

A COMBINATION OF GRAPHIC NOTATION AND MICRO-TONAL PITCH NOTATION IN THE VIDEO SCORE OF THE OPERA “THE CROSS OF THE ENGAGED”

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ABSTRACT

This paper describes a procedure for isolating pitch notation in the environment of a flexible real-time graphic video notation. It aims to combine precise microtonal pitch and the flexible interpretation of other parameters such as rhythm, volume, attack and decay. The procedure was developed and tested in the opera *The Cross of the Engaged*. The pitch is notated exclusively by note heads and accidentals on the lower third of the screen, sometimes supplemented by short written explanations or pictograms. These note heads are linked to a corresponding graphic element on the upper part of the screen by using the same color. Each musician, conductor, director, singer and technician was given a custom-made video file, playable on his or her private laptop or tablet, regardless of operating system or video player app used.

1. INTRODUCTION

1.1 The Opera

In January 2015, the preparations for the microtonal opera *The Cross of the Engaged*¹ began. As the financial means were limited, the rehearsal time with the orchestra had to be reduced to the minimum.

After the development phase, the individual scenes were combined through video editing to a single piece with duration of 1h45.

In the process, some scenes' lengths had to be shortened in collaboration with the director. Similarly, silence was added to other scenes in order to create space for musical development. A score for the orchestra, singers and lighting technicians had to be created before the premiere on the 4th of February 2017, based on the transcription of this video.

After some experiments with different notation systems, real-time graphical notation, playable on tablets and notebooks, had been chosen. This made microtonal notation and complex rhythm readable and more intuitive for

the musicians. Every musician, conductor, director, singers and even the lighting technician received individual scores.

1.2 The Libretto

Nicole Erbe, writer and theatre director at the *Landestheater Neuss* (Germany), was commissioned to write the libretto and later to direct the opera. The topic was given – the libretto is based on a true story:

Marie Solheid and François Reiff are probably the most famous victims of the High Fens, a huge moor area in the Ardennes. In the summer of 1870, during the fair in the village of Jalhay, Belgium, two young people have met. Soon, they were yearning to be wed. In January 1871, Marie and Francois made their way to Xhoffraix, Marie's birth-place, in order to get her marriage papers, but were surprised by a severe snowstorm. Weeks later, on March 22, 1871, the 24-year-old Maria Solheid's body was found.

2. THE COMPOSER

2.1 Previous compositions

The author's first microtonal compositions² included a complex rhythmical structure. When rehearsing, musicians were sometimes overloaded by the sheer amount of information – the double complexity: on one hand the complexity of the rhythm notation, on the other hand the inclusion of the additional accidentals. One possible solution was to search for a possibility to separate rhythm and pitch.

Looking at the compositions of the “classic” pioneers [1] in the field of graphic notation, such as Earle Brown, Sylvano Bussotti, John Cage, Morton Feldman and Roman Haubenstock-Ramati, one notices how often the pitch is notated relatively imprecisely. Often the musician is offered an approximate range. Specifying a precise pitch, of course, was usually not a concern of these composers. The origin is likely that these compositions were mostly intended for the 12-equal temperament. The musicians knew all the sorts of intervals and combinations in this temperament due to lifelong experience.

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¹ *Das Kreuz der Verlobten – Eine Oper.*
<http://www.daskreuzderverlobten.com>

² <http://christianklinkenberg.com/>

Symbol	Inflection	Cents
	- 1/4 tone	-50
 or 	- 1/8 tone	-25
	0	0
	+ 1/8 tone	+25
	+ 1/4 tone	+50

Figure 1. Examples for microtonal accidentals.

However, when starting to work with quarter-tones or even eighth-tones, most musicians can no longer rely on this wealth of experience. In this case, the composer must have a clear way of notating pitch while other parameters might remain in the spirit of “classical” graphic notation.

The notation for the accidentals (Figure 1) used in the opera is inspired by the suggestions for quarter tones from Kurt Stone's book “*Music Notation in the Twentieth Century*” [2], and was combined with up or down arrows for eighth tone deviations.

2.2 Microtones³

Specially designed acoustic instruments based on alternative scales have been constructed in recent years in the recent years. Examples are Stephen Fox's⁴ Bohlen-Pierce clarinet or Stephen Altoft's⁵ 19edo trumpet. Another tendency is the production of instruments that extend the 12-equal temperament with additional flaps and valves⁶ (for wind instruments) or additional frets (for example, for guitars) to quarter, eighth or even twelfth tones. The reason to limit the composition for this project to eighth tones (in consultation with the artistic director of the ensemble) was the collaboration with the *Ensemble 88*⁷, which specializes in contemporary music with standard instruments.

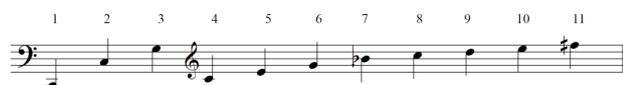


Figure 2. Harmonic series.

The *seventh harmonic* (Figure 3) is lowered by 1 eighth-tone⁸ compared to the twelve-equal temperament and the *eleventh harmonic* (Figure 4) by a quarter-tone [3]. The 2, 3, 5, 9 harmonics (Figure 2) and their multiples are not corrected in comparison to the standard notation in twelve equal temperament, because the difference is closer to the traditional notation than the eighth-tone (25 ¢⁹) or quarter tone deviation (50 ¢). The possibility of the notation of quarter-tones and eighth-tones allows a relatively acceptable approach to the 7th and 11th partials.

Eighth-tones can be produced by means of special microtonal techniques on most traditional instruments.

³ A microtone is an interval smaller than a semitone.

⁴ *Stephen Fox Clarinets*, <http://www.sfoxclarinets.com>

⁵ An example of the microtonal technique for a standard 3-valve trumpet playing eighth-tones can be found on the blog by Donald Bousted and Stephen Altoft, <https://microtonalprojects.com>

⁶ <http://www.21stcenturyoboe.com/>



Figure 3. 7th Harmonic ≈ 31 ¢ flatter than a minor 7th in 12edo¹⁰. Ratio 7/4.



Figure 4. 11th harmonic ≈ 49 ¢ sharper than a fourth in 12edo. Ratio 11/4.

Thus it becomes possible to reproduce approximate intervals from the harmonic series that do not occur in the twelve equal temperament. Some of intervals/ratios (Figure 2) used in the opera are 7/3, 7/4, 7/5, 9/5, 11/7, 11/9.

3. THE PAINTER

3.1 Introduction

Since 2014, the composer and author of this paper Christian Klinkenberg have been working together with the painter Marc Kirschvink¹¹ on the project called “*Partitur*”, intended for a jazz quartet. The musical output was pre-eminently based on intuitive, temporally variable musical interpretations of different elements of a painting. That is, the length of interpretation of individual graphical elements was variable, as was the length of the entire performance. At that time, we were working with individual paintings rather than a series of pictures. Also, the pitch was never specified.

A year later and 4 concerts richer in experience, this collaboration evolved into a part of an opera production. The aspect of improvisation had to be retained, but the temporal aspects and pitches had to be defined.

Real-time video notation with individual versions per instrument was ultimately the result of various experiments with many notation forms. The staves for the pitches ended up being positioned below the common graphic score, which is a series of paintings.

For this opera project the painter Marc Kirschvink was also asked to give final form to the composer's sketches. These sketches were combined in a film score and parts.

⁷ Ensemble 88 is a Limburg (NL)-based musical ensemble for contemporary music, <http://www.ensemble88.nl>

⁸ Rounding up – strictly a 1/6 tone.

⁹ ¢ = cent, the standard semitone can be divided in 100 ¢.

¹⁰ edo = equal division of the octave.

¹¹ *Marc Kirschvink's Website*, <http://www.mkirschvink.com>

3.2 Graphical elements

Under the painting, the lyrics and microtonal pitches in eighth-tone notation were notated in 4 different, easily distinguishable colours: red, green, blue and black.

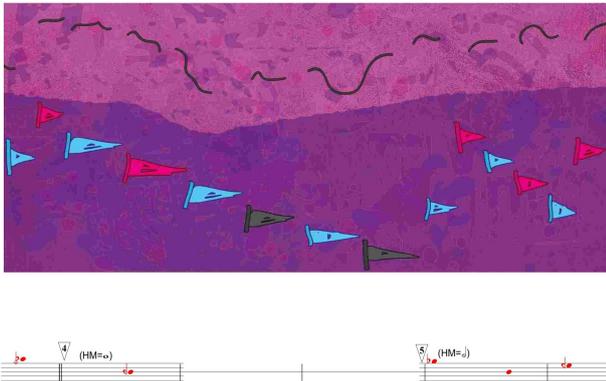


Figure 5. Flute, page 99.

First example: The flute-player (Figure 5) has to play the red graphical symbol. A possible interpretation would be a strong attack followed by a long decrescendo. Other musicians play the blue and black shapes.

Second example: Every musician, in this case the viola (Figure 6) plays his/her individual film score on a tablet or a notebook. Underneath the painting that is common to all, one can see the separate pitch notation that has to be combined with the graphical symbols in the upper painting with the corresponding colour. The viola player has to play the green clouds. As the violin is using this colour as well, both pitches are included for an easier intonation.

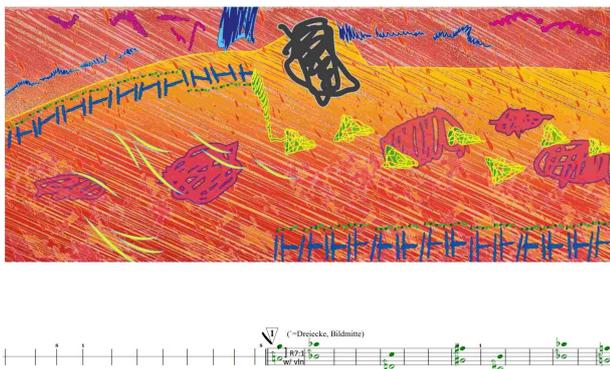


Figure 6. Viola, page 28.

3.3 Tempo and grids

The scrolling in this graphical score runs from right to left. The score length on the sketch paper was 40 cm per page.

¹² Portable Document Format (PDF) is a file format used to present and exchange documents reliably, independent of software, hardware, or operating system.

It takes 40 seconds to perform one page. This is not apparent to the performer, since the individual sheets are connected to each other.

The rhythm can be precisely transferred to a transparency (Figure 7) with the different underlying grids.

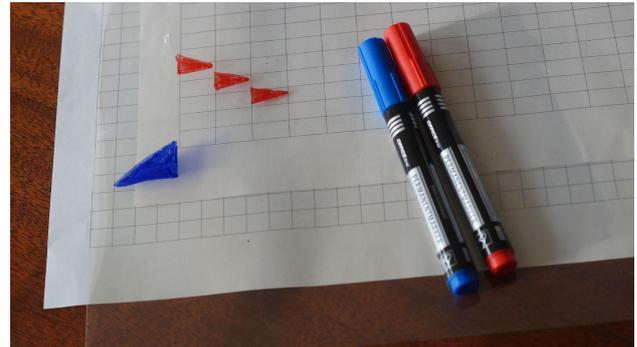


Figure 7. Transparent foil, permanent markers in different colors, grids for 54 and 32 BPM.

3.4 Duties and liberties of the painter

The painter receives the sketches of the composer. The sketch is scanned into the PDF¹² format and the painter can save this sketch as a layer¹³ in his drawing software (in this case a combination of Adobe Acrobat [4], InDesign [5] and Illustrator [6]). After this, he can paint over this sketch in a new layer. The size, the basic colour, the vertical and the horizontal position, the background colour, the basic form and its outline are specified by the composer.

3.4.1 Size

The size must be kept, as it affects the volume parameter.

3.4.2 Color

The basic foreground color (black, red, blue, green) must be adhered to, as the form must be linked with the note on the bottom part of the screen. The basic emotions (anger, disgust, fear, happiness, sadness and surprise) [7], researched by the American psychologist Paul Ekman [8], are used as a basis for the background. These have then been combined with the psychology of colors. In Figure 5 the background is colored in violet. "Violet" stands for a depressed situation. In Figure 6 the background is colored in red. "Red" stands for anger and passion.

However, the painter has the opportunity to adapt the color tone and the graphic design to his pictorial composition and to the background.

3.4.3 Positioning

The vertical and horizontal position must be adhered to, since the temporal aspect of the note is important in terms of composition.

¹³ <https://helpx.adobe.com/illustrator/using/layers.html>

3.4.4 Form

The basic form (triangle, square, circle, cloud, funnel ...) must be respected by the painter, but the design is left to him. For example, within the size, the painter can creatively form the shape of the cloud.

3.4.5 Outline

The composer gives the outlines. For example, wavy, jagged, round, straight. However, the painter also has creative freedom to a certain extent: Shape of the waves, regularity, irregularity or thickness of the outline.

3.4.6 Filling

The painter can choose the filling of the form. For example, the default may be “restless” or “fluent” (added to the sketch in writing). The painter can freely choose the design of these fillings.

3.4.7 Background

The composer gives the background colour, as the background can change the character of the music. This way, through the background colour selection, the musical scene becomes “agitated” or “graceful” – without the composer's notions such as “agitato” or “grazioso”. In addition to the colour selection, the background design chosen by the painter (large dots, lines, blurred shapes...) can influence the musical character as well.

3.5 Mutual enrichment

The influence of the painter on the musical output is significant. The mood is completely changed with only small graphical variations. There are possibilities of influencing the tone colour, shape variation, outlines and filling. An example: the strings change the style of their playing according to the intensity of the form in the graphic. So the painter can to a certain degree influence whether the strings ultimately play “arco”, “pizzicato”, “tremolo”, “sul tasto” or “sul ponticello”. It would be an interesting experiment to explore the musical output from the work of another painter using the same composer's sketches. Apart from that, the overall visual impression is much more appealing, compared to composer's rough sketches.

4. SIMILAR APPROACHES

Only a few months after the premiere of the opera, the composer learned about a software called *Decibel ScorePlayer*¹⁴. It is interesting to see how many similar solutions have been found: screen scrolling from left to right, vertical line indicating position, possibility of relative pitch by vertical arrangement, etc. [9]

In the opera, the vertical line was intended only for the conductor, not for the musicians. In this way, the conductor was able to detach himself from this line as needed. This was necessary, especially because the singers/actors

had to play freely and therefore did not have the screen with the video score while singing.

A big advantage of the *Decibel ScorePlayer* is the synchronization of the scores over a network connection. This means that all musicians always see exactly the same time window. In the opera, the conductor counted at the beginning and all musicians had to press “play” simultaneously. An exact synchronization can of course not be guaranteed in this way. However, it did not cause problems in this case, as the conductor conducted with numbered hand signals.

Knowing about *Decibel ScorePlayer* would probably have significantly influenced the development of this project. Individual solutions, such as the isolation of the pitch might not have been found.

A disadvantage of *Decibel ScorePlayer* is the binding to Apple. This would have already been a deal-breaker for this project because of budgetary restrictions. The musicians are forced to use a single vendor's hardware exclusively. Also, the painter could not create the entire composition on canvas as was the case with the software of his choice.

5. THE PERSPECTIVE OF THE MUSICIANS

After initial difficulties, the musicians (Figure 8) quickly got used to this alternative notation system. Of course, some musicians are alienated by the world of computers. Another negative point was the unreliability of computers as opposed to notes on paper. At the concerts there were several crashes of individual computers. For this reason, a replacement computer was provided (Figure 9). It included all scores. It was observed that the sections in the composition, which had a stronger rhythmic impetus, were difficult to coordinate. Intricate rhythmic writing is probably not best suited for this style of notation.



Figure 8. The premiere, beginning of the second part.

However, there are a lot of advantages: Different tempos can be performed concurrently and the music is understandable even to non-musicians: the lighting technician got his own score, which did not require any knowledge of music notation, but it still allowed a comprehension of the scenic and musical events.

¹⁴<http://www.decibelnewmusic.com/decibel-scoreplayer.html>



Figure 9. One rescue-notebook is placed on the scene for safety. With so much electronics involved there is a higher probability of failure.

A very positive aspect was the possibility of improvisation. The musicians interpreted some graphic symbols in very different ways during the 5 performances. On the other side, the lack of possibility to make notes (e.g. conductor's remarks) on the score was a common complaint.

6. THE CONDUCTOR

Apart from the conductor, none of the musicians and singers received a fixed positional reference on the screen. The conductor received a vertical black line (Figure 10) on his score, which would not change its position during the play. Thus, the conductor could act freely within the score in a range of 40 seconds. There is always a possibility that the singers in certain places "wander" too far in advance, or they may lag behind in other places. Similar to Lutosławski in his *3rd Symphony*, 5 numbers were used in connection with the finger marks. These are hand signals from numbers 1-5, in which the respective number of fingers is shown. The numbers are notated in the middle of a downward pointing triangle. Kurt Stone also proposes this solution, which is quite similar to the subject of video notation, in the context of *Proportional Notation* in his book. This way the director is able to tell or show the musicians where on the screen he wants them to be at this moment. This is especially important in free passages.

7. THE SOFTWARE

*Finale*¹⁵ was used as a notation software for the lower part of the score. The individual line for every musician involved was placed under the painting.

The paintings were transformed into high resolution JPG¹⁶ files, so they could later be incorporated in a slideshow (Figure 11) with *Adobe Premiere Pro*¹⁷.

The painting was in 16:7.5 format and the score in 16:2.5 format. Afterwards the movies could then be rendered in 720p resolution.

Figure 10. Page 52 of the score: The conductor has a vertical black line on his score and finger-numbering marks are indicated.

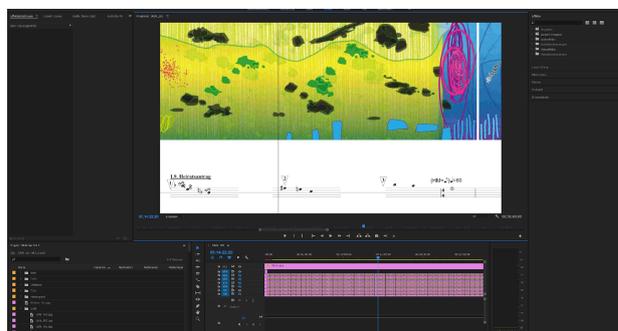


Figure 11. In *Adobe Premiere Pro* all JPG files had been imported: on top is the painting that is common to all the parts, on the bottom are the individual pages from *Finale* (exported to PDF and converted to JPG).

¹⁵ <https://www.finalemusic.com/>.

¹⁶ JPEG is a common format for lossy compression of digital images.

¹⁷ Video editing software [10].

8. CONCLUSION

8.1 The score

The main reason for the graphic notation was the isolation of pitch from the other parameters. This has succeeded in any case. The pitch is easily readable despite many additional accidentals. Unfortunately, structured fast rhythms are easier to read using traditional notation. This implies that the composer must adapt his music to the notation method.

8.2 Outlook

A composition in the alternative tuning system Bohlen-Pierce¹⁸ is planned for the 27th of April 2018. Unlike the 12edo, the repeating frame is not formed by an octave, but by a tritave¹⁹. This tritave is divided into 13 steps. The result is an alternative scale that opens new possibilities to music. For this reason, the musicians have specially constructed instruments (clarinet, keyboard, chimes). The string instruments (e-guitar, bass, and violin) also need to retune their strings and have to increase the spacing of the fingerings or frets by about half.

The use of a characteristic alternative temperament such as Bohlen-Pierce opens the doors to a interpretation of the intervals that has more freedom compared to “classical” graphic compositions, as mentioned at the beginning of this paper. It is quite similar to a guided improvisation. The lower note head would not always be necessary. The use of eighth-tones, as in the opera is an extension of 12edo. Compared to improvising in systems like Bohlen-Pierce, the combinatory possibilities of the intervals are almost too many.

Since this graphic notation requires no prior musical knowledge, it is possible to integrate the audience into the performance via a projection. This is made possible by a web app for smartphones or tablets (Figure 13). The spectators will interact proactively with the orchestra by reading the projected symbols.

A second opera is planned for November 2019, combining various systems like 19edo, 48edo and Bohlen-Pierce [10] (Figure 12).

8.3 Considerations for improvement

8.3.1 Synchronization

In the open-source software *syncplay*²⁰ there is the possibility of cross-system synchronization of video players such as VLC²¹ or MPV²² over network.

8.3.2 Alternative to the connection through colors

Unfortunately, colorblind people are disempowered by the combination of the music heads and graphic elements. One approach would be to highlight the linked graphical elements and to blur the remaining elements.



Figure 12. For the next opera project (2019), three micro-tonal keyboards have been built. From top to bottom: A Bohlen-Pierce keyboard in Lambda mode; a 19edo-keyboard (yellow: C, black C#, silver Db, white D, black D#, silver Eb, white E, ...); and The Bohlen-Pierce Keyboard in Dur II-Mode.

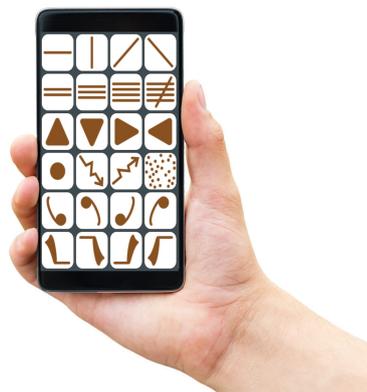


Figure 13. Web app for smartphones. Spectators can press on different symbols to send commands to live electronics during performances.

8.3.3 Clearer indications of rests

As a pictogram to indicate that the colour connection (e.g. black) is over, the scissor-symbol was chosen. Sometimes, however, the musician overlooked this symbol. This means that the musicians combined the previous sound with the coming symbols of the same colour that were not intended for them. An alternative would be to hide the staves in the parts where the musicians should not play.

Acknowledgments

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¹⁸ The Bohlen-Pierce Site. <http://www.huygens-fokker.org/bpsite>.

¹⁹ perfect twelfth.

²⁰ <https://syncplay.pl>

²¹ www.videolan.org

²² www.mpv.io

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