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Deux Ex Machina: Methods, Processes and Analysis of Mixed Music

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Abstract

This paper presents the author's doctoral research project in the field of mixed music. The term mixed music has often caused confusion and has many different connotations. Therefore, it is imperative to establish a common definition and limitation for the boundaries of this project. Mixed music is a rather difficult term to define, and different authors have defined it in several different ways (Tiffon, 1994 and Teruggi, 2016 among others). For this project, I will use a narrow understanding of the term and focus on mixed music as a type of mainly through-composed concert music taking elements of both art music and acousmatic music with live performers playing acoustic instruments, and electronics. This definition thereby excludes improvised electronic music, popular music or music played on electronic instruments. My understanding of the term mixed music is the crossing point between sound-based and note-based music, inheriting the possibilities and problems of both sound worlds.

The main aim of this project is to analyze and understand mixed music in terms of the different technologies and methods that allow composers and performers to use electronics and their influence by looking at three main elements: the score/composition, the performance and the electronics/technology. This can be separated into the following sub-aims:

1. To further develop a theoretical framework which allows people to discuss and analyze mixed music based on the current literature
2. To understand how synchronization strategies play a part in the compositional process
3. To investigate performative aspects of synchronization strategies in the repertoire

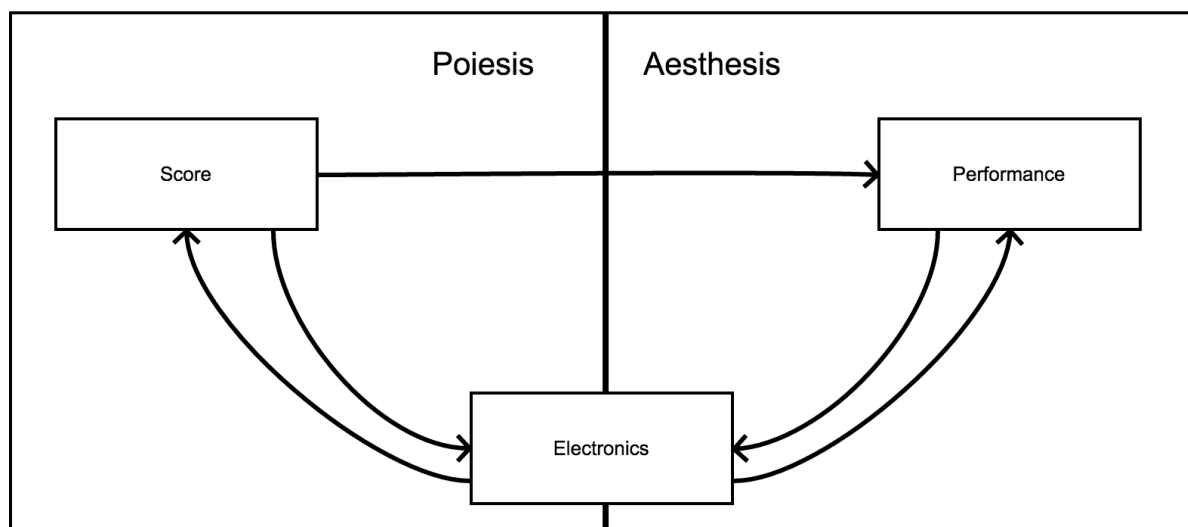
Introduction

Mixed music is a slightly unclear term in English, which comes from the French "musique mixte" (although it should be "musiques mixtes"). The concept is generally thought of as being the combination of an acoustic instrument, in the presence of electroacoustics (in its broader sense to encompass tape as well). However, according to Teruggi (2016) and Di Scipio (2018) among others, this definition is often too broad to be useful. It essentially includes almost all types of music, which is not very useful to our studies. Therefore, for this project, mixed music is music that blends acoustic and electroacoustic sound sources, yet maintains the tradition of the classical music concert at its heart (Tiffon, 2005). This is not an aesthetic judgement of, for example, the many different constellations of jazz bands with electronics present in Scandinavia today, it is just that these formations often face different challenges and in a highly different context than the more art music oriented music this project focuses on.

The title of this project “Deus Ex Machina” is a pun and a reference to several observations done over a few years in the field. This expression means literally “god in the machine”, however it mainly refers to a dramaturgical device used in Greek tragedy. It is the cliché device of “any unanticipated intervener who resolves a difficult situation” (Cuddon, 2012, p. 217). This is the famed “...and they lived happily ever after” without any explanation or logical conclusion to the proposed problems earlier in the play. How is this related to mixed music?

Electronics have often been portrayed or seen as esoteric. Classical musicians are often sceptical to them, often owing to a lack of training and experience (Rudi & Bullock, 2011). Some composers have difficulty understanding how involved or complex the process can be. Some sound technicians also happen to have trouble understanding what will be going on with, for example, processing an acoustic instrument on stage. This can lead to electronics being seen either as a big red button or a mystery box. In all cases, this can lead to tensions, misunderstandings, and at worst, exasperation. This shows the importance of demystifying mixed music and its electronic processes.

How can one approach such a monumental task? The first step is to acknowledge the different aspects of this music, and recognize their different modes of understanding (poiesis versus aesthesis). In my doctoral research, I propose to separate mixed music into three pillars: score, performance and electronics. This research will be looking at mainly the relationships between the score & electronics (ie. composition), and the relationship between the electronics and performance. This article will serve as an introduction to this research, as well as a short view of what earlier research has shown in these different fields.



How do we discuss mixed music?

Discussing mixed music composition (and from there analysis) can sometimes be quite difficult. One of the reasons for this is the large span of compositions in this single genre. Landy (2007) mentions the concepts of note-based music versus sound-based music which can serve as a good starting point. Tiffon (2005) on his side draws this different as a continuum,

effectively adding several other poles such as “composing the sound itself”, “the cult of beautiful sound”, “the primacy of writing” and “anti mixed-music”¹.

Such large differences in the conception of what is mixed, as well as vastly different compositional aesthetics makes it difficult for us to use a single analytical system. Traditional musicology can often fall short for works that are closer to acousmatic music. On the other hand, analytical methods from electroacoustic music can often underrepresent the importance of pitch organization and other formal structures.

In this research, the aspect that will be developed the most is the compositional role of the electronics. Although many have created topologies to explain the relationship between acoustic instruments and electronics such as Lalitte (2017) we are often left wondering why. As Dusapin (2009) has explained, it is often easy to explain the *how*, but we struggle with the *why*, and it is a question that even composers often have trouble answering. Why are the electronics in this piece? What is their compositional role? An important aspect of this will be to explore the compositional problems that required electronics, however few composers tend to write about their creative process. Manoury (1998, 2001, 2012, 2013) is possibly the most relevant composer here, having often explained his original ideas and concepts compared to what the final product became. Donin (2008, 2016) has also written extensively about the creative processes of composers, such as Philippe Leroux. It is of primordial note that many of these relationships are conceptual and not necessarily based on any physical (gestural) or computational concepts.

Battier (2003) has also argued for a technological understanding and its influence. If one understands the technological limits at the time of composition, as well as what equipment was available, perhaps we can have a better understanding of the compositional parameters explored. This approach is perhaps more relevant and important historically such as in Zattra (2003). However, it does have several issues for more modern compositions. As Ungeheuer (2013) mentions, what once took a lot of dedicated hardware is now possible on a single laptop. This democratization of digital technologies also limits composers much less than say the European or American composers of the 80’s. In this context, investigating the specific MaxMSP patches or other programs used could perhaps be more relevant.

Throughout the history of mixed music, there have been any documented examples of both concepts. In essence, we can refine it to the question: what is the relationship between the written score and the electronics (which together give us *l’écriture*)?

Lorieux (2004) in an analysis of Saariaho’s *Amers* (1992) shows that the written pitch organization and electroacoustic processes are inherently related. The synthesis sounds heard are based on the same formal diagram (based on trill between Eb1 and G3) as the acoustic instruments. However, contrarily to the acoustic derived sonorities, the electronics use the full analysis of the original trill. As Stoianova (1994) notes, the use of electronics in this piece supports Saariaho’s ideas of changing the compositional parameters towards a harmony/timbre as explained in Saariaho (1987). The use of real-time processing of the solistic voice only reinforces the use of spectral techniques horizontally and vertically.

Tutschku (n.d.) has on several occasions explained the links between the musicians and electronics especially in his use of adaptive parameters. For example, in the Still Air composition series, the player’s playing can affect the transposition of several sound files that

¹ All translations done by this author unless noted otherwise. It should be noted that the French word *écriture* includes a larger richness than its English counterpoint.

are to be triggered. In his piece *Zellen-Linien* (2007), the concept of the prepared piano led him to make electronics. He wondered “how could one create a digitally prepared piano?” which led him to combine granular synthesis, a freeze effect, samples and buffer manipulation in this piece (analysis by this author forthcoming).

The limitations of older hardware also limited the compositional possibilities of composers. Nordal (2018) has for example shown how Nordheim’s use of electronics was often directly connected to which studio he was using. Manoury used the limitations of the 4X as a structural device in his piece *Jupiter* (1987). The sections with different types of processing are interlaced with solistic sections as the engineers changed the different cartridges on the machine (May, 2006).

Manoury (2013) explains that his piece *Tensio* (2010) is one of his most experimental pieces since *Jupiter* (1987) and *Pluton* (1988-89). This composition is perhaps a complete fulfilment of Manoury’s idea of virtual score (see Manoury, 1998 & 2012). The writing is partly undetermined, in the sense that it uses real-time data for calculating certain values. An example of this is his so-called 3F synthesis system (Manoury, 2013) which takes three base frequencies (taken from the live string quartet) and then creates a dense spectrum which can vary between harmonic and inharmonic. This piece also sees the return of Manoury’s well-documented use of Markov chains, which are tightly connected to how the quartet plays. These aspects and many more are highly integrated into Manoury’s compositional techniques (not only in this piece). It becomes therefore difficult to separate the score from the electronics to have a full understanding of the piece.

Although these examples are written from the angle of the composer, it is important to point out that the role of the RIM (*réalisateur en informatique musicale*) is crucial. This aspect, and its influence on how the composers have worked and conceived electronics will be explored. Faia (2014), Zattra (2003) and Zattra & Donin (2016) have already explore some issues pertaining to the RIM. An example of this influence is also how Boulez would often bounce ideas back and forth with Andrew Gerzso (Zattra, 2018). Jameux (1991) even suggest Gerzso as a co-author for *Répons* (1985). By looking at how the compositional processes are connected to the electronics of a piece, this author believes that it will be possible to have a better understanding of mixed music in general.

Electronics

The second aspect of this research to be looked at is the electronics. In the first part of this article, we have summarized the relationship between the composition and the electronics. In this section, it will be about the relationship between the electronics and the performers: the issue of synchronization. This concept for this research is defined as the strategies used to have a temporal relationship(s) between the acoustic performer(s) and the electronics. More colloquially, how are these two worlds related to each other temporally in performance?

Although one might expect there to be hundreds of different strategies for synchronization, most systems can be described down to only three different concepts. It is important to note that these can have different flavours and implementations, as well as be mixed together. This is meant as a starting point to be able to discuss issues related to synchronization further.

Synchronization Strategies	Composition example
Fixed Media / Playback	Arne Nordheim – <i>Epitaffio</i> (1963)
Cue / Scene System	Kaija Saariaho – <i>Lichtbogen</i> (1986)
Following	Philippe Manoury – <i>Tensio</i> (2010)

The first strategy is fixed media / playback, which is the oldest method. Already with *Orphée 51* (1951), fixed media was used along with musicians. This was the go to method for many composers and for many years. It has been often criticized harshly with expressions such as “the tyranny of tape” (Risset, 1999 & Bahn et al, 2001 among others). However, it also opens many possibilities, especially for improvisation with tape (Ding, 2006). The use of fixed media is often much simpler than the other systems, and it almost always works. It must be mentioned that the pragmatic aspect cannot be underestimated.

The second strategy is the so-called cue or scene system. This is the idea of switching between different defined states within the piece. Kaija Saariaho has often used this system in her pieces ranging from *Lichtbogen* (1986) to *NoaNoa* (1992), as well as many others. This is often accomplished by giving a MIDI pedal to a performer. This technique can be used to trigger fixed media (as Saariaho does in the latter piece).

The third strategy is the concept of following. This has generally been thought of as score following which already had its start in the 80’s from Berry Vercoe’s and Roger Dannenberg’s work (Puckette & Lippe, 1992). The general principle of score following could be described as having the electronics follow the musician in real-time, effectively triggering any fixed media or effects in musical time. Manoury (1998) separates the concept into two different actions: recognition (*reconnaissance*) and following (*suivi*). The former is defined as “the recognition of notation played by a performer as a chronological succession of events with a certain margin of error” (p. 75). The latter is “a detection of events which we do not know in advance” (Ibid.). Both concepts present issues which are not completely resolved, but show Manoury’s deep understanding of the barriers for mixed music which are relatively similar between 1998 and today.

Recently, research has led us unto the idea of anticipatory score following with the program Antescofo (Cont, 2011). Following can also be entirely different than score following. Gesture following has also been become a possibility such as in Florence Baschet’s *StreicherKreis* (2007-2008) as described in Bevilacqua et al (2012). It is also possible to follow any parameter from musicians if it is possible to extract it. Audio descriptors for example, have become quite common to use. The main question remains on how to use different parameters in a musically interesting manner when it comes to using them as a synchronization strategy.

This author believes that synchronization is an essential aspect of the mixed music composition. It can delimit certain compositional possibilities and give challenges to both the composer and performer. By looking at how different composers and RIMs have approached this, perhaps we could theorize or generalize certain possibilities of each synchronization strategy. A deeper look at our practices as composers and programmers could perhaps help us identify new possibilities, as well as teach these techniques to a younger generation. The question of why a specific technique (or techniques) was used in a piece will be looked at for many of the most

defining compositions of mixed music. This author will also question his own compositional process when it comes to establishing which method to use.

Performance

Many research projects tend to focus on the creative or performative arts as defined by Arlander (2018). Although this research is focusing on the creative art of composition, the aspect of synchronization beckons to be looked upon from more performative aspects. This research comes close to what Borgdorff (2006) calls research in the arts. It is an important aspect that we (as a research community) go away from the traditional only written research, and move towards more multi-media presentations. As Cook (1987) and Crispin (2014) have pointed out, it is quite ironic that the study of music has often been done away from any form of sound. It seems rather contrived to write about such a practical subject as synchronization in composition, and not try it out in the flesh. The point of view of performers, as well as extending the dialogue between composer, programmer and performers is essential.

The original plan for this project was to use a string quartet to test the performative aspects of this research, however this was discontinued for logistical reasons of having a stable quartet. Some research has already been done on the solistic performer such as Berweck (2012), Boutard (2016), Féron & Boutard (2018), McNutt (2003) and several others. However, little research has been written on non-solistic pieces. Although most of the repertoire is indeed solistic (Tiffon, 1994), the use of several musicians requires us to think slightly differently. As Manoury (1998) mentions, polyphonic score following creates completely different challenges. The relationship between several musicians and electronics can also be quite different. The string quartet is logistically still a big ensemble, but it does not require a conductor which is one less variable. As an ensemble, it also has already a large history as a research laboratory for composers as explained in Cassidy (2013), Sheppard Skærved (2013). There has also been research on synchronization and other aspects of the string quartet as an ensemble such as Wing et al (2014) and Young & Colman (1979). It is of note that there is little literature on how synchronization is influenced by the presence of a conductor, except for a few articles and/or examples.

Additionally, the string quartet repertoire in mixed music has become quite large. Although the BRAHMS database at IRCAM lists 70 quartets, this author's own research has found over 130 so far. There is a small amount of literature on the subject currently, mostly looking at the repertoire in a more general manner such as in Bevilacqua et al (2012), Donin et al (2009), Joubert (2016) and Lalitte (2016, 2017). These articles are mainly from the world of French music and academia. Although several other dissertations and articles do mention this repertoire such as Seo (2013), it is an understudied part of mixed music. This author wishes to publish more about this repertoire, as it is difficult to discuss and advance the dialectics of mixed music, when little is written about the repertoire and that it is seldom played.

The main idea was to get permission from certain composers to be able to change around the synchronization method in a respectable manner which respects the composer's wishes. Afterwards, to test out these new methods and compare how the quartet reacts to them. This work had already started with Pierre Jodlowski's *60 Loops* (2006).

An evaluation of how this author has written for other ensembles and solists will also be included in the doctoral research. For example, a new piece called Quasar for sinfonietta and electronics will be premiered in 2019 and will include a workshop to introduce classical musicians to different forms of synchronization and electronics.

Conclusion

This text is a presentation of current doctoral research this author is conducting. The object of research is the different aesthetic and poietic relationships between compositional processes and electronics in mixed music. This can be resumed as looking at the relationships between the score (thought of as the traditional composition) and the electronics, as well as the electronics and performer(s). This research is being done by looking at specific compositions which are already established as part of the mixed music repertoire, as well as composing new pieces and documenting the interplay between these relationships. Another more practical-based aspect of the research is getting more pieces played and looking at how the different synchronization strategies affect the players in performance.

This author feels that the influence between these three different pillars of the mixed music is almost rhizomic. Although it is unrealistic to have a deep analysis of all three domains, it is important to be aware of all three through compositional as well as performative work. The hope is that this pragmatic view can also eventually serve other composers, programmers and hopefully performers to find their way into this wonderful repertoire. A look at both a theoretical, practical and creative angle, this research is perhaps closer to the model of research/creation as defined in Stévanec & Lacasse (2013).

References

- Arlander, Annette. "Characteristics of visual and performing arts." *The Routledge companion to research in the arts*. Routledge, 2010. 345-362.
- Bahn, Curtis, Tomie Hahn, and Dan Trueman. "Physicality and Feedback: A Focus on the Body in the Performance of Electronic Music." *ICMC*. 2001.
- Battier, Marc. "A Constructivist Approach to the Analysis of Electronic Music and Audio Art – between Instruments and Faktura." *Organised Sound*, vol. 8, no. 03, Dec. 2003. *CrossRef*, doi:[10.1017/S1355771803000220](https://doi.org/10.1017/S1355771803000220).
- Bevilacqua, Frédéric, et al. "The Augmented String Quartet: Experiments and Gesture Following." *Journal of New Music Research*, vol. 41, no. 1, Mar. 2012, pp. 103–19. *CrossRef*, doi:[10.1080/09298215.2011.647823](https://doi.org/10.1080/09298215.2011.647823).
- Berweck, Sebastian. *It Worked Yesterday: On (Re-) Performing Electroacoustic Music*. University of Huddersfield, 2012. *Google Scholar*, <http://eprints.hud.ac.uk/17540/>.
- Borgdorff, Henk. *The debate on research in the arts*. Vol. 2. Bergen, Norway: Kunsthøgskolen i Bergen, 2006.
- Boutard, Guillaume. "Solo Works of Mixed Music with Live Electronics: A Qualitative Enquiry in Timbre and Gesture from the Performer's Perspective." *Musicae Scientiae*, vol. 20, no. 3, Sept. 2016, pp. 361–91. *Crossref*, doi:[10.1177/1029864916634421](https://doi.org/10.1177/1029864916634421).
- Boutard, Guillaume, and François-Xavier Féron. "La pratique interprétative des musiques mixtes avec électronique temps réel : positionnement et méthodologie pour étudier le travail des instrumentistes." *Analyser la musique mixte mixte*, edited by Bonardi, Alain, Bruno Bossis, Pierre Couprie and Vincent Tiffon, Delatour, 2017, pp. 39-60

- Cassidy, Aaron. "The String Quartet as Laboratory and Playground for Experimentation and Tradition (or, Opening Out/Closing In)." *Contemporary Music Review*, vol. 32, no. 4, Aug. 2013, pp. 305–23. *CrossRef*, doi:[10.1080/07494467.2013.808410](https://doi.org/10.1080/07494467.2013.808410).
- Cont, Arshia. "On the Creative Use of Score Following and Its Impact on Research." *SMC 2011: 8th Sound and Music Computing Conference*, 2011. *Google Scholar*, <http://hal.upmc.fr/hal-00692575/>.
- Cook, Nicholas. *A Guide to Musical Analysis*. Oxford University Press, 1987.
- Crispin, Darla. "'Scaling Parnassus in Running Shoes': From the Personal to the Transpersonal via the Medium of Exposition in Artistic Research". *The exposition of artistic research: Publishing in academia*, edited by Schwab, Michael & Borgdorff, Henk, Leiden University Press, 2014, pp. 139-152
- Cuddon, J.A. *A Dictionary of KLiterary Terms and Literary Theory*. John Wiley & Sons, 2012.
- Di Scipio, Agostino. "Dwelling in a field of sonic relationships: 'instrument' and 'listening' in an ecosystemic view of live electronics performance". *Live electronic music: Composition, performance, study*, edited by Sallis, Friedemann, Bertolani, Jan Burle & Zattra, Laura, Routledge Taylor & Francis Group, 2018, pp. 17-45
- Ding, Shiau-Uen. "Developing a Rhythmic Performance Practice in Music for Piano and Tape." *Organised Sound*, vol. 11, no. 03, Dec. 2006, p. 255. *Crossref*, doi:[10.1017/S1355771806001518](https://doi.org/10.1017/S1355771806001518).
- Donin, Nicolas. "Enquête sur L'Atelier D'Un Compositeur de Musique Contemporaine." *Revue de Synthèse*, vol. 129, no. 3, Sept. 2008, pp. 401–20. *CrossRef*, doi:[10.1007/s11873-008-0051-6](https://doi.org/10.1007/s11873-008-0051-6).
- Donin, Nicolas, et al. "Organiser l'invention technologique et artistique?: L'activité collective de conception conjointe d'une œuvre et d'un dispositif informatique pour quatuor à cordes." *Activites*, vol. 06, no. 2, Oct. 2009. *Crossref*, doi:[10.4000/activites.2253](https://doi.org/10.4000/activites.2253).
- Donin, Nicolas. "Empirical and Historical Musicologies of Compositional Processes : Towards a Cross-fertilisation." *The act of musical composition : Studies in the creative process*, edited by Collins, Dave, Ashgate, 2013, pp.1-26
- Dusapin, Pascal. *Une Musique En Train de Se Faire*. Éditions du seuil, 2009.
- Faia, Carl. *Collaborative Computer Music Composition and the Emergence of the Computer Music Designer*. 2014.
- Féron, François-Xavier & Boutard, Guillaume. "Instrumentalists on Solo Works with Live Electronics: Towards a Contemporary Form of Chamber Music?" *Live electronic music: Composition, performance, study*, edited by Sallis, Friedemann, Bertolani, Jan Burle & Zattra, Laura, Routledge Taylor & Francis Group, 2018, pp. 101-130
- Jameux, Dominique. *Pierre Boulez*. Translated by Susan Bradshaw, Faber and Faber, 1991.
- Joubert, Muriel. "Un premier regard sur le quatuor à cordes avec électronique." *Le quatuor à cordes, vers les séductions de l'extrême*, edited by Guérimand, Mélanie, Muriel Joubert, and Denis Le Touzé, Microsillon éditions, 2016, pp. 269-288
- Lalite, Philippe. "Le quatuor à cordes face à un environnement électronique." *Musique et technologie : Regards sur les musiques mixtes*, edited by Battier, Marc, Institut national de l'audiovisuel, 2016, pp. 151-174

- Lalite, Philippe. "Topo-analyse de la musique mixte." *Analyser la musique mixte*, edited by Bonardi, Alain, Bruno Bossis, Pierre Couprie and Vincent Tiffon, Delatour, 2017, pp. 21-38
- Landy, Leigh. *Understanding the art of sound organization*. Mit Press, 2007.
- Lorieux, Grégoire. "Une Analyse d'Amers de Kaija Saariaho." *DEMéter*, 2004. *Google Scholar*, <http://demeter.revue.univ-lille3.fr/analyse/lorieux.pdf>.
- Manoury, Philippe. *La Note et Le Son: Écits et Entretiens 1981-1998*. L'Harmattan, 1998.
- Manoury, Philippe. *Va-et-Vient: Entretiens Avec Daniela Langer*. Édition MF, 2001.
- Manoury, Philippe. *La Musique Du Temps Réel: Entretiens Avec Omer Corlaix et Jean-Guillaume Lebrun*. Édition MF, 2012.
- Manoury, Philippe. "Compositional Procedures in *Tensio*." *Contemporary Music Review*, vol. 32, no. 1, Feb. 2013, pp. 61–97. *CrossRef*, doi:[10.1080/07494467.2013.774514](https://doi.org/10.1080/07494467.2013.774514).
- May, Andrew. "Philippe Manoury's Jupiter." *Analytical Methods of Electroacoustic Music*, edited by Simoni, Mary, Routledge, 2006, pp. 145-186
- McNutt, Elizabeth. "Performing Electroacoustic Music: A Wider View of Interactivity." *Organised Sound*, vol. 8, no. 03, Dec. 2003. *CrossRef*, doi:[10.1017/S135577180300027X](https://doi.org/10.1017/S135577180300027X).
- Nordal, Ola. "*Between Poetry and Catastrophe*" - A Study on the Electroacoustic Music of Arne Nordheim. Norwegian University of Science and Technology, Faculty of Humanities, Department of Music, 2018.
- Puckette, Miller, and Cort Lippe. "Score Following in Practice." *Proceedings of the International Computer Music Conference*, INTERNATIONAL COMPUTER MUSIC ASSOCIATION, 1992, pp. 182–182. *Google Scholar*, <http://www.music.buffalo.edu/sites/www.music.buffalo.edu/files/pdfs/Lippe-SanJose.pdf>.
- Risset, Jean-Claude. "Composing in Real-Time?" *Contemporary Music Review*, vol. 18, no. 3, Jan. 1999, pp. 31–39. *CrossRef*, doi:[10.1080/07494469900640331](https://doi.org/10.1080/07494469900640331).
- Rudi, Jøran, and Jamie Bullock. "The Integra Project." *Proceedings of the 2011 Electroacoustic Music Society Conference*, 2011. *Google Scholar*, https://www.researchgate.net/profile/Jamie_Bullock/publication/228464847_The_Integra_Project/links/00b7d52cae28adfec9000000.pdf.
- Saariaho, Kaija. "Timbre and Harmony: Interpolations of Timbral Structures." *Contemporary Music Review*, vol. 2, no. 1, Jan. 1987, pp. 93–133. *CrossRef*, doi:[10.1080/07494468708567055](https://doi.org/10.1080/07494468708567055).
- Seo, Ju Ri. *Jonathan Harvey's String Quartets*. University of Illinois at Urbana-Champaign, 2013.
- Sheppard Skærved, Peter. "The String Quartet Now, or From Where I Sit ... A Very Personal View." *Contemporary Music Review*, vol. 32, no. 4, Aug. 2013, pp. 295–303. *CrossRef*, doi:[10.1080/07494467.2013.809239](https://doi.org/10.1080/07494467.2013.809239).
- Stévance, Sophie, and Serge Lacasse. *Les enjeux de la recherché-crédation en musique. Institution, définition, formation*. Québec, La presse de l'université Laval, 2013.

- Stoianova, Ivanka. "Une oeuvre de synthèse: analyse D'amers." *Compositeurs d'aujourd'hui: Kaija Saariaho*, edited by Bayle, Laurent, IRCAM – Centre Georges-Pompidou, 1994, pp. 43-63
- Teruggi, Daniel. "Esquisse d'une taxonomie des musiques mixtes." *Musique et technologie : Regards sur les musiques mixtes*, edited by Battier, Marc, Institut national de l'audiovisuel, 2016, pp. 12-20
- Tiffon, Vincent. *Recherches Sur Les Musiques Mixtes*. Université d'Aix-Marseille I, 1994.
- Tiffon, Vincent. "Les Musiques Mixtes: Entre Pérennité et Obsolescence." *Musurgia*, 2005, pp. 23–45.
- Tutschku, Hans. "The Use of iOS Devices in Recent Compositions of Mixed Music." *Journal of the Japanese Society for Sonic Arts* 6.1: 12-15.
- Ungeheuer, Elena. "L'électronique live. Vers une topologie de l'interaction interprète-machine." *Théories de la composition musicale au XXe siècle Vol. 2*, edited by Donin, Nicolas, and Laurent Feneyrou, Symétrie, 2013, pp. 1367-1386
- Wing, A. M., et al. "Optimal Feedback Correction in String Quartet Synchronization." *Journal of The Royal Society Interface*, vol. 11, no. 93, Jan. 2014, pp. 20131125–20131125. *CrossRef*, doi:[10.1098/rsif.2013.1125](https://doi.org/10.1098/rsif.2013.1125).
- Young, Vivienne M., and Andrew M. Colman. "Some Psychological Processes in String Quartets." *Psychology of Music*, vol. 7, no. 1, Apr. 1979, pp. 12–18. *Crossref*, doi:[10.1177/030573567971002](https://doi.org/10.1177/030573567971002).
- Zattra, Laura. *Science et Technologie Comme Sources d'inspiration Au CSC de Padoue et à l'IRCAM de Paris*. Paris 4, 2003.
- Zattra, Laura. "Collaborating on composition: the role of the musical assistant at IRCAM, CCRMA and CSC". *Live electronic music: Composition, performance, study*, edited by Sallis, Friedemann, Bertolani, Jan Burle & Zattra, Laura, Routledge Taylor & Francis Group, 2018, pp. 59-80
- Zattra, Laura, and Nicolas Donin. "A Questionnaire-Based Investigation of the Skills and Roles of Computer Music Designers." *Musicae Scientiae*, vol. 20, no. 3, Sept. 2016, pp. 436–56. *Crossref*, doi:[10.1177/1029864915624136](https://doi.org/10.1177/1029864915624136).