

EXPERIENCES OF COMBINING THE RADIO BATON WITH THE DIRECTOR MUSICES PERFORMANCE GRAMMAR

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Abstract

The Radio Baton is a sequencer system developed by co-author MVM. It allows real-time control of tempo and sound level via radio transmitters mounted in the conductor's batons. The trigger impulse for beats is generated either when one of the two batons passes through a plane at an adjustable distance from a pad or by the baton's change of direction of movement. Sound level can be controlled by the position of other baton along the y-axis of the pad. The system has recently been complemented by processing the music programmed into the sequencer by the KTH Director Musices grammar for music performance. This program induces variations of tone duration and loudness and inserts micropauses and accents depending on the musical context. The system has been used in various performances over the last year. Experiences from these occasions will be reported.

1 Introduction

The Radio Baton (RB) is a sequencer system developed by Max Mathews and associates (Boulanger & Mathews, 1997). It is provided with two batons. One of them allows the conductor to control the beat tempo by means of a baton provided with a radio transmitter. The position of the transmitter is traced by receiver system in a pad against which the baton is beaten. The system can be adjusted such that trigger impulses to the sequencer are produced either as the baton cuts through a plane at an adjustable distance above the pad plane or as the direction of baton movement changes from downward to upward. The other baton controls the sound level in terms of the position of the baton along the y-axis on the plate plane. Thus, the system allows the user to conduct any piece of music stored in the computer memory. It has been used in many concerts.

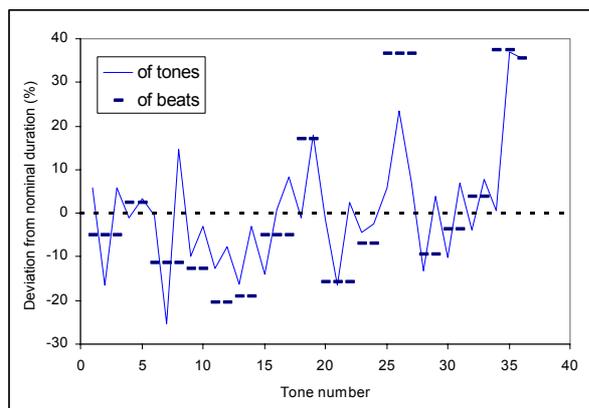
While the RB system allows the conductor to control the beat frequency in a performance, it fails to produce some of the expressive deviations from what nominally is written in the music score that musicians typically make in a performance. Thus, as shown by Gabrielsson and others (see e.g., Gabrielsson, 1987), the expressive deviations from nominal durations occur not only at the beat level, but also at lower levels. Figure 1 shows an example.

These findings support the assumption that in an ensemble, the expressive deviations from nominal durations have two origins. One is the tempo given by the conductor in terms of movements. The other is the musical judgement of the individual musicians.

Expressive deviations are not limited to the duration of individual notes. They also concern other parameters, such as loudness and micropauses. For example, musical phrases are marked not only by minor tempo changes (Todd, 1985) but also by introducing a short pause after the final tone of a phrase. The RB system is unable to generate such deviations.

Director Musices (DM) is a generative grammar of music performance that automatically introduces expressive deviations depending on the musical context as defined by the score (Friberg, Colombo, Frydén and Sundberg, 2000; Friberg, 1995). For example, the program introduces phrase markers in terms of tempo changes and micropauses similar to those that musicians would do in a performance. Also, it introduces lengthenings and shortenings of tones, adds accents, and variations of sound level. Hence it seemed likely that it would be worthwhile to combine the RB system with the DM performance grammar.

Figure 1. Example of deviations from nominal duration at the beat and tone levels in a performance of W A Mozart's Piano sonata in A major, K 331. Data adapted from Gabriellson (1987)



The aim of the present set of experiments was to explore this combination on a set of compositions. The combination was tested under conditions similar to those of a concert.

2 Material

The combination has explored in seven pieces for solo and ensemble:

Second movement from CP Bach's *Piano Concerto op 7:1*,

Aria *Et exultavit* from *Magnificat*, BWV 243, by J S Bach.

Azerbaijan love song from Luciano Berio's *Folksongs*,

Second movement of W A Mozart's *Piano Concerto in G major*, K 453,

Et incarnatus movement from WA Mozart's *Coronation Mass* in C major, K 317

Cavatina *Porgi amor* of the Contessa in act II of WA Mozart's *Il nozze di Figaro*, K 492

Rosina's Cavatina from Giacomo Rossini's *Il barbiere di Seviglia*,

3 Procedure

The *first* step was to write the score into the score editor program Encore and then to save it as a midi file. Some of the pieces were available as midi files on the Internet and could hence be downloaded directly. These files needed to be checked for errors in the encore program. The *second* step was to convert the midi files into the mus-file format used in the DM environment program. As some performance rules in the DM program are triggered by phrase and chord symbols, such symbols were hand edited into the mus-files. Moreover, an extra voice was added to the score containing the notes used as triggers by the

RB system. This trigger voice was automatically created by a new tool in DM. Figure 2 shows an example of the complete score as shown in the DM system. Also, the instrumentation was decided using the DM synthesizer control window, see Figure 3. The *third* step was to have the DM system generate a performance of the piece that was saved as a midi file and transferred to the RB system. The *fourth* step, finally, was to compile the file in the Conductor program in the RB system. The Roland 1010 synthesizer module with the Orchestral II expansion board was used as synthesizer.

For the realisation of arpeggios in the Berio piece a straightforward principle was used, simply dividing the available note value by the number of notes in the arpeggio. For example, if an arpeggio comprised 7 notes to be played during an eight note, each arpeggio note was given the duration of $1/8 * 7 = 1/56$, a truly odd note value. Yet, this strategy yielded a convincing realisation of arpeggios.

4 Experiences

The preparation of the score was rather time consuming. In the conversion of files from the midi to the mus-format errors tended to occur that needed hand editing. In addition, this conversion introduced pauses extending over bar lines, which was incompatible with the introduction of chord and phrase symbols. Therefore, such pauses needed to be edited such that each bar in all voices started either with a note or a pause. This hand editing of the score consumed a good deal of the time needed for generating a RB file. Thus, the current MIDI reader in DM was not particularly suited for this task and should be modified for future work.

A large set of performance rules in the DM system was used as a starting point, see Figure 4. As expected, the choice of performance rules was critical. We first included all rules of potential relevance, however excluding the Final Ritard and the Phrasing rules, since these rules produce tempo changes that are likely to be controlled by the conductor's timing of beats. From the result we noted that the application of rules affecting tone duration caused difficulties in the control of beats in the RB performance. A possible reason for this was that the interaction between the rule-induced variations and the variations by the conductor made the prediction of the tempo in the RB less precise. Further refinement of the tempo prediction algorithm might allow a larger rule-induced variation. We therefore had to reduce most of the temporal effects, thus mostly limiting the effects to sound level variation and micropauses.

The differences in conducting an ensemble and conducting the RB are important. Conducting the RB requires precise baton movements, void of all expressivity that is an essential part in conducting an

ensemble. The skills needed for handling the RB seemed somewhat more similar to those of a percussionist than to those of a conductor. It was also somewhat difficult to reduce the sensitivity of the RB system to imprecision in the beating. On some occasions a minute oscillation of the baton caused double trigger pulses, such that one beat was skipped in the performance.

The synthesizer was a weak link, as might be expected. While the woodwinds sounded quite natural the quality of the bowed instrument possessed an unnatural sound quality. The overall quality of the ensemble was, however, significantly improved by adding reverberation.

complemented the regular loudspeakers with two special speakers provided with electrically excited soundboards instead of the paper cones; this improved the quality of the synthesizer sound somewhat.

The movements from the *Piano Concertos* by Mozart and by CP Bach and the two arias by Mozart were performed by different soloists and conducted by **Gerald Bennett** or **Max Mathews** in demonstrations at different music conservatories in Switzerland and Austria

The image shows a screenshot of a music score software interface. The window title is "Score". At the top left, it says "Start time (ms) 0". The score is displayed on multiple staves, each labeled with an instrument: Solo, Molin I, Molin II, Viola, Continuo, Bass, Kontrabaß, and Radio-bar. Each staff has a "bar" and "phrase-end" indicator at the bottom. Numbers in parentheses are placed below the staves, indicating the location and level of phrase endings. For example, on the Molin I staff, there are numbers like 13(6), 14, 15, 16, and 21(6). The interface also includes a control bar at the bottom with zoom options for the y-axis and x-axis, a "Show Vars.." button, a checked checkbox for "x-axis: ndr (dr)", and a "Redraw" button.

Figure 2. Score as shown in the DM system of the *Et exultavit* aria. Numbers in parentheses indicate the location and the level of phrase endings. Chord symbols are not included.

(see <http://www.hmt.edu/musik/index.html?zfh/forschung-uebersicht.php>).

The aria from J S Bach's *Magnificat* has been tried only under studio conditions so far.

5 Performances

Berio's *Azerbaijan love song* and Rossini's *Rosina's Cavatina* were both performed by soprano **Malena Ernman** and conductor **Jan Risberg** at the Opening Session of the 4th Pan-European Voice Conference in Stockholm, August 23, 2001. The result can be seen in the video recordings that were made on this occasion. During this performance we

6 Conclusions

The experiences of combining the RB and the DM systems are overall promising, although the procedures for conversion between the different file formats would profit from some improvement. The system should be useful in music education where students and their teachers would prefer to practise solo parts together with a sound similar to an ensemble rather than with a piano transcription.

Type	Active	Name	Instrument type	Synth	Channel	Program	Volume	Delay
Mono-Track	<input checked="" type="checkbox"/>	Solo	String	Roland-PMA5	2	80 Ocarina	0	0
Mono-Track	<input checked="" type="checkbox"/>	Violin I	String	Roland-PMA5	3	74 Flute	0	0
Mono-Track	<input checked="" type="checkbox"/>	Violin II	String	Roland-PMA5	4	74 Flute	0	0
Mono-Track	<input checked="" type="checkbox"/>	Viola	String	Roland-PMA5	5	70 EnglishHorn	0	0
Mono-Track	<input checked="" type="checkbox"/>	Continuo	String	Roland-PMA5	6	7 Harpschord	-8	0
Mono-Track	<input checked="" type="checkbox"/>	Bass	String	Roland-PMA5	7	71 Bassoon	0	0
Mono-Track	<input checked="" type="checkbox"/>	Kontrabass	String	Roland-PMA5	8	44 Contrabass	-40	0
Mono-Track	<input checked="" type="checkbox"/>	Radio-baton-tracl	String	Pinnacle	1	1 Acou Grand Pian	-40	0

Figure 3. Instrumentation panel for the aria *Et exultavit* in the DM system, allowing adjustment of overall loudness and delay of the various instruments within the ensemble. The delay option was not used.

Play performed	1.5	0	High-Loud
Play nominal	1.5	0	Melodic-Charge :Amp 1 :Dur 1 :Vibamp 0
Init&Apply	2.0	0	Harmonic-Charge :Amp 1 :Dur 1 :Vibfreq 0
Apply	0.0	0	Chromatic-Charge
Scale: 1.5	0.3	0	Faster-Uphill
Save as..	0.5	0	Leap-Tone-Duration
<input type="checkbox"/> log to file	1.5	0	Leap-Articulation-Dro
<input type="checkbox"/> log to score	1.0	0	Repetition-Articulation-Dro
<input type="radio"/> No-Sync	0.3	0	Duration-Contrast :Amp 1 :Dur 1
<input type="radio"/> Melodic-Sync	1.0	0	Score-Staccato-Art
<input checked="" type="radio"/> Simple-Mel-Sy	1.0	0	Double-Duration
	1.0	0	Social-Duration-Care
	1.5	0	Punctuation :Dur 1 :Duroff 1 :Markphlevel 7 Nil
	0.0	0	Phrase-Articulation :Phlevel 5 :Subphlevel 6 :Dur 1 :Dur
	0.0	0	Phrase-Arch :Phlevel 7 :Power 2 :Amp 1 :Next 1 :2next 1
			<input type="checkbox"/> Normalize-Sl
			<input type="checkbox"/> Normalize-Dr
			<input checked="" type="checkbox"/> Normalize-Dr-Bar
	0.4	0	Final-Ritard :Q 3

Figure 4. Rule panel of the DM rules allowing adjustment of the magnitude of the effects of the various rules on the performance. Thus, slider positioned at the center implies that the rule is disengaged, a position to the right or to the left of the mid point produces the normal and the inverted effect, respectively. For instance, the rule High-Sharp, which sharpens intonation of tones as a function of their pitches, will produce such sharpening if the slider is right of the mid point, and a flattening if positioned to the left of the mid point. The magnitude values for the various rules are shown in the white windows to the left of the rule sliders. The panel shown was used for Rosina's Cavatina.

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