Score scroll: replacing page-based notation with a technology-enhanced solution in composition and performance.

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Introduction

In my practice-led research into timbre transformation and the devices required to construct a coherent musical form with a very slow distribution of structural sound events, the aesthetic of the music conflicts with the physical limitations of human ensemble performance. The music is structured based on precise timings, yet the material does not provide regular cues for player synchronization; what is more, very detailed and evolving instructions regarding articulation demand full attention, creating problems for the conductor-performer communication. This music, which focuses on slow transformation of parameters, requires an alternative approach to presenting the score and facilitating ensemble performance.

The problem is addressed by producing animated scrolling scores as video files, to be projected during performances. This simple and elegant solution, while fitting very well with the nature of the material and avoiding conducting issues, presents multiple challenges regarding the technology, logistical execution, and reliability of performance. The score is required to move horizontally across a static play-line in a steady, smooth, and continuous manner, for the complete duration of a composition, between 12 and 15 minutes. Therefore, it must be professionally edited and exported in a format that is high-definition, compatible with these requirements, and with video editing software. Professional score editors have limitations and default behaviours that need to be overcome to make this possible, e.g. automatic re-sizing of bars to accommodate notes and the process of exporting images. Moreover, the video score must be presented to the players in real time, and in a size ensuring full legibility, without jeopardizing the immersive quality of the concert. In this respect, the composer's concern was

that a large display, e.g. a flat-screen TV measuring more than 40 inches, would obscure the visual contact between the performers and the audience to the point of breaking the psychological relationship which lies at the core of live performance. This is comparable to a basic issue of musicians performing in a recording studio, removed from an audience, as discussed by Frederickson (1989):

> For the musicians, the microphone becomes the audience, and an unforgiving one at that, for the microphone does not respond, it does not register the personal presence, expression, and communication of the performer.

This approach also raises questions connected to the interpretative value of human performer input in the context of automated presentation.

It is important to note that the idea of video score presentation in live performance is not new, but it has usually been combined with non-standard graphic notation, whose effect on the dynamic of execution is very different. Vickery (2012) identifies 2007 as the year software solutions became capable of satisfactory manipulation of notated music, leading to the emergence of the 'screen score'; however, this paper traces the development back to the 1950s and the 'mobile score' experiments of Earle Brown, John Cage, and Morton Feldman. This shows a line of development in the area of graphical notation, which Vickery amplifies in the definition of the 'scrolling score'. Just as the description of this concept identifies the key elements relevant to the author's project, i.e. a continuous sideways motion with events striking a playhead, it also proceeds to observe that the technique is successfully applied to graphical notation in particular, due to the fact that traditional notation does not maintain proportionality in the duration of notes and events.

Vickery's role in the Decibel Score Player application project makes it convenient to find further evidence of the strong connection between the video score and graphical notation.

Examples of application are focused exclusively on graphical notation in both the conference paper introducing the application (Hope, Wyatt, & Vickery, 2015), and on the relevant web page on Apple's App Store (App Store, 2018), where three screenshots are provided for illustration. Similarly, other papers on the topic rely on a wide variety of graphical approaches to notation, e.g. Kim-Boyle (2014), Hope (2017), as does the most comprehensive online resource on animated scores, Animatednotation.com (Smith, 2018), which offers an impressively broad overview of composers utilising video for score presentation.

By contrast, the scores investigated in this paper are predominantly presented in standard practice traditional notation, with consistent barring, even if they contain symbols and elements associated specifically with twentieth century practice.

The two case studies discussed in detail in the following sections serve to provide the context and justification for the necessity of introducing this idea into the composer-performer relationship. The reasoning behind it is explained from the composer's perspective, and based on the players' feedback, without which it would be impossible to appreciate the full impact of this performance practice. The first composition, *Eight*, was workshopped, rehearsed, and performed by Konvalia Quartet with Alina Hiltunen on first violin, Agata Kubiak on second violin, Marietta Szalóki on viola, and Sam Creer as a stand-in cellist; the composer played the piano. *Six Spiders* is a duet which features the composer in the role of the guitarist, and Agata Kubiak, who commissioned the inclusion of a unique dual part of voice and violin for herself to perform, and who became closely involved in the creative process and experiments with score presentation. These musicians' contribution has been of great importance and has undoubtedly enhanced the result of the investigation.

Case study 1: Eight

The first composition of the project is entitled *Eight*, which refers simply to the arithmetical value – a structurally relevant number. While a low-pitched pre-recorded electronic drone is engaged in an extremely slow glissando of a whole step from G to A, the piano sounds non-triadic chords at large distances, and the string quartet creates a polyphonic texture which, in its slowness, mimics the idea of time-stretching in digital audio processing. The music can be described as slow and stretched out, quiet and fragile, tense and sustained; it is moderately dissonant, with non-directional harmony projected as cyclical transformations of two starting-point chords. There are no programmatic influences or references, although the extramusical meaning of inability to externalize emotion through music is suggested by the performance direction "Slow and yearning for lyricism."

The processes that led to *Eight*'s creation laid the foundations for the methodology of composition guiding the practical work behind the entire 90-minute portfolio for this research project, simultaneously exposing the major challenges of score presentation and performance that have led to the notational investigation described in this paper. Apart from the general aesthetic of the stretched-out sound-world, which by itself need not enforce the assumption of technical problems for twenty-first century performers, it was the approach to balancing, in visual presentation, the intended effects of timbre, line, and harmony that made traditional paper score presentation impractical for live performance.

Moving slowly

The composition has a slow perceived tempo of unfolding. This is achieved by means of a careful placement of stronger musical gestures at timed intervals averaging eight seconds, but ranging from 0.5 second to 24 seconds. The backbone of this structural conceit is laid bare by the sparsely distributed chords in the piano part, although they do not project the form in full;

there are a number of melodic steps in the string parts which do not coincide with the chords, but have sufficient textural strength to be formally relevant.

//FIGURE 1//

Figure 1: Bars 1-8 of *Eight* with hit-point markers indicating structural events

Stretched between these remote tentpoles are the quartet's individual lines, finding a sense of counterpoint in predominantly scattered, overlapping phrasing. Note durations, dynamic envelopes, and timbre transformations are implemented with a strong sense of independence between the parts, in order to create the effect of continuous morphing of colours in a balanced overall texture. The downside of this approach is that shared rhythmic cues are rare, making temporal synchronization within the unaided ensemble impractical. Forcing the ensemble to seek out cue points within this texture would carry the risk of shifting the performers' attention away from the key expressive aims, especially the implementation of controlled gradual changes of timbre, and towards alleviating the undesired pressure stemming from striving to stay in time. The potentially simple solution of employing a conductor is made less tempting by the exceptionally slow tempo and complete avoidance of pulse, as well as the fact that conducting might create a visual distraction by introducing onto the stage aspects of movement too vigorous to correspond to the physicality of the players' actions or, more importantly, to the resultant sound.

Sliding slowly

Excessively slow *glissandi* covering small pitch intervals are a feature of the composition. More than a modernist cliché, they are a key contributing factor in the engineering of the taut but fragile auditory experience; additionally, they become a time-stretched version of portamento detail in lyrical string performance.

//FIGURE 2//

Figure 2: Bars 23-27 of *Eight* with slow *glissandi* in violins 1 and 2

This device creates problems both at individual and at ensemble level. An individual string player is likely to find it challenging to anticipate and maintain the correct speed of a stretched-out glissando, especially if a small intervallic bend forces them to zoom in on microtones; and it is important for the integrity of the music to ensure this speed is as close as possible to consistency. When it comes to performing these events in an ensemble, the prolonged duration of a player's glissando makes it challenging for the rest of the group to remain aware of the exact rhythmic placement of events in their own parts while the slide is continuing.

Transforming slowly

Whether a long note remains static in pitch, undertakes a slow glissando, or reaches a point of standard fingered note change, it is most likely also subjected to a slow gradual change of articulation parameters, resulting in timbre transformation. Predominantly, pitch shifting and timbre transformations occur simultaneously, or in an overlapping fashion.

//FIGURE 3//

Figure 3: Bars 8-14 of *Eight*, violin 2 and viola only – timbre transformations

As in the case of *glissandi*, a major part of the challenge to the performer is the expectation that the full duration of a timbre transformation will be executed faithfully to the notated score, requiring a special degree of control. The types of gradual timbre transformations required of the string quartet in *Eight* are listed below; they occur in a wide array of combinations.

1. Bow position, e.g. *sul tasto* to *sul ponticello*;
2. Vibrato intensity, e.g. *non vibrato* to *molto vibrato*
3. Dynamic level

In addition, the standard articulation on-off effects are in use: unmeasured tremolo, half-step trill, natural and artificial harmonics. The key impact of this on the notated presentation of the score is that a lot of information is being relayed to the performer, occasionally with considerable levels of independence between different aspects of articulation. Not only is the performer tasked with keeping track of the start and end points of the different layers of timbre control, but also they are expected to execute the gradual transitions at the right speed, and combine these with ensemble timing and pitch control, as discussed in the previous two sections.

From the composer's perspective, the importance of an accurate execution of these parameters results from two fundamental aspects of the composition process:

The structure is based on precisely calculated timings, in order to adhere to the average of eight seconds between strong gestures;

The composition uses a points-based grading system controlling the timbre complexity, which is projected as another formal device onto the timed structure (harmony also plays a significant role, which is beyond the scope of this paper).

At the same time, it is of importance to note that the aim is not surgical precision at the cost of interpretation and expression. The structural calculations and the timbre grading system are actively involved in creating the general atmosphere of fragility and introspection, which should be emphatically projected by the performers; therefore, pursuing the idea of animated scores becomes a quest for preserving expressive freedom within a performance which is faithful to the composition process. It is a technical solution to the question of offering the performers the maximum level of comfort, so that expressive involvement of the players is unhindered by the challenges of timing and ensemble synchronization.

Case study 2: Six Spiders

Several primary features of the second composition, *Six Spiders*, were developed as solutions to the unique problems presented by the initial commission, by Agata Kubiak, to include a prominent dual part of violin and voice by one performer. In order to avoid logistical issues with rehearsals and performances, the ensemble was kept very small, adding only an electric guitar and pre-recorded electronics. In this context, much emphasis was placed on ensuring that compositional choices regarding the violin/voice part made this part fully responsible for controlling the primary parameters of time, timbre, and harmony. As the effect would have to be in agreement with the general aesthetic of the project, with slow development and interest in timbre, the burden on the dual soloist part created a set of challenges which put to test the methods created in the initial stages of composing *Eight*. The individual's near-complete responsibility for maintaining musical interest on the one hand, while tackling the dual performance challenge on the other, affected the composition process to the point where the ambition of reproducing the methodology that enabled the detailed pre-planning of the structure of *Eight* was not implemented. The problem of building a correspondingly slow musical experience with very limited instrumental means became a priority and a driving force behind an increased flexibility with regards to the application of the existing methods. Placing this music in the medium of a scrolling video score would prove transformative in the composer’s endeavours to address the challenges; more importantly, it would change his understanding of the way the different component parts should correspond to project the intended sound-world The work is in five sections and, for reasons explained below, the lyrical content is very limited. The text is reprinted here, due to its importance for considerations of timbre and notated representation.

Section 1:	*with*	Section 2:
Interact	*human beings.*	*Get over*

it.

We've been

through this.

Section 3:

Have faith

in you.

You will never

let you down.

Section 4:

Achieve!

Achoo!

Bless you.

Section 5:

No more fear.

Moving slowly

Settling on a single average duration of a sound event at the pre-composition stage was one aspect of the formal method that proved unsatisfactory early in the process. In order to maintain musical interest over the course of the composition, the decision was made to explore varying textural relationships between the main instruments. With this in mind, the time control was revised to include two types of average time periods.

In movements 2 and 4, this reflects the approach of *Eight*, as the average distance between prominent chord attacks in the violin part was measured, in order to clearly declare the musical spaces enclosed between them as the moments of interrogating the timbre transformations. In movements 1, 3 and 5, the pre-compositional average time distance between events was replaced by controlling the average duration of a single-breath vocal phrase; the phrases are separated by moments of repose for the voice, and these are not included in the calculation.

Compared to the ensemble of *Eight*, the unusual idea of assigning independent vocal and instrumental parts to a single performer changed the reasons for the material presenting challenges of presentation, but it did not change the nature of the challenges. The work traces the expansion from an average of 12 seconds in the first movement to an average of 13 seconds in the final movement. Again, stronger musical gestures provide tentpoles, between which

gradual timbre transformations are stretched. As the electric guitar part is harmonically fluid and supportive in nature, the voice and violin performer is not concerned about ensemble synchronization. Instead, the context of slow development presents a challenge to maintaining the correct timings while a single player controls two independent instrumental lines.

//FIGURE 4//

Figure 4: Bars 8-15 of *Six Spiders* with time indications

The nature of the challenge resulting from the slow development is similar to *Eight* in one respect – ensuring that the timings of the events are performed correctly, despite the large distances between them – and very different in another. Ensemble synchronization is not a concern, especially as the guitar part is designed to follow the central voice/violin part, but the ability of a single performer to sustain the stretched-out events in two independent parts, while looking after intonation, is emphatically put to the test. In addition, if the performer is required to engage in page turning, the level of pressure may reach a level detrimental to the quality of the performance.

Taking these issues into consideration, an intension was formed to ensure, firstly, that the video presentation should support the player in maintaining the structural integrity of the piece – by nearly guaranteeing the various set timings of events would be executed correctly with the correct timbre transformations achieved. Secondly, it should make it convenient for the voice + violin dual part player to read from the two staves, thus removing a potential source of anxiety and helping them focus on expression and execution of articulations.

Furthermore, the player is asked to explore several textural relationships, varying the way in which attention must be divided between the two staves – it is not possible to maintain a consistent approach to reading the music from the dual part throughout *Six Spiders*. The global structure of the piece is inspired by Béla Bartók's symmetrical approach (Locke, 1987), as

there is a movement three which is central in both formal position and importance; this is surrounded by a two and a four which are related to each other; finally, a one and a five related to each other on the surrounding outer layer, and also related to the "kernel" movement. These movements and how they connect with each other are characterized by the type of textural relationship between the violin and the voice; whether the voice or the violin part is subjected to the control of the average duration of events; and by soft or hard quality of note attacks in the violin:

Section 1 (2m. 52s.): soft: unison

Section 2 (2m. 36s.): hard: melody and accompaniment

Section 3 (3m. 44s.): soft: unison to counterpoint

Section 4 (2m. 56s.): hard: melody and accompaniment

Section 5 (2m. 52s.): soft: unison expanding

With a video score presentation in front of the players, all the timings for these changes could be rendered very accurately.

Singing slowly

The sense of slowness is then enforced by placing, usually, two to four syllables under a phrase of this length, which is the reason behind the limited lyrical content. As clarity of words is prioritized over phrase complexity, there is a maximum of only two notes to a syllable; therefore, this links to harmony in the number of pitches per vocal phrase, which is between two and five. The human voice within an ensemble inevitably draws more attention to itself that the instrumental colours, providing me with an opportunity to use the economy of lyrical content to support the main structural characteristics produced by the control of the placement

of notes in time. The decision was made to select this idiomatic parameter, the lyrics, as a key feature of *Six Spiders*.

This adds another stream of information being sent to the dual-part performer alongside pitch, timing, dynamics, articulation, and texture – this is a lot to read from the printed pages, especially as much has to be stored in memory from looking ahead of the play point in the score. Therefore, the risk is that a performance might become an inaccurate representation of the artistic intentions – an approximation rather than an execution of the parameters.

//FIGURE 5//

Figure 5: Bars 211-218 of *Six Spiders* with a large amount information for the singer-violinist

Sliding slowly

Similarly to *Eight*, lengthy *glissandi* covering very small intervallic distances are a feature and a potential problem during performance. It is challenging to stay in control of the progress of a long slide at this slow tempo, in order to ensure the correct durations; however, in *Six Spiders* a violin glissando potentially coincides with an independent vocal phrase executed by the same performed, making it considerably more valuable to introduce a visual aid capable of supporting both parts simultaneously and securing their synchronization.

//FIGURE 6//

Figure 6: *Glissandi* in bars 16-19 of *Six Spiders*.

Transforming slowly

Building on the methods developed for *Eight*, slow changes of articulation parameters are implemented to achieve expressive timbre transformations. The method of grading timbre complexity remained an efficient way of making compositional choices, but application required more flexibility than in the case of *Eight*, primarily due to the efforts to maintain a

meaningful relationship between the violin and the voice and, once again, the size of the ensemble. Additionally, the existence of the words meant that the more complex articulations had to be used with caution, lest the combined effect become grotesque. In the vocal part, very complex articulations were avoided entirely, due to the potential of conflict with the emotional colour of the material.

The nature of the challenge in *Six Spiders* is different primarily due to the fact that the voice/violin player is in a very exposed performance context, having to cope with large amounts of changing information without the comforting support of a larger ensemble. The material is tense and fragile, requiring a highly developed level of control from the player, making meaningful the effort to develop an approach to score presentation that relieves some of the pressure of keeping track of all the information.

Developing the solution

A majority of the problems listed above were clearly identifiable at the composition stage, but the consequences and potential solutions became considerably more defined during the initial discussions with prospective performers. In particular, *Six Spiders*, being commissioned by violinist, vocalist, and researcher Agata Kubiak, was scrutinized in-depth, due to the unusual nature of the instrumentation. The other key influence was internal – resulting from the composer's urge to present the music visually in such a way as to make it reflect the auditory experience – and the drive was to design a mode of delivery of the score that had the relevant physically to it. The fragile, tense atmosphere of the music, emphasized by the protracted timbre transformations, with the slow distribution of strong gestures, creates a sound-world in which page-turning breaks the immersion and interpretive efficiency of the players. In the case of *Eight*, the combination of voice-leading and texture characteristics means that convenient page-turns cannot be located, so relying on traditional paper-based part scores would require

modifications of the musical material, which was not an acceptable solution in this project. Additionally, the activity would take away some of the ceremonial quality of performance experienced by the audience, as the page-turn gestures are a highly exposed physical element not directly involved in producing sound, and not designed to supplement the key composition devices – page-turning is purely mechanical.

The solution has been to reproduce the scores as animated side-scrolling graphics, encoded as video files to be broadcast to the players in rehearsal and performance. This idea was inspired by the recent, yet already well-developed, movement to publish various types of animated scores with synchronized music online on the YouTube platform – the most prominent channel devoted to this is Score Follower (Scorefollower.com, 2018) With only basic synchronization features, the existing examples of traditionally notated music in video formatare primarily designed for score study and music appreciation activities, as well as promotion of new music and emerging composers, so the aim to present this type of notation medium to players as a full-scale replacement for hard-copy parts has created a new, specialized area of investigation within the associated composition project.

Compared to video scores for study purposes, employing the medium as part-score replacement in performance imposes unique requirements:

- The score has to scroll right to left smoothly and at a constant speed, as any change in scrolling pace, if there is no tempo change precisely indicated, would risk breaking the focus established between the player and the display. Issues of timing and synchronization would be likely.
- Unless the music is intended to stop for a time, there should not be any page-turn effect, as it is visually too startling and confusing in a video file. The effect must be that of the score as a single extremely wide image gliding steadily across the screen.

- There must be a playhead (play line) showing the current playing position to all performers, in order to maintain synchronization. A degree of transparency is required to ensure it does not obscure any notated information.
- The points above will only ensure a true representation of the music if the note-spacing in the score editor is consistent and there is a constant bar width in place.
- The video must be in high definition (1080p) and a high frame rate (30fps) should guarantee a smooth reading. The clarity of presentation should be maximized to satisfy player eyesight requirements, and to compensate for lighting problems.
- Any screens used for playback of the scores would have to be sufficiently large to make the music very comfortable to read, especially considering the amount of additional information about changes in articulation, and the unique dual part in *Six Spiders*.

A key early decision was that all players would read from the full score. While the primary reason was ensemble synchronization – being able to glance at other musicians' parts to gain a better understanding of the music – it also meant that only one video file per composition would be needed, and that multiple players would be able to read from a single screen. The additional workload connected to using part scores would be a great challenge, particularly when score revisions are considered, and the logistics of setting up multiple video displays would be a considerable complication. What is more, it would contradict the key achievement that the musicians' were most enthusiastic about – the ability to see what the others are doing.

Stage 1: Score editing

The score editor of choice for this project was *Sibelius*. No major issues were encountered during the process of engraving, but preparing it for video editing proved a significant challenge. The first step was to consider note spacing and automatic layout options governing staff spacing and bar width – the fundamental topic of rhythmic spacing in music editing

(Smith, 1973). The first two are basic modifiable options under House Style and only took a small amount of trial and error to adjust; the bar width on the other hand, while controllable, does not have an option to set a fixed width. Sibelius would automatically choose a default width based on the contents of the bar, and changing every barline by hand would be inconsistent. Therefore, a workaround solution was needed and the only one to prove effective was to create an unused empty staff, fill its bars with a string of quaver notes for the entire duration of the score, then use the Layout option *Focus on Staves* to force Sibelius to only display the staves needed in the score. The rhythmic value of the notes on the empty staff should depend on the shortest value found in the score. The effect of this, a fundamental requirement for a scrolling score, corresponds to what Smith describes as an 'extreme case' of 'strict rhythmic spacing', which highlights the contrast of media.

The second step became the most time-consuming element of the whole process – exporting image files of the scores for video processing. The aim was to achieve a single image file of an entire score, in order to set the parameters for the scrolling motion only once and avoid trying to join separate images while maintaining a consistent speed of motion. It proved impossible to achieve this aim on the computers available to the author, although it is an option that may be practical on a high-specification graphics workstation. *Sibelius* gives the option called *Select Graphic*, and the selection may be exported in a small range of image formats; viewing the score in Panorama mode makes it possible to zoom out until the whole score is visible, which can be selected and exported, with options for size and quality. While to achieve a quality image it is customary to aim for the size 300 dots per inch, it proved necessary to decrease it gradually until the employed computer's GPU was able to deal with the size of the resultant files. Through lengthy trial and error, respecting the limitations of the available hardware, a reliable process crystallised which involved exporting even sections of just under 3 minutes of score length.

//FIGURE 7//

Figure 7: Section 2 of *Six Spiders* as a 'sausage' graphic exported from Sibelius.

Stage 2: Video editing

Video editing took place in *Lightworks* and, once the trial and error to find the right image size was resolved, it was a process satisfying in its efficiency. By using a keyframe effect it was possible to achieve the smooth scrolling motion, as well as an opacity-controlled playhead, and most of the work was focused on setting the right speed of motion. Finally, it was necessary to ensure the score sections exported from *Sibelius* had equal number of leading and trailing bars (evident in figure 7), in order to create cross-fade effects when joining the separate video-files into a single full-score experience. The pre-recorded electronic drones were embedded in the video files to aid me in setting the scroll speed, and to make it convenient for the musicians to rehearse with the playback.

//FIGURE 8//

Figure 8: Editing and calibrating sections of *Six Spiders* as video in Lightworks.

Stage 3: Performance

Even though the approach was new to all parties involved, presenting the completed scrolling scores for both *Eight* and *Six Spiders* to the musicians during rehearsals was very rewarding. Having set up a duplicate HDMI display feed from a laptop PC into a large TV screen, it was possible to complete the first read-through attempts with a minimal amount of preliminary discussion, which primarily focused on details of articulation and expression.

//FIGURE 9//

Figure 9: Rehearsing *Eight* with Konvalia Quartet (piano out of frame).

In the case of *Eight*, the key achievement was ensemble synchronization, which the scrolling score made seamless and automatic. There was no need to compare the parts and agree cues, which removed considerable pressure, making it possible to focus more closely on details of timbre. Agata Kubiak, the second violin, summed up this improvement in rehearsal logistics when asked about the usefulness of this approach beyond the compositions currently at hand:

> I think this is going to save so much time, because if you looked at what we do when we work on something in the first few rehearsals, we spend half of the rehearsal flicking between the score and our parts. Because we're making little cues and writing little notes on who's doing what (…), so just seeing everything laid out as a score as you play it, it will save an enormous amount of time (…) It gives you that additional help with seeing what everyone else is doing, and you need to know that anyway.

Any potential issues with timing and executing various articulations over extended periods, as well as the problematic *glissandi*, had thus been solved before the first rehearsal. The chords in the piano part, frequently separated by considerable amounts of time, would approach the playhead gradually with no need for the performer counting the beats, and, on second attempt, the ensemble timing was executed with nearly surgical precision.

Agata was in a very different situation when it came to rehearsing *Six Spiders* with the scrolling score. She had already performed a well-formed draft from a printed part score and she found herself re-adjusting her approach, almost re-learning it, which was evidence of just how different the two media are, despite the fact that both contain traditional notation. Nonetheless, the unusual voice and violin role became easier to play, as Agata felt it allowed her to "look in between the two parts", rather than shifting her focus from one to the other. She was also optimistic about the expressive interpretation of the music presented in this fashion:

> I actually found it easier – I would love this as a practice device if not for everything. It's like having a visual silent metronome (…) fluidly, without the rigid beats.

The fact that the composer participated as a musician allowed him to maintain a very good level of understanding with the other musicians throughout the rehearsal process and he also benefitted greatly from this medium of score presentation as a performer. The ensemble were able to successfully premiere *Eight* after only two rehearsals of 45-60 minutes.

//FIGURE 10//

Figure 10: *Six Spiders* performed in St Mary's Church, Ealing, London, 7 December 2017.

Conclusion

The premiere performance of *Six Spiders* and *Eight* took place on 7 December 2017 at St Mary's Church in Ealing, London, and of the experience was reassuring with regards to the effectiveness of these scrolling scores. While the pianist comfortably read the music from a 15-inch laptop display, Agata and the quartet had a 42-inch TV placed in front of them, and the set-up worked successfully, even though it was logistically challenging to implement. While there remain interesting issues for further investigation, e.g. working with a larger ensemble, the potential role of a conductor, audience engagement, it can be noted with satisfaction that, in a first performance situation, the issues previously identified as the reasons behind the scrolling score approach had all been solved and the music produced was very close to what the composer had intended.

It is important to note that this solution was developed specifically for the stretched-out textural music exemplified by *Eight* and *Six Spiders*, and it is possible that there are approaches to composition, for which it would be a failure. At the same time, the musicians' feedback leads to the belief that the scrolling score has potential applications in rehearsal and performance strategies considerably broader than the author's own compositional output.

The key achievement of this project has been to test and confirm the potential of the scrolling score to be used for reading traditional musical notation in rehearsal and live performance, especially that involving an ensemble. The question of traditional notation is important, due to the fact that the well-explored use of video for graphical notation limits the application of the technique to music associated with radical modernism and aleatory, leaving unexplored a great number of combinations of this mode of score delivery with other aesthetics. In the context of a rehearsal, the approach creates a new experience as regards the simplified logistics and increased speed of practice, as well as ensemble dynamic, where the need for preparatory discussion and cue planning is considerably smaller. Additionally, with neither page-turning nor memorisation required, and with the greatly simplified timing of events, live performance is also strongly affected.

There remains much to improve from the technological standpoint. The process of preparing these scrolling scores was very cumbersome and suffered from recurring issues of processing power, and inflexible settings individual to each image processed. Whenever revision was needed, the entire process might have to be restaged. Streamlining by means of bespoke software is a future development without which a wider application of the technique might prove impractical; for larger ensembles, this would require the ability to handle individual parts dynamically. At the same time, improving the technology is likely to create further opportunities for new developments in the efficiency of composer-performer communication.

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Scores

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Szafranski, B. (2017) Six Spiders. For Singer-violinist, Electric Guitar, and Electronics. Score available on request.

Recordings

Kubiak, A., Szafranski, B. (2018). Eight live premiere December 2017 backup video. [Online Video]. 7 December 2017. Available from: https://youtu.be/zgfZLppJRRo. [Accessed: 15 January 2018].

Kubiak, A., Szafranski, B. (2018). Six Spiders live premiere December 2017 backup video. [Online Video]. 7 December 2017. Available from: https://youtu.be/EvqfHh6hCUg. [Accessed: 15 January 2018].