, theatrical performances, and even in installations and performance art modalities in museums, than in the realm of classical concerts. However, the drive to transform and experiment by incorporating new technologies, as well as by drawing from the influence of other fields like theater in live concert music performance, is not new. It became particularly evident after World War II. From this period onward, avant-garde composers, with their various approaches, began to raise profound questions not only about compositional practices but also about the current formats of live concert music performance. As Brüstle argues:

> Additionally, the performative changes on the concert stage were also driven by the desire to break away from the traditional concert ritual, whether for compositional and performance-related reasons, out of anti-Romantic, anti-bourgeois protest (as in the 1960s), in the search for new spiritual experiences, or to (once again) turn listening experiences into "events." (Brüstle, 2013, 58)[1]

It is not appropriate, within the scope of this article, to delve into the various avant-garde schools, their respective composers, contributions, and artistic philosophies, nor how they impacted and were interpreted by their contemporaries (Griffiths 2010). However, it is possible to identify, in current live classical music performance practices, traces – albeit simplified – of what was more extensively experimented with by those artists in their respective contexts. The focus here is on the integration of technologies in live classical music performance, whether through interventions in the act of music-making itself or in the way concert music is presented in terms of aesthetic experience.

The process by which various musical genres influence and transform one another is not linear, but diffuse and complex. Beyond the extensive developments in avant-garde music related to the use of technology – whether for the creation of electro-acoustic interactions or interactions between music and visual art – the contributions made by popular music, particularly rock, in exploring these resources cannot be ignored. As Murail states, “the spectacular development of synthesizers, of electronic sound, owes considerably more to Pink Floyd than to Stockhausen” (2005, 123), and thus has undoubtedly influenced, to some degree, contemporary live classical music concert practices.

The adoption of technological resources in live concert music performances assumes, beyond its experimental nature, the role of a bridge connecting this vast repertoire, which spans an entire historical spectrum, to today’s audiences. These resources also allow this immense body of musical material to be interpreted in increasingly creative and authentic performances.

The integration of technologies, alongside other music mediation strategies, into live concert performance practices has been attributed by some researchers to the following factors: the decline in interest in classical music concerts in recent years and the consequent aging of its audience (Petri-Preis 2022, 60); the emergence of new technologies and practices, accelerated particularly after the pandemic, such as livestreaming, audio platforms, and the sudden development of artificial intelligence (Phillips and Krause 2024, 334; Laidlow 2024, 355-378). However, the interest in new practices is also associated with a desire for artistic fulfillment by the musicians themselves, through experimenting with new strategies of musical expression and communication, whether by exploring new performance formats and/or incorporating new technologies (Tröndle 2020, 336-341).

It is important to highlight and reflect on the issue of the decline in interest in concert music, particularly with the reduction of audiences attending live performances of the genre. This issue has been linked by some to the resistance of uninformed or

[1] Translated by the author.

younger audiences to the traditional classical music concert format, as well as to the rituals still practiced in the environment of major classical music institutions (Uhde 2020, 107; Ungeheuer 2020, 51-57). Some point to a perception of the concert music scene as an elitist space, which represents an obstacle to younger audiences identifying with the genre (Smith and Peters, 2024, 2). Additionally, some argue that the physical environment of theaters and concert halls themselves can serve as potential barriers to the appreciation of this art form (Haferkorn 2018, 148-171; Kirchberg 2020, 188-192).

Many concert halls and theaters that exist today are ingeniously constructed spaces designed to provide the best acoustic experience for both audiences and performers. Additionally, these venues are structured and equipped with the minimum technical resources necessary for the basic production of their artistic programs, making the operation of each space feasible both financially and logistically. However, at least regarding strategies for developing new audiences, moving away from conventional musical performance spaces has been a strategy adopted by both large institutions and independent projects for various reasons.

Articles such as those of Haferkorn (2018, 148-171), Smith (2024, 277-298), and Kirchberg (2020, 188-192) offer reflections on the relationship between space and musical appreciation, analysing practical examples of various projects. The issue of how these spaces dedicated to classical music were constructed physically and ideologically, as well as the entire formal and ritualistic construct associated with the practice and appreciation of this genre, are common points of criticism among these researchers. However, there is also convergence among them regarding the effectiveness of converting classical music practices in unconventional spaces and the cultivation of new audiences. Kirchberg states:

> Can “un-usual”, that is, unconventional locations and venues, which tend to be geared specifically to a new target group of unconventional listeners, be used to reach new audiences? Or are these unconventional places in unconventional spaces more likely to still reach only a segment of the typical audience for classical (or art) music that might be looking for an innovative, albeit temporary, change of what is otherwise their standard musical diet? Unconventional places alone do not automatically mean unconventional possibilities of reception, and they also do not automatically create an inroad for people newly interested in music (Kirchberg, 2020, 189)

From this perspective, Kirchberg (2020, 189) acknowledges, however, that concerts held in non-traditional venues allow audiences to enjoy the genre in a more relaxed atmosphere and that new spaces may provide new creative possibilities for concert configurations. Additionally, in analysing the classical music live performance scene after the year 2000, he highlights the polarization that has emerged between those who value the continuous development of concert halls as ‘sonic temples’ and those who focus on fostering experiences through the exploration of new concert formats using tools of dramaturgy, contextualization, and sociability (Kirchberg, 2020, 191).

Regarding this polarization, Haferkorn (2018, 148-171) emphasizes the latter approach, with the prominence of various projects, mostly autonomous, that between

2004 and 2017 invested precisely in producing concert events outside conventional spaces, also pointing out the challenges faced and positive outcomes of each. The projects presented share not only the choice of non-traditional locations, but also the attempt to bring the classical music performance experience closer to the experiences offered in spaces for enjoying popular music. Ultimately, she argues that further research is needed to understand whether these practices indeed lead to audience development in the long term (Haferkorn, 2018, 168).

More specifically, addressing the challenges and issues, both for the audience and musicians, of projects that venture into experimenting with performances in new non-theater and concert hall spaces, is what Smith (2024, 277-298) discusses. In reflecting on the existence of a direct relationship between musical experience and space, he concludes that actions, possibly ones involving music mediation, might perhaps be more effective than simply abandoning conventional spaces.

> A welcoming concert-hall environment could well be more effective than a cold or austere outdoor performance. Just as music produces spaces, so can words, actions and conversation. (Smith, 2024, 295)

Despite the uncertainties and challenges of performances outside conventional spaces, it is a fact that numerous institutions, festivals, and independent projects see in these formats the opportunity not only to reach new audiences and explore new creative interpretations of live classical music, but also to foster new employment possibilities, especially for musicians and independent ensembles.

Conversely, Haferkorn and Dromey argue against the perspective that "classical music or its industry are in terminal decline" (Dromey and Haferkorn, 2018, 2). The 2018 edition of *The Classical Music Industry* lists various research lines analyzing the classical music scene and its challenges, ultimately suggesting adaptation and flexibility as solutions for the genre's development amid recent transformations. In *Classical Music Futures: Practices of Innovation* (2024), Smith and Peters discuss the difficulty of shaping "new futures for an art form that revolves around reiterating the past" (2024, 5), and emphasize how "the word 'tradition' might suggest something that lies behind us, or that is repeated without reflection" (2024, 6). They argue in the introduction that "shaping new futures for classical music brings to the fore the practical work of *mediating music* from the past in the present" (2024, 7, emphasis added).

Considering the broad spectrum of creative tools available in music mediation practices, my focus will be limited to listing and exemplifying recurring instances of technology insertion in live classical music performances in the current context, produced in conventional or non-conventional spaces, and subdivided into the following categories: video projections, the electronic sound, virtual space, and expanding technologies. However, before that, it is important to clarify, in a separate section, how the role of the music mediator arises not only in the pursuit of experimentation, creativity, and innovation in live classical music performance practices but also as a specialized agent in generating connection and identification between music and the audience.

CURATION, PROGRAMMING, MUSIC MEDIATION

In direct response to the need for transformation and renewal in the classical music scene in recent years, the development of strategies, creative solutions, research, and artistic restructuring of existing practices has become imperative. This task has fallen to agents who possess not only deep musical knowledge and an understanding of the intrinsic challenges within the field, but also expertise in extra-musical resources that could potentially bring about beneficial changes to the genre. Within institutions, festivals, and independent projects, various titles for these agents have emerged, such as curators, programmers, and music mediators, yet they essentially serve the same function: rethinking the classical music landscape to align it with the diverse and complex reality of today.

The term 'curation' in music is borrowed from a practice commonly associated with the visual arts (Spaan, 2018, 173). Some also draw parallels between the work of museum curators and conductors, suggesting a similar role in shaping and guiding the artistic direction and experience.

> Hanging pictures and paintings has long since gained widespread recognition as a discipline, and the curator has become acknowledged as the conductor of a sort of "concert" in a museum. Equally important, however, is how music is put into various contexts [...] (Fein, 2020, 129).

In recent years, the programming of orchestras, concert halls, and festivals – traditionally managed by conductors or music directors – has increasingly been entrusted to specialized professionals known as programmers, curators, and music mediators. These roles now encompass much more than selecting one repertoire over another. They involve the creation of concepts, contexts, historical and artistic connections, and the integration of diverse communicative strategies, both musical and extra-musical, to enhance the dramatic construction of each musical performance. When it comes to developing concert proposals that go beyond traditional approaches, the entire creative process, whether within institutions, autonomous projects, or festivals, is now managed by these professionals, who are often also trained musicians.

The term 'music mediation' originally referred to classical musical performance practices aimed at children's education. As Chaker and Petri-Preis (2022, 13) highlight, the concept expanded in 1998 with the introduction of the first academic program in this field by the Detmold University of Music in Germany. This expanded concept, that is not necessarily connected to educational purposes, now includes, for example, the creation of live musical performances that enhance the audience's experience and broaden the communicative spectrum of the artists through aesthetic concepts. Although different terminologies are used around the world – such as curator, programmer, concert designer, and music mediator – 'music mediation' is the term that designates a field of practice, as well as an academic discipline with its own growing research field.

The way practitioners of music mediation work is highly individualized, showcasing a new language of artistic expression that reflects the artistic, technical, and theoretical background of each professional. For example, the American composer, DJ, and self-titled curator Mason Bates divides his process of creating new concert formats into three parts: 1. programming, 2. production, and 3. platform (Bates, 2020)[2]. In the programming phase, he selects a diverse repertoire in terms of musical genres and periods, and strategically arranges the pieces. The production phase involves choosing which extra-musical elements, such as technologies and set design, will enhance the audience's experience. The final phase, platform, involves integrating additional musical languages and educational strategies, such as pre- and post-concert activities, turning the concert into a platform for new artistic expressions and expanding its reach to a more diverse audience (Bates, 2020). His creative process is documented in the video miniseries *Mason Bates: Curating the Concert Experience*[3].

Folkert Uhde, a German musician and cultural manager, describes himself as a concert designer. In creating new concert formats for institutions and festivals, he begins with the following questions:

> What can the classical music concert offer audiences today, apart from repeating that which is familiar? What kind of aesthetic experience does it invite? And what kind of emotional experience can it offer? [...] If, along with offering a musical experience, the concert once met the need for social participation and prestige, what are the needs of today? In other words, if the aspect of "prestige" influenced the dramaturgy, audience, rituals, and performance venues of the concert in the nineteenth century, then wholly new forms of performance in entirely different settings would have to emerge to support a function that has changed today. (Uhde, 2020,108)

However, he also argues that it is not merely about proposing "new forms" against the "traditional concert music format", but rather about suggesting the most diverse concepts possible, aligned with today's diverse realities and their distinct needs (Uhde, 2020, 109). It is interesting to note that the term 'concert design', originally developed in the rock music scene, later adopted by pop music, and in particular related to the use of technology, is now being embraced by the classical music community to describe creative approaches to classical music performances.[4]

All the technological tools (which I will address next), exploration of new spaces, development of concepts, educational projects, and other elements, are the resources that these professionals manage in their work, whether in proposing the conception of a concert, conceptualizing a festival or structuring a recital.

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[2] masonbates.com/curating (accessed May 20, 2024).

[3] www.kennedy-center.org/education/resources-for-educators/classroom-resources/media-and-interactives/media/music/mason-bates-on-curating (accessed May 20, 2024).

[4] For further information see Jackson (2020).

VIDEO PROJECTION: From the Entertainment World to the Concert Hall

Throughout the 20th century, classical music expanded its scope beyond the conventional lines of music for religious celebrations, opera, and concert music, with all their respective variations. With the development of the entertainment market, in fields such as cinema, musicals, video games, animation and others, orchestral sound, often in connection with choral music and blending with other musical styles and technologies, not only found new performance spaces but also gained communication access to new audiences. Michel Chion argues:

> The cinema is the art *par excellence* where all kinds of music have a place and where musical styles and eras rub shoulders, sometimes within a single work. Many who have never heard atonal music on the radio or in concert have heard it while watching a Hollywood melodrama of the 1950s. Others, those whose radio or computer are permanently tuned to a classical station, say, will discover a folk-rock or rap song in a movie theater; in the same place, soul or techno fans may have the opportunity to hear a few minutes of Bach, Ravel, or Marin Marais, an encounter that would perhaps never have happened otherwise. Even back in the sixties, spectators of Fellini's *Satyricon* or Pasolini's *Medea* could discover in the 'background music' a veritable anthology of 'ethnic' musics served up to them all mixed up, with no labels or titles. (Chion 2021, 5, t.n.)

Throughout its history, cinema has showcased numerous composers across various genres, whose works have been incorporated as soundtracks, and has revealed composers who specifically wrote for the medium, such as Max Steiner, Bernard Herrmann, Ennio Morricone, John Williams, Howard Shore, Hans Zimmer, and the young Ludwig Göransson, just to name a few.

Cinematic music has been integrated into the programming of various orchestras worldwide in recent years, whether through the presentation of musical excerpts from specific films, compilations of tracks from different movies, or even the live performance of an entire soundtrack alongside the film projection. In the Brazilian classical music scene, cinematic repertoire is recurrent, for example, in the programming of orchestras such as the Brazilian Symphony Orchestra (OSB)[5] and the Symphony Orchestra of Bahia (OSBA)[6].

In this practice, not only is the music composed for a specific artistic language and context, the cinema, performed live on stage, but the visual communication provided by the projector and screen also becomes part of the conceptual construction of the concert event. The use of repertoire outside the classical concert music canon, along with technological elements like video projections, may serve as a strategy for music mediation in concert programming. This can be done to diversify the repertoire, offer an extra-auditory experience, or communicate with uninitiated audiences.

[5] www.osb.com.br (accessed May 20, 2024).
[6] www.osba.art.br/projeto/cineconcerto (accessed May 20, 2024).

Beyond cinematic repertoire, the soundtracks of various video games and anime animations[7] have been gaining space in the programming of major institutions, as exemplified by the presentation by OSESP – Orquestra Sinfônica do Estado de São Paulo in April 2024, in a communication aimed not only at children but also young adults.[8]

It is undeniable that the daily presence of video game consoles and television programming aimed at children and teenagers over the last 30–40 years has brought not only new entertainment formats but also new musical cultures. Aaron Hardwick (2023) argues that today, more young people are exposed to orchestral music through their video game consoles than at any other time in music history.[9] Laurent Bayle and Catherine Provenzano also advocate for this idea,

> Yet over the last two decades, the 'digital revolution' has had great impact on our perception of space, time, knowledge, and sound, all factors that condition approaches to music. To talk about the interface between classical music and technology today is to talk about the interface between classical music and digital culture. (Bayle and Provenzano, 2021, 105.)

Therefore, for audiences not yet familiar with it, introducing them to the orchestral sonority through repertoires and visual languages that they already know has been a strategy employed by both institutional orchestras and private initiatives such as the American projects *Game on Concert* and *Video Games Live*.[10] Both produce concerts in partnership with established orchestras in the cities they visit, creating presentations that include not only video projections of the featured games, but also synchronized lighting effects, lasers, live action performances, stage design and electronic music.[11]

In 2018, in an interview with the digital magazine Classic FM, the then director of the Royal Philharmonic Orchestra (RPO), James Williams, emphasized that the inclusion of these repertoires "is in no way undermining Beethoven and Brahms, which are still the core repertoire. But we are embracing all these new opportunities, they are access points for new audiences."[12]

PRE-PRODUCED VIDEOS FOR THE CONCERT HALL

In addition to audiovisual productions from the entertainment market, I will also highlight initiatives, albeit less common ones, such as video production for repertoire within the realm of classical music itself.

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[7] Genre of 2D Japanese animation.

[8] osesp.art.br/osesp/pt/concerto/9 (accessed April 16, 2024).

[9] theconversation.com/how-video-games-like-starfield-are-creating-a-new-generation-of-classical-music-fans-211016 (accessed April 16, 2024).

[10] gameonconcert.com and www.videogameslive.com (accessed April 16, 2024).

[11] Live action refers to a method of capturing human movement using sensors, which transform these movements into digital images.

[12] www.classicfm.com/music-news/video-games-children-classical-music (accessed April 16, 2024).

The term 'classical music', as it is conceived of today, reached its zenith and underwent formal and conceptual structuring during the 19th and early 20th centuries. Particularly during this period, as Greckel (2021) emphasizes, music was advocated by many composers as an art form intended primarily for aural appreciation,

> Throughout history there was also the parallel development of music as purely an aural art-music as an art for the ears only, not for the eyes. [...] This 'absolute music', and the 'intellectualization' of music into abstract forms which had no intended association with dance, drama, ceremony, or pageant reached an unsurpassed peak of development in the great classical tradition of Haydn, Mozart, and Beethoven. The popularity and importance of 'program music' during the nineteenth century brought to the concert hall a kind of 'implied' visualization, in the sense that the descriptive titles and intent of the music all suggested a visualization, albeit only in the mind's eye' of the audience. (Greckel, 2021, 40)

One of the earliest works, towards the end of this period, to break away from this paradigm and associate concert music with a visual experience was Scriabin's Fifth Symphony, *Prometheus – The Poem of Fire*, of 1910, in which he included the instrument tastiere per luce in the orchestration. This instrument illuminated the stage with lights whose colours varied according to the tonal transitions of the composition. Throughout the 20th century, numerous composers delved into experimentation and the incorporation of new visual media into their works and live performances. With the emergence of audio recording technologies and the sound recording of orchestras, classical music could now be enjoyed in the comfort of one's home, paving the way for the emergence of novel creative expressions, such as *Visual Music*. As described by Greg Kurcewicz (2012), who also highlights the prominence of American animator and filmmaker Mary Ellen Bute, visual music

> also harkens back to the pre-cinema centuries; it was theorized and sometimes practiced in the era predating celluloid and video. From the 1940s to the late 1960s, the development of this kind of thinking, these experiments with the fundamentals of vision, perception, and their analogous reactions in music, were led by a succession of artists, all pursuing a similar idea: that light, or visual music, is a form of cinema seeking a meditative state and believes in almost Jungian fundamentals in its approach. This is evident in the work of Hy Hirsh, in the rhythm, color, and motion films of Len Lye, and in the films of Mary Ellen Bute. The connection with music was direct. Bute created animations to be displayed onstage for Grieg, Wagner, and Milhaud. (Kurcewicz, 2012, 36)[13]

What I intend to highlight in this section refers to the production of current original video material, pre-produced to be presented during live classical music performances. The previously mentioned examples, although combining similar media elements to those that will be presented here, have distinct contextual origins. Other examples that could also be cited, mainly from experimental or even popular music (such as rock),

[13] Translation by the author.

have explored the combination of video and music in live performances in various ways, with specific motivations and contexts (Myers 2021). In the case of the following examples, video production was introduced as a more recent music mediation strategy aimed at reinvigorating the interpretative scene of live classical music performances.

An example of this is the partnership in 2017 between the *Komische Oper Berlin* and the British theater and animation group *1927*, which resulted in the creation of an original 2D animation for Igor Stravinsky's *Petrushka* and Maurice Ravel's *L'Enfant et les Sortilèges*.[14] The British group premiered its first commissioned production by the same institution in 2012 with a reduced version of Wolfgang Amadeus Mozart's opera *The Magic Flute* in a visual language inspired by the style of *film noir*. In the 2017 production, Ravel's opera is preceded by Stravinsky's ballet. The production blends the projection of the 2D animation in interaction with circus artists and singers, who, together with the orchestra, create a live narrative-visual concert.

vimeo.com/229449813

Video 1. Teaser trailer for the production of *Petrushka and L'enfant et les Sortilèges* by the *Komische Opera Berlin* with the group *1927*.

In 2021, the Early Music Academy at the Barbican Centre, United Kingdom, commissioned *Pixel Lux Studio* to create an original video to visually complement the performance of Joseph Haydn's oratorio *The Creation*.[15] In addition to the traditional setup on stage, consisting of the orchestra, conductor, and soloists, the presentation incorporated the projection of visual material onto the back walls of the stage, introducing a new layer of interpretation and communication of Haydn's work to the audience. Several other similar initiatives have been and continue to be produced by institutions and independent projects around the world. However, what has been growing recently is the use of video mapping projection technology, which I will elaborate on in the following section.

VIDEO MAPPING

The technique of video mapping, or projection mapping, is a technological resource that can map surfaces, whether they are 2D or 3D, and project images onto them. As described by Rocha and Ghizzi:

> There are practically infinite possibilities for video mapping, as it can be done using objects on small scales to immense scales for mapping/projection, all depending solely on the potential of human creativity and technique, as well as the potential of hardware and software. (Rocha and Ghizzi, 2020, 183)[16]

[14] www.19-27.co.uk/productions (accessed April 16, 2024).
[15] www.pixel-lux.com/live-events/haydn-s-creation (accessed April 16, 2024).
[16] Translated by the author.

Currently, there is a variety of software available on the market, with the most well-known being Resolume Arena.[17] What sets mapped video projection apart from conventional video projection is its ability to create video interactions on surfaces, objects, and spaces in a more organic and personalized manner, without limiting the creative space for video projection to the traditional rectangular screen. Often, it takes advantage of the architecture of the space itself as an interactive element. In the production of concerts which are still considered non-traditional today there is often a combination of various technologies depending on the creative project's requirements, including the integration of conventional and mapped projection, and the use of software for light and music synchronization, among other resources that I will further describe in this article.

An example of this practice is the one produced by the Czech Philharmonic Orchestra in 2015, in partnership with the audiovisual creation studio The Macula. The performance, entitled *SIM/NEBULA*, was a production of over 45 minutes, featuring music by Bedřich Smetana, Antonín Dvorak, and Pyotr I. Tchaikovsky synchronized with original videos created in Motion Graphics and VFX, projected in a mapped manner onto the architecture of the Rudolfinum Music Auditorium itself.[18] As described by Marian Sandberg in an article on the website *Live Design Online*,

> The content was broken into seven themes (matter, technology, message, mission, new world, *rendez-vous*, and birth), presented in visual futuristic poems, and shaping the emergence of a cybernetic organism. The project was developed in collaboration with 11 international artists (from UK, France, Switzerland, Turkey, Slovakia, and Czech Republic) (Sandberg, 2016).[19]

vimeo.com/138894725
vimeo.com/184505874

Video 2. Video links, respectively, to the teaser trailer for the *SIM/NEBULA* project and recordings of the pre-production stage of the video mapping material.

Mapped projection, which today is an artistic expression in its own right, with its own language, dedicated festivals, and own community, enters the classical music concert hall as a visual element that supports new interpretative possibilities. With the introduction of this technology in the conception of a live classical music concert, it provides various repertoires with the opportunity to gain new contextual and interpretative dimensions, offering the audience a chance to listen to these repertoires in a new way through the lens of the audiovisual combination.

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[17] www.resolume.com/software (accessed April 22, 2024).

[18] Motion Graphics and VFX are, respectively, a graphic design resource that combines animation, design, and digital images in the creation of visual content in motion, and a technique of visual effects that simulate realistic images.

[19] Projection Mapping Sim/Nebula For Czech Philharmonic At Prague's Rudolfinum, 2016, Marian Sandberg. www.livedesignonline.com/concerts/projection-mapping-sim-nebula-for-czech-philharmonic-at-prague-s-rudolfinum (accessed April 22, 2024).

VIDEOS PRODUCED LIVE IN THE CONCERT HALL

The interaction between visual technological resources and live music currently enables a wide variety of creative approaches, as well as new avenues for artistic communication. In addition to the image projection resources listed in the previous sections, there are also practices and technological resources for creating visual elements live, in direct response to the presented musical repertoire. As described by Cooke (2011, 1), audiovisual performances are emerging in which visual elements are created in real-time as practices, known by various names such as "VJing", "Live Cinema", "Live Media", "Visual Music", "Expanded Cinema", among others, sharing the characteristics of improvisation, spontaneity, and uniqueness (Cooke 2011, 9). These practices are mainly associated with the realms of pop, electronic music and contemporary experimental music, specifically within the scene that explores improvised musical creation.

In the context of classical music, the use of this artistic practice is still primarily explored in academic settings and through independent initiatives, such as the Chinese chamber group New Media Ensemble Nova Trio.[20] Through technological resources for image and sound manipulation, as mentioned earlier and referred to by the group as integrated reactive media, they perform audiovisual interpretations of both traditional classical music repertoire and contemporary music.

The potential of these technological resources still needs to be studied and further explored by musicians and music mediators in general, in order for them to be truly considered creative tools in the conception of live concert music performances.

THE VIRTUAL SPACE

Another space that has expanded significantly, particularly in response to the limitations imposed by the COVID-19 pandemic, is the virtual realm. An old and common practice in the sports sector – the live broadcasting of games, initially via television networks – was adopted by various fields during the pandemic through internet streaming, transforming the possibilities for live content dissemination. The virtual space introduced a new concept of presence and the experience of what is represented as live in a digital context.

This context brought forth the concept of 'liveness', which pertains to the mediatization of live performances and how this practice impacts various levels – social, economic, artistic, and more, as discussed in texts by Auslander (2023) and Phillips and Krause (2024). According to Phillips and Krause, audiences have different motivations for attending live performances versus livestreams. Live events are valued for their social interaction, emotional, and immersive experiences, while livestreaming is preferred for its convenience and accessibility (Phillips and Krause, 2024, 349).

The classical music live scene has also adapted to being present in the virtual space, integrating practices adopted during COVID-19 into the current activities of both major

[20] www.novatrio3.com (accessed April 22, 2024).

institutions and independent projects. Livestreaming itself does not overhaul traditional concert formats but expands their accessibility and dissemination possibilities. However, in an emerging scenario, some initiatives, such as that of the Hong Kong Philharmonic (HKPhil), have ventured into experimenting with live concert streaming simultaneously using real-time VR technology. An example is the 2023 premiere of the *Metaverse Symphony* by composer Elliot Leung, which took place simultaneously on the stage of the Hong Kong Cultural Centre for a conventional audience and on the Sandbox Metaverse platform for a virtual audience who could experience the work in an interactive digital environment.[21]

youtu.be/ApXozjSefTQ
www.youtube.com/watch?v=7nFOwIpGO8I&t=153s

Video 3. Links to videos of the *Metaverse Symphony* concert, featuring both the traditional stage performance and the VR experience in the *Sandbox Metaverse*.

Although still a microcosm, the rapid development of technology and the emergence of virtual spaces as performance venues will increasingly impact how we, as humans, create, experience, and consume art. The effects of this evolution, whether positive or negative, remain to be seen.

THE ELECTRONIC SOUND

Another resource extensively explored in the scene of contemporary experimental and academic classical music performances, but still relatively uncommon in projects of large institutions, is the interaction between acoustic music and electronic sounds. According to Manning (2004, 5), one of the earliest attempts to use non-traditional sound generation techniques as a form of artistic communication arose from the practices developed by members of the Futurist movement, which began in 1909 with the publication of the *Manifesto of Futurist Poetry* by the Italian poet Filippo Marinetti. Inspired by the ideas of this poetic movement, the experimentation with sound was launched in 1913 through the manifesto *The Art of Noises* by composer Luigi Russolo. Regardless of the concepts advocated and developed from these movements, the fact remains that new sound technologies caught the attention of various composers throughout the 20th century, from Edgar Varèse, Paul Hindemith, John Cage, Olivier Messiaen, Karlheinz Stockhausen, György Ligeti, and Luciano Berio to the entire generation of composers that continue to this day.

Much of what was experimented with and developed in relation to electronic sound took place mainly in a context that specifically questioned the principles of the concert music canon. Ironically, or perhaps as a natural historical progression, performances featuring the repertoire of avant-garde composers, as well as 'traditional' concert music

[21] www.sandbox.game/en/blog/what-is-the-metaverse-a-guide-to-the-future-of-the-web/3362 (accessed April 22, 2024).

sonically modified by specific electronic resources (though still rare), are now part of the programming of major concert music institutions.

In the current context, music performances can be conceived with the addition of expressive layers simultaneously drawn from the combination of various computer technologies, as described by Padovani et al.:

> In these considerably heterogeneous contexts, devices, tools, applications, languages, and techniques have come to be applied in the most diverse situations of musical/multimodal performance. [...] The variety of applications that emerges from this explains, moreover, the emergence of computational environments specifically aimed at real-time multimodal performance. (Padovani et al., 2021, 620-621)[22]

In this section, the focus will be on tools that work in the transformation or interaction of acoustic music with electronic sounds. Live electronics is just one of the main tools that fulfils this purpose.[23] This technology has been developing as a result of the computational advancements of recent years, and its operational mechanics offer those who use it numerous possibilities for creative interaction in transforming and/or interacting with acoustic music (Pierangeli 2011).

A recent example from the world of chamber music, featured in the Los Angeles Philharmonic's program, is the 2022 project *Electric Fields*, a collaboration between Canadian soprano Barbara Hannigan, French pianists and sisters Katia and Marielle Labèque, and French composer and live electronics operator David Chalmin. The project is based on works by medieval and baroque women composers (Hildegard von Bingen, Barbara Strozzi, and Francesca Caccini) and creates a multimodal performance that proposes the live combination and transformation of acoustic music into electronic music. It is also accompanied by specially created mapped video projections by artistic director and designer Netia Jones.

Beyond the use of live electronics, other tools exist to alter, amplify, or collaborate with acoustically produced sounds, primarily through specific computer programs (Manning 2004). However, the presence of computers in live concert music settings today is still met with resistance, particularly due to the question of whether the computer itself can be considered a musical instrument. On this issue, Brüstle (2013, 287) argues that it is not inherently the computer itself, as an artifact, that is a musical instrument, but rather its programs and specific interactive platforms, which can store, process, and transform sound.

The physical presence of computers on stage during live concert performances is still uncommon today, especially in orchestral music. However, given the creative possibilities this interaction can offer, it is up to musicians, conductors, composers, and music mediators to work together to explore how to embrace the many possibilities that

[22] Translated by the author.

[23] Live electronics is one of the possible denominations of this tool, which can also be known as interactive music systems, real-time computer music, as well as by other names.

this new instrument may offer and find ways to use it in support of their respective creative intentions.

EXPANDING TECHNOLOGIES - AR, VR, AI

Some current technological languages still in development, such as AR (Augmented Reality) and VR (Virtual Reality), have been explored as new possible interfaces for music mediation. As Rudenko et al. (2022, 397) argue in their work on visualizing musical narratives based on different compositional formats of classical music through the use of AR and VR, these technologies offer applications that can potentially contribute both to the audience's experience and to the creative and expressive process of the artists.

Despite being represented by similar acronyms, each of these technologies is associated with specific computational resources that allow the generation of images in two distinct formats: AR allows a real scenario to be augmented with virtual images (which will be perceived as long as the observer has equipment such as a smartphone equipped with specific software or glasses that allow the viewing of AR and VR images, such as Hololens)[24]; VR is a technology that enables the creation of virtual realities, i.e. the creation of digital universes that can be visually explored in 360° by the observer. The way to access these universes is currently limited to the same options as AR, but it is also possible in spaces that allow projection of 360° images.

Although the use of these technologies is still difficult to access in terms of financial, logistical, and creative aspects, some projects such as *Symphony*, produced in 2020, under the artistic direction of Gustavo Dudamel and the creative direction of Igor Cortadellas, have ventured into interactive experimentation between VR and classical music. With a repertoire dedicated to Ludwig van Beethoven, Gustav Mahler, and Leonard Bernstein, the project, despite not featuring a live orchestra performance, produced an immersive audiovisual experience recorded and edited in VR, and exhibited to Spanish and Portuguese audiences inside a truck container. The project, which began its tour in 2020, has a 10-year program, which will enable various communities and rural cities in these countries to access a virtual orchestral experience in VR technology.[25]

Another equally recent and rapidly developing resource is AI (Artificial Intelligence). As Laidlow asserts, "AI is both dangerous and full of potential, encompassing both good and bad aspects, operating both behind-the-scenes and prominently displayed as a corporate buzzword" (2024, 358). Despite still representing a lot of insecurity, various ethical issues, authorship and authenticity problems, and potential threats to several professionals, especially in the creative sector, Laidlow argues that AI can provide surprising creative possibilities when incorporated into live performances (2024, 358).

As Colotti (2021, 8) summarizes, the history of AI development dates back to the period of World War II, based on the work of English mathematician Alan Turing,

[24] www.microsoft.com/pt-br/hololens (accessed April 22, 2024).
[25] igorstudio.com/creaciones/symphony-en (accessed April 22, 2024).

whose test (Turing Test) is still a reference today for determining whether an artificial system is 'intelligent'. The possibilities for applying AI currently cover practically all areas of human knowledge, and every day they are being updated and attaining new levels of performance.

In the context of live classical music performance, composers such as Iannis Xenakis, Karlheinz Stockhausen, and François Pachet represent some of the pioneers in the field of interaction between acoustic and algorithmic music (Laidlow, 2024, 359). Currently, it is mainly on the academic scene, in the experimentation, creation, and research between AI and musical performance in various genres, that possible examples of using these technologies in the creative realm of music are to be found. This is the case with the piece entitled *Silicon* (2022), written as part of composer Robert Laidlaw's doctoral research for the BBC Philharmonic Orchestra, in which he creatively explores ideological issues between past and future music, what is fake and what is real, among other aspects, with the application of different AI interfaces such as *PRiSM-SampleRNN*, *MuseNet*, and *DDSP* (Laidlow 2024).

youtu.be/3xmpywK0ACA

Video 4. Recording of the BBC Philharmonic Orchestra performance of the piece *Silicon* by R. Laidlow.

It is undeniable that AI technologies will transform the way humans create and produce art in the future. However, the challenge that remains is to find applications for these technologies in our practices that truly benefit and value both the diverse artistic languages that exist and the individuals who practice them.

FINAL CONSIDERATIONS

In this article, I presented an overview of the incorporation of technological tools in live classical music performances in the current context, whether for direct interaction in musical creation or as resources that assist in building audiovisual aesthetic experiences. International examples were considered in relation to the use of these technologies, both by large musical institutions and by independent projects. Given the rapid pace at which technologies develop, their dynamic nature and the way in which artefacts, as also the technologies themselves, are viewed and then quickly discarded in artistic practices in general, it is possible that this article has a limited shelf life. However, the exploration of these practices can provide insight into what is currently being done, as well as which technological tools have already been integrated into live performances in the genre in recent years (some are still in their early stages and under development). This overview can help identify potential gaps, new creative possibilities and insights for future transformations.

The identification of these practices supports the arguments put forth by numerous researchers, mentioned earlier, who contend that the landscape of the live classical music concert is currently at an impasse that requires critical reflection on its traditions.

The incorporation of technologies, the search for new spaces beyond traditional classical music concert halls, the development of concepts, and new concert formats, among other resources, demonstrate that this landscape is adopting music mediation strategies as a method of innovation.

So-called 'traditional' formats of the appreciation and expression of live classical music are already well established and have their own spaces and audiences. The pursuit of innovation, despite the ambiguity that the term may imply, can benefit not only those who already appreciate the genre by offering performances that can provide new interpretive readings of traditional repertoires, but also, more importantly, foster identification and communication with new audiences.

Beyond the practices adopted by large music institutions, music mediation strategies, due to their creative nature, can facilitate the emergence of authentic independent initiatives for live classical music performances, contributing both to the diversification of the genre's landscape and to the inclusion of musicians in the job market.

All the practices and reflections presented in this article advocate not that live classical music concerts should be practiced solely in the presence of technologies, but rather that the introduction of these tools can support the existence of increasingly plural proposals in terms of interpretation and expression in the musical programming of both musical institutions and independent musicians and groups, aligning with the diverse and plural reality of today's audience.

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