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TENOR 2015

THE DECIBEL SCOREPLAYER - A DIGITAL TOOL
FOR READING GRAPHIC NOTATION

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ABSTRACT

In 2009, the Decibel new music ensemble based in Perth, Western Australia was formed with an associated manifesto that stated "Decibel seek to dissolve any division between sound art, installation and music by focusing on the combination of acoustic and electronic instruments" [1]. The journey provided by this focus led to a range of investigations into different score types, resulting in a re-writing of the groups statement to "pioneering electronic score formats, incorporating mobile score formats and networked coordination performance environments" [2]. This paper outlines the development of Decibel's work with the 'screen score', including the different stages of the 'Decibel ScorePlayer', an application (App) for reading graphic notation on the iPad. The paper proposes that the Decibel ScorePlayer App provides a new, more accurate and reliable way to coordinate performances of music where harmony and pulse are not the primary elements described by notation. It features a discussion of selected compositions facilitated by the application, with a focus on the significance of the application to the author's own compositional practices. The different stages in the development, from prototype score player to the establishment of a commercialized 'Decibel ScorePlayer', are outlined in the context of practice led investigations.

INTRODUCTION

The Decibel new music ensemble is made up of six renowned exponents of new music in Perth, Western Australia. Three of these performers are also composers,

and one of the performers has a mathematical computer programming background. The other two performers are supportive of workshopping processes and a variety of approaches to new music, including working with electronics and improvisation. Decibel have sought to support Australian, and specifically, Western Australia new music practice, and have commissioned over eighty Australian works since their inception. A large proportion of these works are from composers within the group, but many are from significant Australian composers, electronic artists and songwriters. There is also an international aspect in their repertoire, with the group having presented monograph concerts of works by US composers Alvin Lucier and John Cage, as well as works by the late Italian composer Giacinto Scelsi and French *musique concrete* artist Lionel Marchetti. All the Decibel commissions feature acoustic and electronic components, and the group perform these works without a standard public amplification set up or live engineer. All electronics are generated from the stage, and a collection of powered monitor type speakers are used to present the electronic components throughout, which may vary from electronic playback to interactive and spatialised electronics. The rationale for this approach is to enable electronics to behave more like acoustic instruments, by using directional monitor speakers on the stage, giving a focus to the source of sound, and the way the sound is controlled and manipulated created by an operator [3]. This approach has lent itself to music scores that use graphic and extended notations, and included parts where electronics are scored quite specifically, and often, read on a computer. Decibel ensemble member Lindsay Vickery calls these 'screen scores' - music presented on and read from a computer screen. He classifies these scores into four types: real-time, scrolling, mobile and traditional [4]. Decibel engages all of these types of score in their repertoire, with a focus on real-time and scrolling scores - but also developing new categories.

In 2009, the composers within the group, Cat Hope,

Lindsay Vickery and Stuart James, worked together to develop a solution that would enable the presentation of screen scores for Decibel to perform. The entire ensemble has been involved in a process of creation and interpretation of musical works in where new ideas and techniques are conceptualised, tested, evaluated, revised and disseminated in performances, recordings and archiving [5]. Through this process, the group developed a system for reading scrolling scores that was prototyped in MaxMSP. With the assistance of programmer (and Decibel viola player) Aaron Wyatt, these systems evolved into an iOS App, the Decibel ScorePlayer for the Apple iPad. It is now available on the iTunes Store internationally.

Decibel are of course not the first to engage with screen scores - previous work by Dannenberg [6], Clay and Freeman [7], Kim-Boyle [8] and others have examined the possibilities for real time score generation on computers, and a variety of propriety score generators for traditional notation are available, two examples being INscore [9] and MaxScore [10]. However the use of graphic notation - newly composed and extant - in screen scores has been limited, and often tied to traditional notation. The digital format offers a range of possibilities to develop graphic notation practice - through the incorporation of aspects such as colour, real time generation, video and interactivity. Decibel's score player investigations have focused primarily on this area of development, and in providing a 'reading mechanism' for performance, rather than a score generation tool.

THE DEVELOPMENT OF A SCROLLING SCORE PLAYER

The iTunes store describes the Decibel ScorePlayer as software that "allows for network-synchronised scrolling of proportional colour music scores on multiple iPads. This is designed to facilitate the reading of scores featuring predominantly graphic notation in rehearsal and performance" [11]. It works best for music that needs to be coordinated in a "timed" way, with proportional pitch structures. It is particularly useful for music that is pulseless, or requires pulse to be removed from the reading mechanism. The Decibel ScorePlayer is very good at presenting scores that in the past would have required a clock to coordinate multiple performers.

The Decibel ScorePlayer began as a bespoke solution to the problem of reading certain graphic scores, specifically those by author Cat Hope, who is a composer and ensemble director of Decibel. In 2008, before Decibel had began, Hope's *Kingdom Come* (2008) for

laptop duet featured A graphic notation read from left to right. The image was put in motion in a movie program, and the performers read the score at the point just before it passed off the screen. This was not particularly accurate but provided an approximation of coordination that facilitated the performance. The score had been created on a computer, and did not exist in any real "physical" dimension. In preparation for the first Decibel concert in September 2009, Hope presented a score consisting of a computer print out of ten landscape A4 pages stuck together, a kind of coloured line graphic score for five instruments - one of which was a turntable - again with the problem of how to read the music in a coordinated manner.
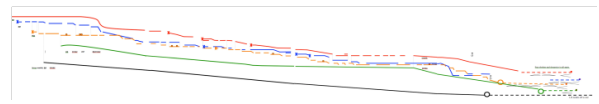
Figure 1. Cat Hope's score *In The Cut* (2009).

This piece was *In The Cut* (2009) for violin, cello, bass clarinet, bass guitar and turntable with sub woofer and is shown in **Figure 1**. The piece does not treat harmony or meter in any 'traditional' way, adopting graphic notation as a way to better reflect a proportional approach to music composition [12].

A solution to the problem of reading *In the Cut* was provided through the creation of a MaxMSP patch, where the digitally created score file (a JPEG or PNG) was read by passing under a vertical line over a pre prescribed period of time, in the case of *In The Cut*, seven and a half minutes, as shown in **Figure 2.** A control panel was built to adjust specifications for each performance, and was shown on the same screen as the score.

Figure 2. Lindsay Vickery's control panel for the score player built in Max MSP.

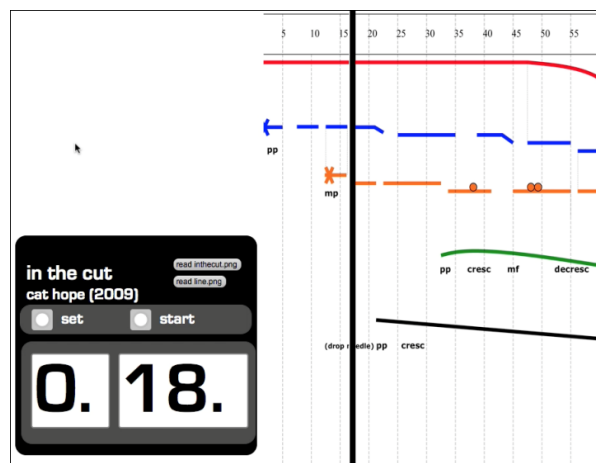This vertical line came to be known as the playhead, referencing the tape head on tape players. Musicians would play their part as it passed by the playhead, providing an accurate way of coordinating the performers together by reading the same part in the score at the same time. The playhead was placed slightly in from the left side of the score image, so that the performers could see the material approaching the playhead in advance, but also so a small amount of material already performed, which would often assist in referencing the upcoming material. The coloured parts provided easy identification for the different performers, and the piece itself was proportional in its representation of pitch across all the instruments. The score presents each instruments part as a long, slowly descending line, representing a very smooth sound quality that uses glissandi to move between different pitches. Simply, the score looks very much as it sounds, and this is supported by a number of audio spectrograms made of different performances, such as the example provided in **Figure 3.**
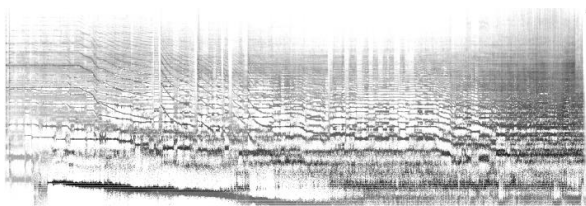

Figure 3. Spectrogram of a performance of Cat Hope's score *In The Cut* (2009) [13].

Vickery built the MaxMSP patch in consultation with Hope and ensemble. It usually required the performers to have access to a full version of MaxMSP to run the program, though it was later made workable on Max Runtime. A number of works were written for this software player prototype, some for other ensembles, and some without electronics. One example is Hope's *Kuklinski's Dream* (2010) for instrumental trio, carving knives and electronics. Like *In The Cut*, the work is characterised by a lack of pulse, proportional pitch relationships, colour representations for different instruments and unusual instruments (in particular, carving knives bowed and amplified). A notated electronic part was also featured, required programming by the ensemble's electronics operator prior to performance. Another work by Hope, *Wolf at Harp* (2011) for four drum kits, used blocks of notation to describe fields of activity on certain parts of percussion

kits, in this case the bass drum, cymbals and toms. The scrolling nature of these scores effectively communicate the composer's intention a kind of pulseless music characterized by long sustained sounds. They also allow careful ensemble interactions enabling an accurate reading of the proportional nature of the score.

READING AND NETWORKING

The first Decibel scrolling scores were projected onto a screen in the performance space, to facilitate musicians reading the score in performance. Whilst providing a straightforward solution to coordinating a performance, the performers mostly had their backs to the audience, hardly a desirable performance presentation format. The score was also a very predominant feature in the space. Many audience members would comment on the nature of the score and follow it intently during the performance. Whilst this brought a new audience to our concerts seeking to 'understand' the practice of new music, it had become more of a focus than the music itself. To overcome this, Decibel member Stuart James added networking capacity, so that multiple laptop computers could be connected and coordinated over cabled Ethernet. This meant that each performer had their own score player coordinated with the others in the ensemble. The patch was further developed by Vickery to fast-forward to different parts of a score, and to slow the speed of the piece for rehearsal purposes.

These developments made the software more workable in rehearsal situations, and some fifteen works were composed for this version of the player. The ensemble also began adapting a range of other composer's scores to be read by the ensemble using the patch, including Earl Brown's *December 1952* for open instrumentation and Giacinto Scelsi's *Aitsi* (1974) for piano and electronics among others. Works from Percy Grainger's Free Music project, namely his *Free Music No. 1* (1936) for four Theremins and *Free Music No. 2* (1937) for six Theremins were put into the player. The pages of Grainger's hand drawn score were joined together and scanned into a single file, the different parts traced over in different colours and a playhead designed to include the list of pitches represented by the undulating lines that are a feature of this composition, as shown in **Figure 4** [14].
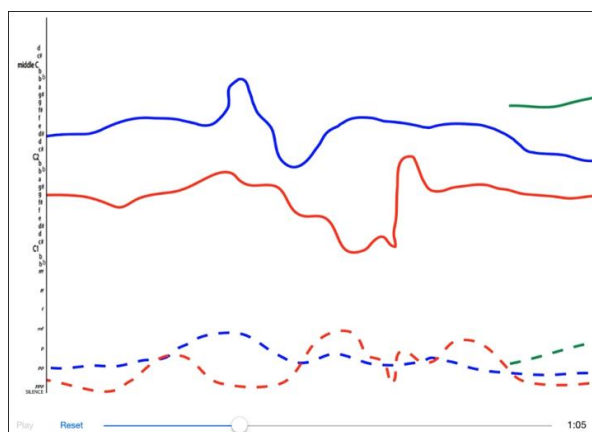
Figure 4. Percy Grainger *Free Music No. 1* (1931) adapted for the iPad Decibel ScorePlayer. This image shows the playhead replaced by a chromatic meter, and the scrub function along the bottom of the image, with the time elapsed on the right.

Other screen scores were being developed within the ensemble that included variations on the theme of scrolling presentation. Vickery's *Ghosts of Departed Quantities* (2011) for bass flute, bass clarinet, cello, keyboard and live electronics, for example, features music notation that subtly appears and disappears to the reader as it passes a playhead. **Figure 5** shows the presentation of two instrumental parts, bass flute and bass clarinet. The musical information passes from left tor right across the playhead.
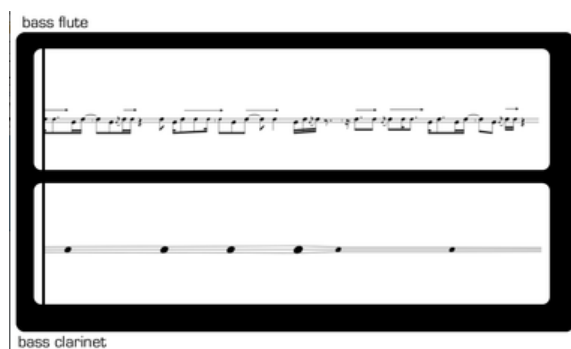

Figure 5. Lindsay Vickery's *Ghosts of Departed Quantities* (screen shot) excerpt.

In *Ghosts of Departed Quantities*, each performer has unique score activity, unlike Hope's scores, which required a tightly coordinated presentation of fixed materials. Vickery's screen scores presented materials that would arrive in a different order and quantity each time the piece was performed. Scores such as *In the Cut* provide performers with the possibility of choosing different starting notes for each performance, but require them to maintain the same pitch relationships each time.

The score player patch continued to be adjusted and developed to incorporate a range of new behaviors, including changes in the direction of the score. Hope's *Liminum* (2010) features a score that musical material goes backwards and forwards, and the play head jumps to different parts in the score at certain points. Again, each player's score is independent in this process, whilst being coordinated to start and finish together. In *Juanita Neilsen* (2012) these 'jumps' are coordinated to occur in random places, but coordinated with all players. These scores have been categorized as 'Variable Scrolling Scores'. In a collaborative work between Hope and Vickery, *Talking Board* (2011), circles traverse a larger than the screen image, serving as the guide for musicians to read said image, as shown in **Figure 6**. The movements of the circles provide information to an electronics operator for generative, interactive and spatialised electronic parts. *Talking Board* was a radical departure from the scrolling score format used on the score player up until that point, completely breaking away from the linear, left to right presentation and reading of the score. The circles have a series of different behaviors, including swarming, following, getting larger and smaller, appearing and disappearing [15]. It also required the transmission of data generated by movements on the score to another sound generating computer, signaling the need for the score player to send more than score data, leading to investigations around the incorporation of Open Sound Control (OSC).
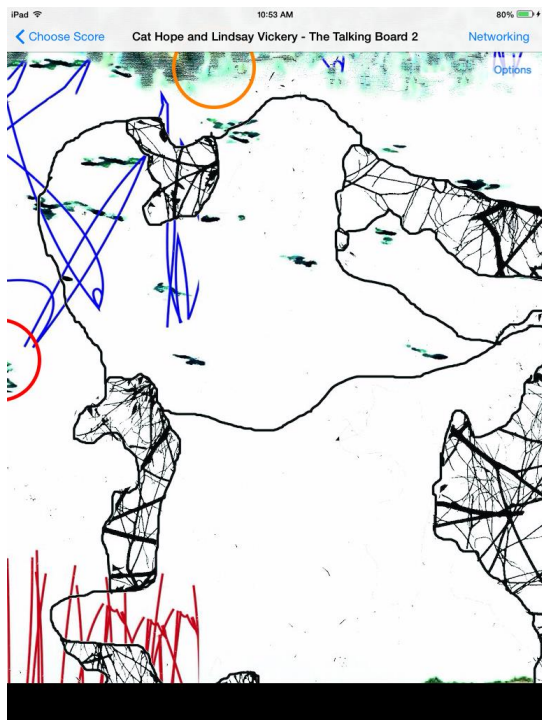
Figure 6. Cat Hope and Lindsay Vickery, *The Talking Board* (2011), screen shot of score excerpt. Here, two circles are visible - one at the top of the score, the other to the left - each half off the screen.

EXTENDING THE PARADIGM

The score player project involved a number of other developments for reading scores other than graphic notations that are worth mentioning here. Automated page turning and synchronised click tracks were adopted and used in performances of pieces such as Thomas Meadowcroft's *Pretty Lightweight* (2001) and Lindsay Vickery's *Night Fragments* (2011). Mauricio Kagel's *Prima Vista* (1967), is a piece designed to feature slides shuffled and presented in a slide projector at random order. This 'score play' technique too was automated in a MaxMSP patch.

Decibel also performed other MaxMSP generated screen scores written specifically for the ensemble. Sam Dunscombe's *West Park* (2010) provided a range of changing score slides that would connect with the live electronic processing. In David Kim Boyle's *Point Studies No. 1* (2011), a beautiful spiraling colour video

score produces sine tones as a result of the generative activity in the patch producing the score [8]. Between 2010 and 2012, a number of pieces were written for the scrolling score player by a range of composers, often characterised by the inclusion of non traditional instruments, that would otherwise be difficult to notate using conventional notations.

From laptops to tablets

Despite moving to wireless networking in 2011, the laptop presented a number of limitations for presentation of the scores. Most performers laptops were used for other purposes than score reading - leading to issues with different operating systems, networking protocols and personal settings. Despite the development of a network utility developed in MaxMSP to monitor network activity, the collection of IP address and constant monitoring of who was on and off the network provided ongoing problems. A European tour in late 2011 featuring Decibel repertoire in the prototype score player provided a turning point in the development of the score player. It was decided to move the score player project to portable tablet computers. Funding was secured in early 2012 to purchase five iPads and to develop the score player on the iOS platform.

Decibel members Aaron Wyatt, Malcolm Riddoch and Stuart James set about developing what was to be called the Decibel ScorePlayer for iPad in early 2012, and the first release was issued on the Apple App store later that year. This release come with packaged with two scores each by Hope and Vickery, and provided a link to a free desktop application, the Decibel Score Creator, developed by Wyatt to enable users to create their own scores in the format required for uploading to the player, a *.dsz* file. The Decibel Score Creator is where important elements of the piece are assembled and stored into the file, and the interface is shown in **Figure 7.** In addition to naming the piece by title and composer, the length of the piece, the position of the play head, extra (separated out) parts and any instruction notes for performance can be added. Any instructions would appear in a drop down menu on the ScorePlayer when the piece is selected from a menu listing all the compositions in the player. These elements all constitute the *.dsz* file
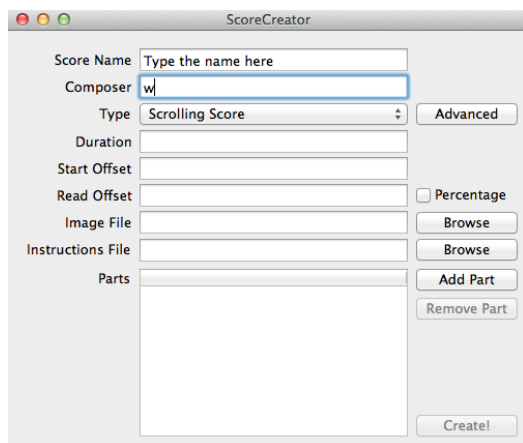
Figure 7. The Score Creator interface built by Aaron Wyatt and designed by Decibel composers in conjunction with him.

The iPad Decibel ScorePlayer provided a number of benefits over the laptop version. A much easier networking facility, native to iOS meant each iPad user could join any network agreed on by the ensemble, and users could see who else was on the network at any time using a network tab [16]. Once *.dsz* files are created, users can add scores to the Player by uploading them in the sharing facility of iTunes, as seen in **Figure 8.**
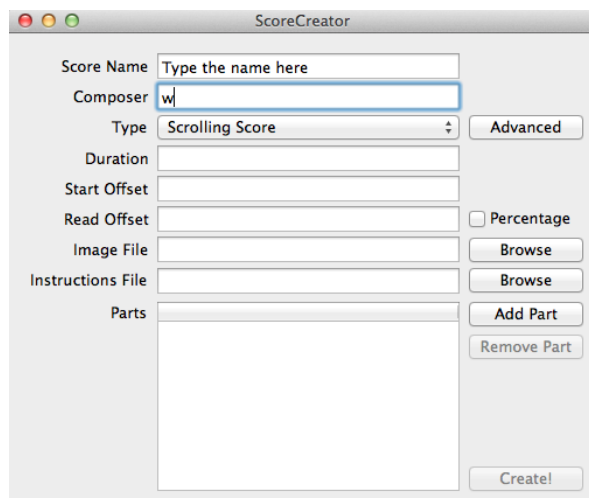

Figure 8. Screenshot the sharing facility in iTunes, showing the Decibel score player (red for testing version, black for current commercially available version) and the place to add scores.

Whilst the lengths of each piece were set in the Score Creator, they could be altered for rehearsal purposes, and would reset to the original speed if the score was re-opened. A scrub button along the bottom of the screen provided easy access to any part of the score, and an information tab provided a drop down note for any

instructions required for each individual score, as in Figure 9.

A User Guide is provided on the App to explain how it works, how to set up network, and how to create your own scores for the App. This includes a contact email for any enquiries or bug fix suggestions to be made, and point the user to a web site where instructional videos are provided [17]. On the iPad ScorePlayer, you can choose to see the score as a whole, or as individual parts. This function was first used on Hope's piece *Juanita Nielsen* for two violas, two cellos, piano, electric guitar and electronics, at the premiere performance of the Decibel ScorePlayer in September 2012 at the Perth Institute of Contemporary Arts. It became evident in rehearsals of *Juanita Nielsen* that the complex nature of the diagrams in the piece required magnification to be read accurately, and so the idea of providing separate parts was born. These can be added in the score creator in addition to a master score. The parts are coordinated with each other, even when you use the finger drag up and down on the screen to change between different parts.

Figure 9. The 'User Guide' pop up, as seen over the list of works in the player (screen shot).
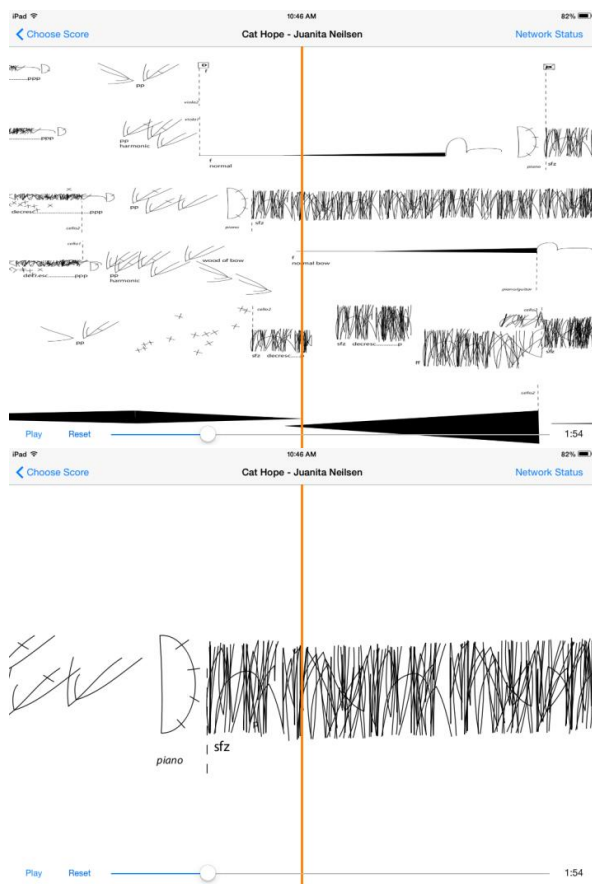
Figure 10. Hope's *Juanita Nielsen*. The top image shows the full score in the player. The lower image shows one part - in the same point of the piece, visible. The playhead is in the middle of the screen as the score goes in different directions. I red light in the top right flashes twice as a warning that the direction is about to change.

Figure 10 shows one of the parts at the same part in and next to the master score on the Decibel score player.

Early testing versions of the Decibel ScorePlayer were deployed using a program entitled Test Flight [18], which enabled Decibel to test new developments to the App. The composers for the ScorePlayer could make a standard scrolling score and parts in the Score Creator and test these in the player themselves. Whilst all the scrolling scores for the prototype player were adapted for the iPad player, new types of scores continued to be created for the Player, with the group using a 'developer' version of the App as new works, and updates to the player, could be tested before updates to the App on the iTunes store would be made.

Some scores were designed to read up and down, rather than left to right. This is useful when an instrument

or group of instruments needs to be referred to spatially in the score. The shift can be done by simply locking the rotation on the iPad and turning it to a portrait, instead of landscape, view, so the score flows upwards, rather than from left to right. The Hope's piece *Broken Approach* (2014) for solo percussionist is read across a horizontal playhead, reflecting the spatial arrangement of the different percussion instruments in the performers set up, and is seen in **Figure 11**. Likewise, Hope's piano works *Chunk* (2010) and *Fourth Estate* (2014) use the playhead to reflect the horizontal presentation of the piano keyboard to the performer, the latter providing a shuffling mechanism that presents the composition differently each time, with eight different score images joining seamlessly in a different order each time the piece is opened on the ScorePlayer, using a 'tiling' approach for the different images. These scores have been named 'vertical scrolling scores'.
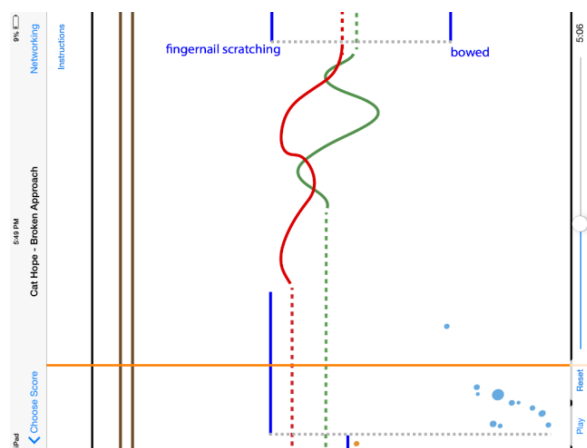

Figure 11. *Broken Approach* (screen shot). Note the presentation of the kit on the horizontal access, which is how it should be read.

Score Materials

The scores that can profit from being read in the Decibel ScorePlayer on the iPad are quite diverse. These include pieces that feature some elements of traditional notation, such as James Rushford's *Espalier* (2012) (also featured at the premiere concert of the ScorePlayer), featuring a stave and pitched note heads throughout, as shown in Figure 12.
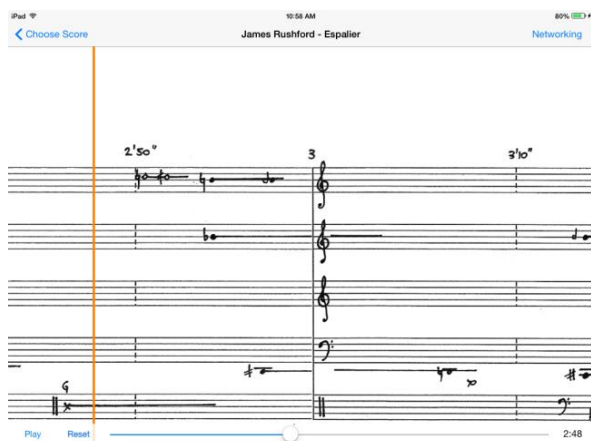
Figure 12. James Rushford's *Espalier* in the Decibel ScorePlayer (screen shot). Note the times on the top of the score - rendered superfluous by the ScorePlayer.
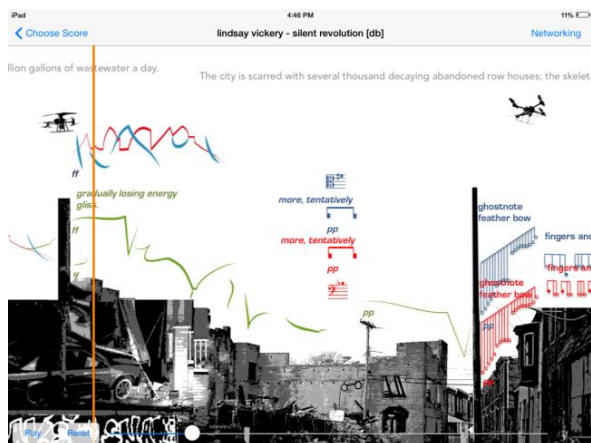

Figure 13. Lindsay Vickery's *Silent Revolution* (screenshot) showing pictorial elements that are not read literally as part of the score.

An interesting development has been the use of pictorial imagery in the scores. Vickery's *Silent Revolution* (2013) includes images that are not 'read' by the musicians as such, but still provide useful information to the interpretation of the notations, as shown in **Figure 13.** These scores have come to be known as 'poctorial'. Hope's 'Miss Fortune X' (2012) uses the photocopy 'noise' from an old copy of a model aircraft plan as notation for radio static, as shown in Figure 14.

A variety of techniques have been engaged to generate the actual scores images - from Computer Assisted Design (CAD) software in Joe Stawarz's *Cells* (2012), coloured pencils in Mace Francis's *When Traffic Rises* (2012) and shades of graphite in Lyndon Blue's *Decabell* (2012). Chris Cobilis's *Forever Alone Together Or* (2012) features freehand text and interspersed with hand drawn colour shapes and written pitch suggestions, as shown in Figure 15.
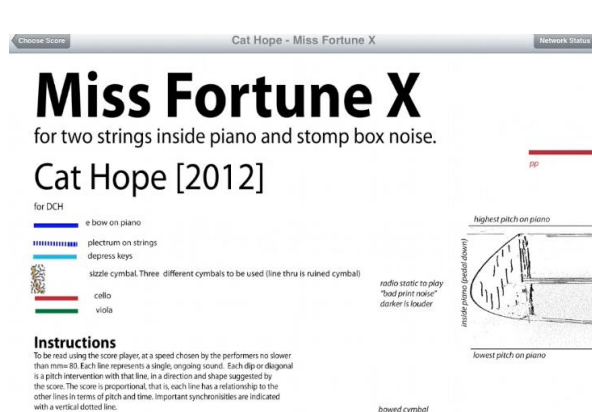

Figure 14. Hope's *Miss Fortune X* score excerpt, (screen shot) showing the first issue Decibel ScorePlayer's welcome screen for the piece. This information was later replaced with an information dropdown tab. Note the copy 'noise' on the right hand side of the image.
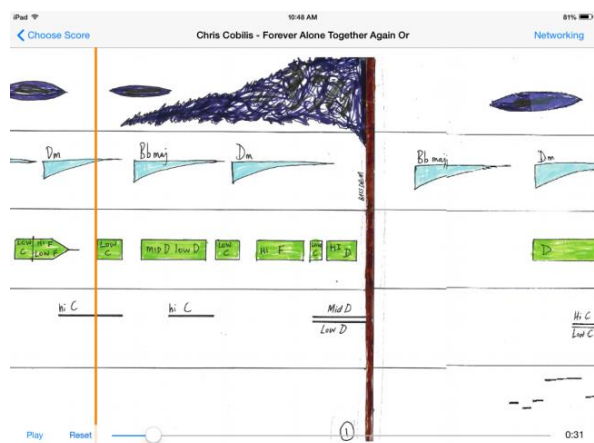

Figure 15. Chris Cobilis *Forever Alone Together Or* score excerpt (screen shot). Showing chords, notes and textural information.

Cobilis is an experimental electronics/singer songwriter who does not read or write traditional notation, and who created a work by recording it on a home recorder then 'drawing it' out over time. His work provides an excellent example of the wide variety of approaches to the design of scores that are featured in the Decibel Score Player, and potential it offers musicians who do not read or write conventional music notation.

ONGOING DEVELOPMENTS

The ScorePlayer paradigm has served as a springboard for other works. Decibel celebrated the centenary year of John Cage's birth by creating a score player for their 'Complete John Cage Variations Project' in 2012. This began as a laptop prototype, but was soon adapted to the iPad as a stand alone App. The score player involved the development of score generators for Variations I, II, III,

IV, V and VI and packaging them with the remaining two Variations into the John Cage Variations App, in consultation with Cage's publishers, Peters Edition, and the John Cage Foundation in New York. Scheduled for release in conjunction with the groups recordings of the eight Variations on US label MODE in 2015, the App takes aspects of the Decibel ScorePlayer and applies them to the Variations, creating graphic scores by following and automating Cage's detailed processes. The result is very accurate and easy to read notations for each of the Variations, an example of which can be found in Figure 16. This example shows the graphic representation selected by Decibel of the data generated according to Cage's specifications around the placement of dots, lines and other shapes.[1] It also shows the similarity of the presentation on the iPad to the Decibel Score Player.
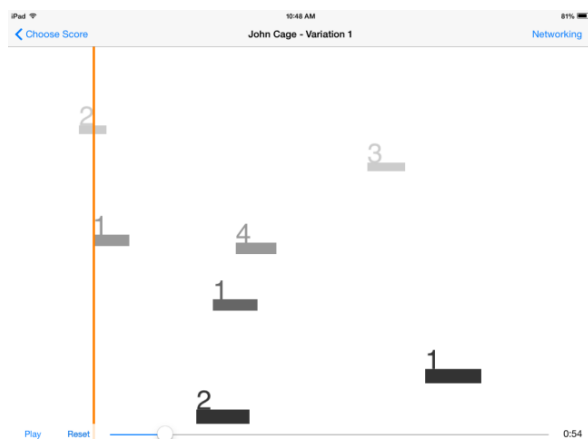

Figure 16. John Cage *Variation 1* score excerpt (screen shot) showing the graphic representation that scrolls in the Decibel 'The Complete John Cage Variations' ScorePlayer.

Australian sound poet Amanda Stewart's *Vice Versa* (2001) is a one-page text for live performances. Decibel adapted the work as a variable scrolling score by typesetting the text in the score player, facilitating reading from different directions, at different times. A range of differently coloured parts are provided, and occasionally text would appear scrubbed over, leaving the instruments to play the resulting shapes. Figure 17 shows the original score in the player, beside and a screen shot of how scrubbed over version. Experiments such as this one highlight the number of ways the simple reading

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[1] A more detailed discussion of the implentatoin and the other Cage Variations can be found in a paper in the 2013 *Malaysian Music Journal* [19] and papers by Lindsay Vickery [20] and Cat Hope [21].

device of the playhead can be used to create readable scores for different kinds of composition.
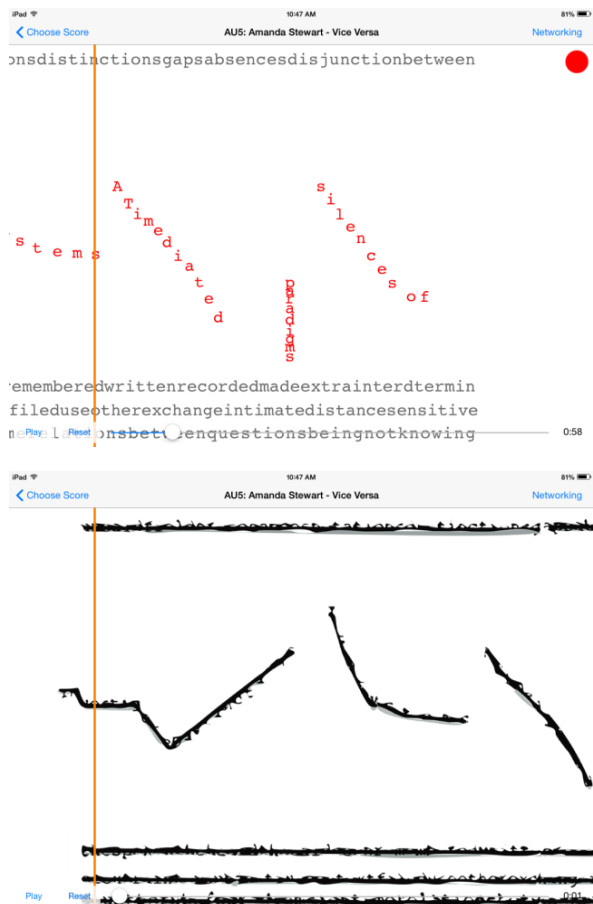

Figure 17. Amanda Stewart's *Viceversa* (excerpt screen shot). The top image shows the score part (a different colour for each performer. The lower image shows the 'scrubbed out' text for instruments to play. The image goes left to right, and right to left in the player.

There are ongoing updates and bug fixes to the Decibel ScorePlayer, but the most recent developments have included the ability to create score files that embed a full quality audio track into the *.dsz* format, opening the possibilities for a huge range of works for instrument and tape that could be adapted for the Decibel ScorePlayer. Vickery created a score player for his 2009 performance of Denis Smalley's piece *Clarinet Threads* (1985) for clarinet and tape that enabled the score to be read accurately alongside playback [22]. Hope's *Signal Directorate* (2014) for bass instrument/s and prerecorded sounds, prototyped in MaxMSP by Vickery, is the first piece to use the iPad ScorePlayer to deliver the score synchronized with audio playback from within the iPad, and contained within the *.dsz* file. The Score Creator will

be updated to enable the most recent facilities enabled by the player. The next release will feature OSC compatibility and extra options for the *Talking Board* circle reading paradigm, allowing users to insert their own image and select the number of circles required for a performance, as shown in Figure 18. OSC will enable the data required to drive the electronics in this piece to be sent to another computer running the audio manipulation software.
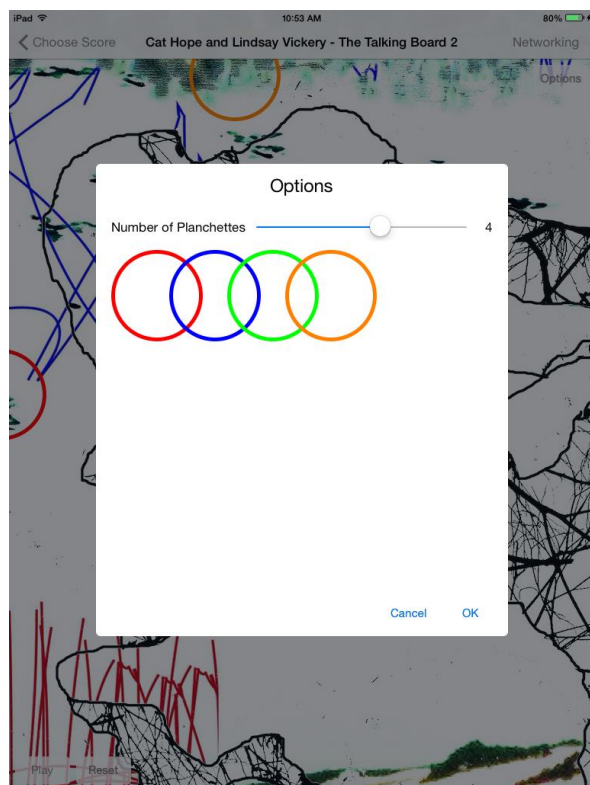

Figure 18. The 'circle selector' for *The Talking Board*, available when pressing the options tab.

In 2012, the first survey of Australian graphic music notation was curated by Cat Hope in two Australian cities, and featured a number of the scores for the scrolling score player presented as movies on a screen in a gallery [23]. These movie representations of scrolling scores are a fixed alternative for the reading of the scores, when a single projection is desirable. Synchronised with a live performance, they can also provide useful illustrations to how the works may be performed. However, in for larger ensembles or more complex parts, it is sometimes difficult to see the required level of detail and no variation of speed is easily possible.

CONCLUSIONS

Without any marketing support other than a few Facebook posts to the DecibelNewMusic page, and showcasing though tours, the Decibel ScorePlayer has sold 140 copies to date at AUD$2.99, not including the free copies the Decibel composers can access for the performances of their works. A visit to Malaysia by Decibel performing the 'John Cage Variations Project' using the bespoke application brought into sharp focus the need to make an Android version of the application, as Android appears to dominate the tablet computer market in large areas of Asia. However, funding for this development is yet to be found.

The potential for the Decibel ScorePlayer is substantial. There has been a recent resurgence of interest in graphic notation with some detailed examinations of practice [24] [25] [26] and an awareness of animated notations disseminated by online services such as YouTube and Vimeo. Yet it is quire remarkable how few of these developments engage with the full potential of digital representation. Further negotiations with publishers could result in a number of approaches for digital publication of extant works, and currently any composer can put their work in the ScorePlayer and publish it.

Research into the impact of reading different kinds of screen scores has recently commenced. Using eye-tracking equipment, Vickery has been comparing traditional paper notations and the different kinds of score formats developed in Decibel [27], leading to detailed examinations of the way readers process colour and movement in music notation.

The Decibel ScorePlayer embraces the possibilities of colour and graphic notations in digital score reproduction, as well as the interactive possibilities inherent in digital score creation and composition. Whilst currently a relatively simple device, the possibilities for its development are considerable. It does not claim to solve problems for all types of graphic notation, but makes certain types more efficient to read. Screen scores are in their infancy, and the way we understand colour and shape as musical information, as well as our ability to process moving information on computer screens requires further investigation [28]. The Decibel ScorePlayer represents the potential of group projects where composers, musicians, programmers and music curators can work together to extend the possibilities of available technologies.

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