René Mogensen, Nicolas Deletaille
and Alain Roudier

The arpeggione and fortepiano of the 1820s in the context of current computer music

The arpeggione[1] has been largely neglected in mainstream concert music culture since its brief early life in the 1820s. The only piece that has survived into current concert repertory from its beginnings is Schubert's Sonata in A minor for arpeggione and piano (D821) of 1824.[2] One of only a handful of current arpeggione soloists is Nicolas Deletaille,[3] who has made two recordings of the sonata, one with Paul Badura Skoda[4] and one with Alain Roudier.[5] Since 2000, Deletaille has been actively encouraging composers to create new works for arpeggione, with the reasoning that 'if a performer learns this instrument today, his reward should be to be able to play more than the Schubert sonata'. This has helped to expand the available concert repertory to some 60 works for arpeggione, many of which Deletaille has premiered.

Deletaille and Roudier have collaborated with composer René Mogensen[6] in a cross-European project to reinvent the musical thinking and performance practice of the arpeggione with piano, as inherited from the Schubert sonata. This 'reinvention' was to be realized in the context of interactive electronic sound. The concept was to integrate the musical idioms of the two instruments from the 1820s with current interactive digital sound technology. The results of the project were artistically successful, giving rich experiences both for performers and audiences.

Mogensen composed two new works for arpeggione and computer in 2010, with advice on arpeggione technique from Deletaille. One of these works, *Sonata Neo-Schubert*, is based on study of the Schubert sonata,[7] but integrated with interactive computer sound technology. The second work, *Walls of Nicosia*, brings influences from traditional Cypriot folk music to the arpeggione with computer. These new works were presented in concert programmes alongside the Schubert sonata and other period works, during tours in Belgium, Denmark, France and Italy, and were also included on a 2011 CD release.[8]

We will discuss several issues that the project encountered in rehearsals and performances which were specific to the combination of acoustic instruments with computer sound, and cover some of the resulting practical solutions and considerations for these issues, which point towards new adaptations and adjustments of performance practice on the instruments from the 1820s in the context of computer music. To give some insight into the relations between acoustic instruments and electronics, we also introduce analytical tools that can help develop grounded understanding of this musical context. We hope this report on our project will be useful to those who are interested in exploring this new area of contemporary chamber music performance.

Technologies: The arpeggione and fortepiano of the 1820s and concert computer sound of the 21st century

The arpeggione used for the project (illus.1) is a modern replica of an arpeggione from the 1820s, and was built in 2001 by Benjamin Labrique in Brussels for Nicolas Deletaille. It is designed with a special modification: the frets on the fingerboard can be moved individually on each string. This allows for microtonal intervals or exotic scales. The moveable frets can also, to some extent, facilitate performance in different temperaments.

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1 Arpeggione by Labrique, 2001 (photo: Philippe de Formanoir)

Alain Roudier performed on an original Graf[9] piano (illus.2), the soundboard of which carries the number 1547. This piano was constructed in 1828 in Vienna. It was restored by the Ad Libitum workshop in France during 2008, to match its original specifications as closely as possible.[10] It is currently part of the Ad Libitum Collection,[11] which includes some 80 keyboard instruments dating from the 16th to the 19th centuries.

The youngest technology of the project is computer-based sound generation and processing. Part of the score of each of the new pieces is codified as a computer program that creates and manipulates sound in various ways. The control and development of this electronic sound is integrated with the written score from which the musicians perform. The computer components were programmed in a software environment called *MaxMSP*.[12] Two microphones were placed to capture the sound of the arpeggione: one over the top, facing towards the finger-board, and one facing the left sound-hole of the arpeggione, as close as practically possible to avoid disturbing the performer. Two other microphones were placed facing into the open lid of the piano. The computer used the audio signals from all four microphones in various ways according to the programming.

To get a better overview of the performance situation of this kind of work, it is useful to analyse the work as a 'human activity system'.[13] Such an analysis of *Sonata Neo-Schubert* is shown in illus.3. Here the basic technological and physical components are represented, as well as the people involved in the piece. People and technological components influence each other, and these influences are represented as lines, with arrowheads indicating direction. The area of 'Performance activity', in other words the concert situation, includes the encoded work, the musicians and instruments, the electronic system, as well as the sounding music and the audience in the performance space.

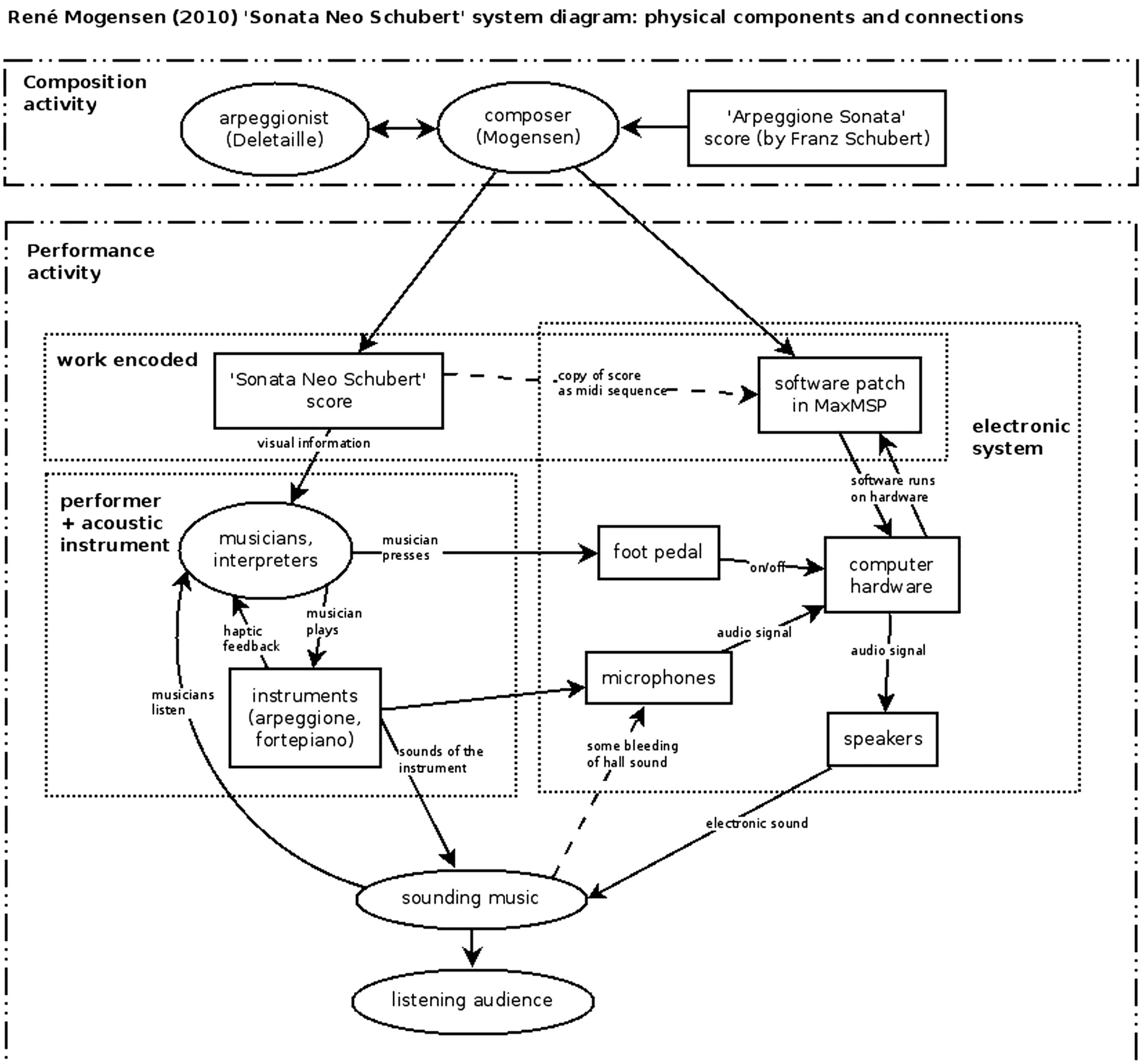
Example of relations between acoustic instruments and computer sound

To give an idea of the relations between instruments and electronics a brief excerpt of *Sonata Neo-Schubert* is shown in illus.4. At bar 16 the arpeggione and piano are continuing the theme which the piano initiated at the beginning of the

2 Graf piano, 1828 (photo: Ad Libitum Collection)

piece. So far, the listener has only heard the two acoustic instruments. At bar 16, the foot-pedal trigger (indicated as A2) tells the computer to record a sample (a short excerpt of the sound) of the instruments, which the computer will use later on in the piece. Then at bar 20 (foot-pedal trigger point A3) the arpeggione plays a gesture that the computer echoes in the speaker system. This echo is 'panning' (i.e. moving) between left and right stereo speakers. This 'panning delay', coupled with a noticeable reverb effect, dramatically changes the perceived acoustic space for the audience.

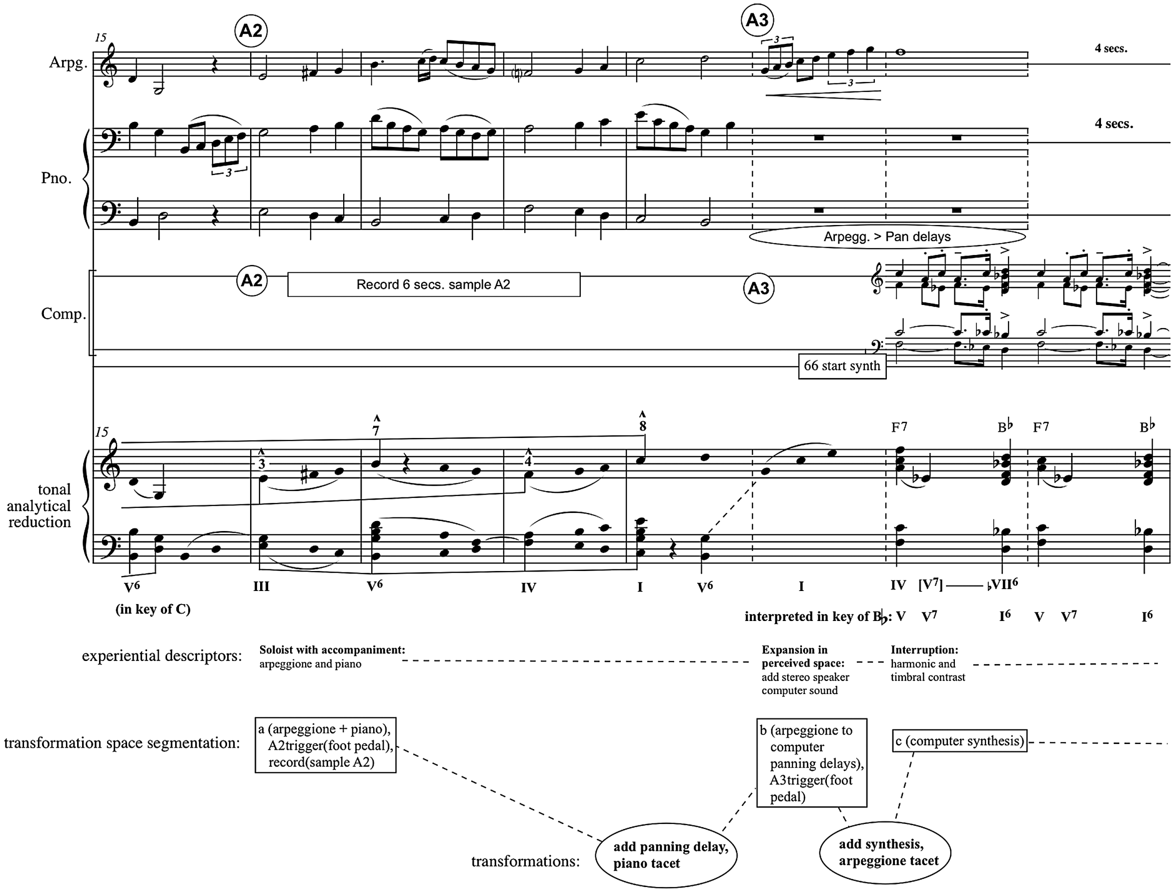
In the following bar, the computer plays a contrasting motif. This interruption in the music is dramatic both in its tonal content and through the contrast between the synthesized timbres and the timbral qualities of the acoustic instruments. While this effect is indicated in the score, it is still quite surprising when heard in rehearsal and performance. The timing of the onset of the electronic sound at this point is achieved by the foot-pedal trigger marked A3, with the computer playing its part at a rehearsed tempo. Illus.4 also includes three analytical interpretations that are useful in this context to help ground the listening experience and performance practice. Just below the score excerpt there is a reduction that shows one way of hearing the tonal relations in the music. Below that, several experiential descriptions are shown, that emphasize the coordination of contrasts in timbres, harmonic materials and perceived space in the music. On the bottom line we segment the music into a 'transformation space'.[14] Here, pitch structures are reduced to types that are named 'a', 'b', 'c', with the contributing acoustic and electroacoustic parts in parentheses behind each type, enclosed in rectangles. This relates to our system analysis (illus.3). In the transformation space we can trace the changes in components of the system, which are involved for different segments of the music. Transformations are described, enclosed in ellipses. In summary, this can all be interpreted as: at bar 16 only the acoustic instruments are heard, at bar 20 the computer joins in with the 'panning delay' effect, and in bar 21 the computer has a short solo, playing a synthesized pitch structure 'c'.



3 Mogensen, *Sonata Neo-Schubert*, viewed as a 'human activity system'

Background: multiple roles of the computer in recent musical works

Modern stringed instruments tend to use metal strings, giving more volume and a different colour to the sound as compared with gut strings that were usually used on stringed instruments until about the mid-20th century. In the present project, gut strings are used on the arpeggione, while volume and timbre can be amplified and transformed by computer-controlled sound. In this case, the computer takes on the role of transforming and extending the instrumental sound. This kind of role is what Robert Rowe[15] classified as an 'instrumental paradigm' for the computer. An example is shown in bar 20 of illus.4, where the computer transforms the immediate sound of the arpeggione with 'panning delay' and reverb effects. These effects take the sound from the instrument (via the microphone) at the time of performance, and produce the transformed sound of the effect processing in the speakers. The blend of the instrumental and speaker sound then gives listeners the impression of a transformed or expanded instrument sound.



4 Mogensen, *Sonata Neo-Schubert*, bars 15–22, with analytical reductions

Rowe proposed a contrasting 'player paradigm', which is exemplified by the computer taking on more independence as 'an artificial player, a musical presence with a personality and behaviour of its own'. This more independent role of the computer can be illustrated at bar 21 of illus.4. There, the computer plays contrasting material with synthesized timbre, generated from the score without reliance on the arpeggione or piano sounds. In this situation, the computer functions more as an additional musician, sounding the appropriate musical part, according to the score.

The flexibility of software programming and the resulting capacity for dynamic organized sound production allows computers to be given many different roles in new compositions for the concert stage.[16] Todd Winkler proposed three performance models for music with interactive computers:[17] (1) 'the conductor model', where the performer controls aspects of the computer sound; (2) 'the chamber music model', where there is an exchange of influences between performer(s) and computer; (3) 'the improvisation model', where the computer generates material in response to the actions of the performer(s) as improvisation. Diverse experimentation has been done in recent years with the use of artificial intelligence and/or algorithmic systems to create computer 'improvisors' that can generate sound and interact musically with human performers.[18] Some composers are also using computer systems that generate written musical materials ('dynamic scores' or 'reactive notation'), which are to be read by instrumentalists during performance.[19] During the composition process, computers are used by some composers to expedite the creation of musical materials, with software such as *OpenMusic*,[20] which facilitates the systematic generation of musical ideas according to flexible, user-determined rule sets.

Sonata Neo-Schubert: performance challenges and solutions

During musicians' private practice time, they can generally refer to the score and thereby get a complete idea of what the musical context of their part is at any point in the piece before group rehearsals. For the musicians performing *Sonata Neo-Schubert*, it was also possible to read context from the score, but only partly. They were only partly able to interpret how the computer part would interact or sound by looking at the score. For highly trained and experienced musicians, who were however not very used to interacting with electronics, rehearsals held a few surprises. Some of these surprises demanded adaptations of performance practice, and we highlight observations of a few of these adaptations below.

The foot pedal

Technologically speaking, the foot pedal is a relatively simple mechanism for allowing pinpoint coordination of timing between performer and electronics: the musician uses his foot to press an electronic pedal at specified points in the score. But this kind of action takes special practice by the musician, because in effect, a new part is being added to the played instrument. The pressing of the foot pedal must be incorporated into the playing of the instrument, which is a process that involves the entire body of the musician. In the case of the arpeggione there is no end-pin and so the instrument is held between the legs. The stability of the instrument is therefore challenged when one foot has to move to press the pedal.

The pressing of the pedal does not always provoke an immediate sound response in the speakers. Sometimes the pedal initiates processes that are internal to the computer, and not heard, such as recording of sound, or changing parameters in the computer sound that are applied later in the piece. Therefore, the pressing of the pedal often cannot be memorized as part of a heard musical gesture. This lack of direct perceived connection with sound production seems contrary to the instrumentalist's normal expectations that his actions produce sound.

With this in mind, composers and technologists should carefully choose the timing of pedal points in coordination with the played gestures, to make the music as playable as possible. A compelling reason to use the foot pedal is that it enables the musician to have a very direct control of timing with the computer sound. But it is advisable to incorporate a backup for the action of pressing the foot pedal. If a computer technician follows the score and has the possibility of enabling the trigger points directly on the computer, he can rescue possible mishaps related to pedal activity; this gives added security for the musicians during concerts.

Performance space acoustics

During a tour in France we performed *Sonata Neo-Schubert*, along with other works. One concert took place in the art space of the Ferme Courbet, in the Doubs region. This was a medium size exhibition/performance space with relatively live acoustical properties. A few days later, we performed a similar repertory in La Chartreuse, Villeneuve Les Avignon, which was a chapel converted into a full-time performance space with tiered seating, and which was significantly larger than the Courbet space. The different acoustics in these two spaces required some adjustments to the performance approach. In particular, the Chartreuse venue required monitors for the musicians, which were not necessary in the Ferme Courbet.

The use of monitors significantly changed the listening stance of the performers: they had to divide their listening attention between the sound of the other instrument in the space and the electronic sound that was concentrated in the monitor speaker. The adaptation of listening behaviour was especially significant for some performance situations, such as the playing of the 'delay canon' described below.

Special challenges of the 'delay canon'

Nicolas Deletaille highlights the need to revise or adapt performer habits and reflexes for performances of works that include live electronics. One example of the need for adaptation is in the *Ghost Minuet*, the third movement of *Sonata Neo-Schubert*. In this movement, during bars 315–33 of the score (see ex.1), the computer records and plays back the instrumental sound continuously, with a three-second delay. The compositional idea behind this interaction is to create a canon-like texture, where the piano begins, and two bars later the computer then enters together with the second piano entry. Two bars further on, the arpeggione enters together with a second computer entry. This musical construction is a 'delay canon' because it involves the use of an electronic delay (recording and playing back with a time delay) to create some of the voices in a canon-like structure.

A distinct difference between the delay canon in *Ghost Minuet* and a traditional canon that would incorporate only acoustic instruments, is that the computer demands a metronomic tempo. The computer is not programmed to adjust its tempo to accommodate slight changes, unlike performers, who will adjust their tempo to synchronize their playing with other performers. While performers can realize a 'fixed' tempo, it is generally a flexible realization which will include small changes, at times slightly faster or slightly slower. The total of these slight changes will tend to average out during the time of the performance, to result in a consistent perceived tempo.

In the delay canon the computer plays back the sound generated by the performers on their instruments. Thus, if the performers make minute adjustments to their tempo, the delayed playback will include such tempo changes, meanwhile the speed of the computer-delayed playback is always metronomic. This means that even the smallest variation in the musicians' tempo can go out of phase with the metronomic tempo, and this will tend to be disturbing to the performers. It can even appear to the performer that 'the computer cannot keep the tempo'. But this perception probably results from the

Ex.1 Mogensen, *Sonata Neo-Schubert*, beginning of *Ghost Minuet* (third movement)

computer's inability to make the minute changes to synchronize with the group sound, such as is normal practice for chamber musicians. In the delay canon, any out-of-phase tempos make it aurally unclear where in time the beat lies, and chamber musicians are of the habit of sensing the ensemble time by ear.

In rehearsals of *Ghost Minuet* this synchronization difficulty became very apparent, since any non-metronomic playing by the musicians tended to lead to rhythmic chaos. One solution suggested was to employ a 'click track', which is a metronome that is synchronized to the computer sound, that one or more of the performers can hear either in monitors or headphones. This kind of synchronization aid is commonly used in pop and rock music concerts and recordings. For the chamber music context of this project, such an aid was found to impose too much on the ensemble playing. Using headphones was also too distracting. Instead, in rehearsals we found that a visual metronome signal (a blinking LED) was discreet enough, and could get the pianist started at the precise tempo. After a few trial runs in rehearsal, once they had started with the visual metronome, the musicians were able to adjust their playing to synchronize with the fixed tempo of the computer sound, and keep perfect time during the entire movement.

Why combine old and new?

To the music listener of today, the concept of putting Schubertian language into a new context might bring to mind a work such as Luciano Berio's *Rendering* (1989) for orchestra. Berio wrote a 'restoration' or 'ricomposizione'[21] of the sketches for Schubert's unfinished Tenth Symphony in D major (D936a). In Mogensen's *Sonata Neo-Schubert* there is a reworking of ideas distilled from the arpeggione sonata (D821), and also from other Schubert works such as the Sonatina for violin in D major (D384) and the Octet in F major (D803). These distilled ideas are developed within a conception of 'sonata form' where the instrumental sound is intertwined with electronic sound. From the listeners' perspective, the musical-language juxtapositioning in the Berio and the Mogensen might appear analogous, although the musical materials and media employed are very different. But while the Berio is a 'restoration'—filling out and gluing together—of Schubert's sketches, the Mogensen is mainly a development of ideas that are adapted or distilled from some of Schubert's finished works.

In his book *Who needs classical music?*, Julian Johnson comments: 'Someone who lives in a world shaped by electricity and computer technology … does not respond to the inherent tensions of a sonata form in the same way as Haydn, or to the relation between major and minor as did Schubert'.[22] In creating *Sonata Neo-Schubert*, the composer *was* responding to the ideas of a sonata form and major–minor tonality, although perhaps as only a composer living/listening in the 21st century could. A 21st-century audience will hopefully find the morphology and surprises in the work relevant to their own experience, and perhaps even be entertained,[23] as it exceeds 'the limits and boundaries [the work] has established'.[24]

The work *Sonata Neo-Schubert* addresses an audience that is familiar with the musical world of Schubert's chamber music, while at the same time redefining this world in the context of current computer sound. Computer sound is usually directed towards a very different audience, who are in turn invited to experience a reworked Schubertian musicality in what will be a familiar computer music context. We might consider *Sonata Neo-Schubert* to embody a thought experiment, what in literature would be called an 'alternate universe': where Schubert sonatas and computer music would be contemporary and integrated. In this experiment, anachronisms become expressive vehicles, bridging two very different musical sensitivities; familiar colours blend with unfamiliar contexts; and dialogues are made between old and new musical ideas, as well as between old and new technologies. These kinds of bridges and dialogues seem highly relevant to any individual trying to consolidate a sense of past and present in Western culture.

Conclusion: directions of a new performance practice

The special problems and solutions discussed above point towards the emergence of a new performance practice particular to compositions that integrate historic acoustic instruments with the young technology of interactive computer systems. This practice can be informed by the early repertory, but idiomatic performance norms on the instruments are transformed, since the performers must adapt to the context of live electroacoustic sound. In return, the integration of electroacoustic sound is also adaptable to the particular sonorities and physical characteristics of the old instruments.

The rehearsal and performance process of works that embraces an attitude of adaptation is rewarded with a rich and unique palette of sound that is only available from this integration of old and new technologies. This palette, when brought alive in performance, can deliver rewarding musical experiences, which promise the potential of revitalising the spirit of adventure in chamber music with instruments from all epochs, renewed for the musical life of the 21st century.

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Nicolas Deletaille is assistant professor at the Brussels Royal Conservatoire in Belgium and performs and records around the world on cello and arpeggione. He has premiered more than 80 new works.

Pianist Alain Roudier was a student of Menahem Pressler, is based in France, and has been involved with historical instruments for the past 30 years, as a performer, recording artist and author.

1 The name 'arpeggione' refers to an instrument used by Franz Schubert in his Sonata in A minor D821, composed during November 1824. According to the first edition (1871), the name is found in Schubert's manuscript and refers to the bowed guitar built in Vienna by A. Stauffer in 1823. It has six strings, is tuned like a guitar, with a curved bridge and a sound-post and is played with a bow. Usually it is held by the performer in the position of a cello between the legs, although it has no end-pin. It has gut strings (four plain gut and two bass wound gut) and the fingerboard is partitioned by brass frets. Twenty-four frets are needed for the Schubert sonata although some of the bowed guitars of the period actually had fewer frets, while some had more.

2 The Schubert sonata (D821) is most often performed in a transcription for cello or viola with modern piano.

3 See Nicolas Deletaille's web page www.nicolasdeletaille.com.

4 *Schubert arpeggione sonata and quintet in C* (Fuga Libera, 2007).

5 *Franz Schubert* (Ad Libitum, 2012).

6 For more information, see www.ReneMogensenMusic.freeiz.com.

7 The surviving early arpeggione repertory is limited to the Schubert sonata, as some other scores of the period are lost. However, current performers on the instrument have stimulated the interest of a new generation of composers. For example, Steve Tilston's album *Swans at Coole* (Run River Records, 1990) was a pioneering attempt to feature an arpeggione in contemporary music. Nicolas Deletaille has compiled a collection of scores of 60 recent compositions of chamber music, solo works and several concertos for arpeggione, many of which have been written for him, and which he has premiered.

8 *The New Arpeggione: Walls of Nicosia* (Contréclisse, 2011). Excerpts and full downloads are available online from several online services; for audio links see www.ReneMogensenMusic.freeiz.com.

9 Conrad Graf (1782–1851) was born in Riedlingen and was working in Vienna by 1811, being awarded the title of 'K. K. Hof-fortepiano-und clavier-macher' in recognition of the high quality of his instruments. Graf's pianos were built in the Viennese tradition inherited from Anton Walter and Johann Schanz, which were famous for their touch and action. A special feature of this class of pianos is that their hammers are covered with leather. There are four pedals on the instrument, from left to right: *una corda*, *bassoon*, *moderator*, *forte*.

10 The range of this Graf piano is six-and-a-half octaves, *C′–g′′′′*. The length is 243cm and it is decorated with bronze trim. The contemporary composer Joseph de Momigny wrote of the Graf piano: 'The colours of the fortepiano come from its different stops, which are controlled by pedals. ... The moderator stop gives a kind of nocturnal character, and when one wants to return towards day and light, one can begin by lifting the dampers while still applying the lute and moderator stops, and then carefully remove one's feet from all the pedals to make a smooth transition.' Our translation of: 'La couleur lui est donné par les jeux différents qui composent le piano-forté et qui sont mus par l'action des pédales. … Il y a quelque chose de nocturne mêlé au jeu céleste: et lorsqu'on veut ramener vers le jour et la clarté, on peut commencer à lever les étouffoirs, en tenant toujours la sourdine et le jeu céleste, puis ôter à la fois le pied de toutes les pédales en ménageant, par le tact, cette transition' (Framery and Guinguené, *Encyclopédie Méthodique* (Paris, 1818), ii, p.267).

11 www.pianoforteadlibitum.org.

12 Several current computer programming environments exist for manipulating sound in 'real-time' during performances. See www.cycling74.

com for more information about the software *MaxMSP*.

13 Analysis of 'human activity systems' has been developed as an approach to analysing complex situations, mostly applied in the social sciences. For an introduction to the background for this kind of approach see R. L. Flood and E. R. Carson, *Dealing with complexity* (New York, 2/1993). René Mogensen is currently developing the use of this kind of analytical tool for music works.

14 We create a theoretical 'space', which contains the descriptions of our segmentation. This theoretical space can then be used for transformation analysis. Transformation analysis was proposed as a generalized analytical system by David Lewin; see D. Lewin, *Generalized musical intervals and transformations* (Oxford, 1993) and *Musical form and transformation* (Oxford, 1993). René Mogensen's current research includes adaptation of transformation analysis as a tool for study of relations between acoustic instruments and electronics in recent repertory by various composers.

15 See R. Rowe, *Interactive music systems* (Cambridge, MA, 1993) and *Machine musicianship* (Cambridge, MA, 2004).

16 A wide range of recent topics are discussed in R. Dean (ed.), *The Oxford handbook of computer music* (Oxford, 2009). Historical perspectives and other background on computer music can be found in many sources, including: N. Collins and J. d'Escrivan (eds.), *The Cambridge Companion to electronic music* (Cambridge, 2007); P. Manning, *Electronic and computer music* (Oxford, 2004); C. Roads, *The computer music tutorial* (Cambridge, MA, 1996).

17 T. Winkler, *Composing interactive music* (Cambridge, MA, 1998).

18 Eduardo Miranda's book *Composing music with computers* (New York, 2001) is a useful introduction for composers interested in iterative algorithms, neural networks, cellular automata and related topics.

19 Some examples of recent work with dynamic computer-based scoring are described in several articles in *Contemporary Music Review*, xxix/1 (2010): N. Didkovsky, 'Density trajectory studies: "organizing improvised sound", pp.75–80; D. Kim-Boyle, 'Real-time score generation for extensible open forms', pp.3–15; P. Rebelo, 'Notating the unpredictable', pp.17–21.

20 Information about the *OpenMusic* 'visual programming language' from IRCAM, Paris, is available at http://repmus.ircam.fr/openmusic/home.

21 See 'Work introduction' for Berio's *Rendering* at www.universaledition.com.

22 J. Johnson, *Who needs classical music?* (Oxford, 2002), p.101.

23 In *Who needs classical music?* Julian Johnson argues for the distinct value of classical music, but his argument is problematic, as has been noted by several reviewers; see reviews by A. Adler in *Music & Letters*, lxxxiv/4 (2003), pp.679–84; N. Dibben in *Popular Music*, xxiii/2 (2004), pp.227–9; and W. Perrine in *Philosophy of Music Education Review*, xxii/1 (2014), pp.96–100.

24 Johnson, *Who needs classical music?*, p.108.