Lessons from Experienced Gestural Controller Users

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Abstract

Gestural controllers in the musical arts provide a unique perspective on human-computer interaction. Given the novelty of the field, there is little research into the long term usage of gestural controllers. In the course of comparing the Buchla Lightning and the Mathews Radio Baton, the authors questioned users of these interfaces with over 10 years experience. The answers can help performers understand the implications of using gestural controllers, as well as designers who are interested in the long term usage patterns of their interfaces.

1. Introduction

With the rise of inexpensive and powerful computers, sensors, and digital sound synthesis implementations, it is easier to build new digital music instruments (DMI's), and subsequently many have [10] [11]. As a result of all these new designs, the task of evaluating and comparing them has arisen [12] [6]. This is a necessary step if it is hoped that designers and performers will build on the existing corpus of DMI research to help build engaging enactive interfaces for music.

Given the complex relationship between the performer and the instrument [5], it is no wonder that the problem has been approached from a variety of angles. Several visual taxonomies have been presented based on earlier work in Human-Computer Interaction (HCI). Wanderley and Orio [12] presented an overview of these taxonomies,as well as presenting feature sets and evaluation tasks for comparison, and the idea of musical contexts first discussed in Wessel and Wright [13].

In an effort to further the discussion, the authors chose two controllers, the Buchla Lightning II and the Mathews' Radio Baton, for a case study in interface comparison. The entire study entails three parts: a comparison of the technical specifications of each controller, the responses of long term users to a questionnaire regarding their usage patterns, and the motion capture of
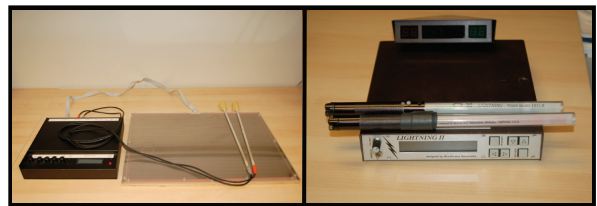

Figure 1: Radio Baton (left) and Lightning II (right)

performances using these controllers. This paper details results from the first two parts.

2. History of the Controllers

The following section gives a background on the controllers to better situate them in the user responses. Figure 1 shows both controllers. Figure 2 shows a modified dimension space [1] so as to quickly highlight the major technical differences.

2.1. Buchla Lightning II

The Lightning was developed in the late 1980s along with three other prototypes called Wind, Rain, and Thunder: of these, it was the only one to go into production. The prototypes were a response to what Buchla felt was a lack of original MIDI controllers on the market [4]. The Lightning II triangulates the infrared signals from handheld wireless 'wands' providing a large 2D (x and z) area for the user to freely gesticulate within. It is going through its third revision and is marketed through Buchla and Associates [1]

2.2. Mathews Radio Baton

The Radio Baton is the culmination of a number of drum-inspired controllers by Mathews, including the Daton and the Sequential Drum [8] [9]. The Radio Baton was created using a variant of capacitive sensing
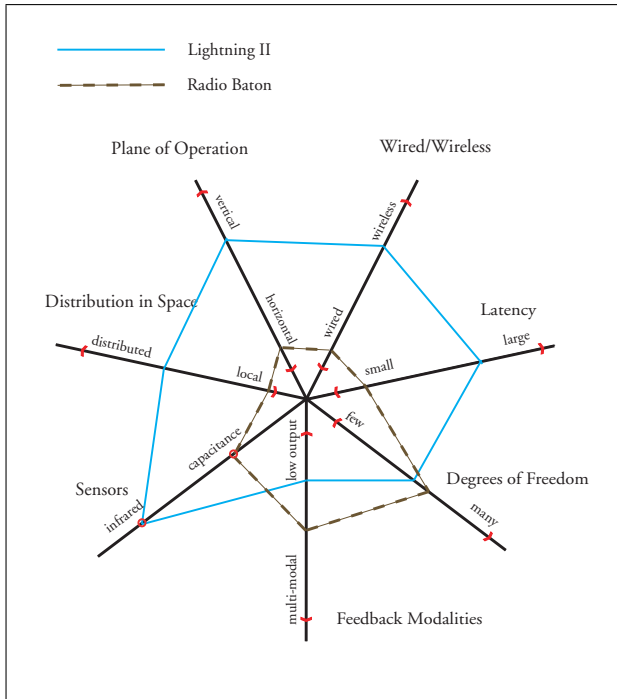
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[1]www.buchla.com/lightning

Figure 2: Radio Baton and Lightning II plotted on a dimension space [1] so as to clearly contrast their technical characteristics.

developed by Bob Boie at AT&T Labs in the late 1980s. Using five electrodes over the surface of a square plate, two wired antennas that resemble batons would increase the capacitance value when near an electrode. The differences between electrode capacitive values are used to deduce the xyz position of each baton [2]. It has been used in over 40 pieces [3] and is marketed by MarMax [2].

3. Long Term User Responses

In order to get a sense of usage over time, questionnaires were sent out to the known professional users of each controller, whiched totaled under ten. Five questionnaires were received, three from Lightning users and two from Radio Baton users. This small set of responses is to be expected when so few are known to play the instruments under study. The questions and resulting answers were informal in nature thus contributing an important qualitative aspect to the present study. Each question and response is reported in the following tables. Answers have been paraphrased for presentation. Performers 1-5 correspond respectively to the three Lightning users and the two Radio Baton users.

The amount of experience amongst the respondents shown in **Table 1** is noteworthy. It has been proposed that over 10 years of formal training on a particular

Table 1: **Experience**
How long have you been using the Lightning/Radio Baton?

1	14 years
2	15 years
3	15 years
4	20 years
5	20 years

acoustic instrument qualifies a musician as an expert [7]. While there is no formal pedagogy for gestural controllers, the ability to become an expert user of these devices given time should be assumed, in the same way as race car drivers are assumed to be more skilled drivers than the average.

Table 2: **Usage**
What were some of your favorite uses of the Lightning/Radio Baton?

1	solo performance, accompaniment of dancers
2	performance of compositions for Lightning, accompaniment of silent films, children's theatre, medical rehabilitation
3	solo performance, as part of jazz ensemble, score-following, conducting, spatialization
4	performance of compositions for Radio Baton w/ voice, orchestra, manipulation of video, spatialization
5	performance of compositions for Radio Baton, improvisation with acoustic instrument musicians, as part of world music ensemble

The responses to the question in **Table 2** seem to indicate that the controllers are extremely adaptable to as many different music performance settings as established acoustic instruments are, (and some that acoustic instruments cannot be used in, such as the manipulation of video media). Also evident in the answers is that many opportunities to perform arose almost solely from the novelty of the controllers, the "shiny new gadget" phenomenon. For example, Performer 3 was approached to perform for millenium celebrations in Times Square, New York for what he supposes was this reason. The novelty aspect also had drawbacks: Performer 1 recalls a dance accompaniment performance where the program notes did not specify his usage of the Lightning. As a result, the audience perceived the movements as dance-oriented rather than those of a music instrument performance. Designers would do well to use the novelty of their designs as a means to reach potential performers while being aware that audiences are not as comfortable with new interfaces as with traditional instumentation.

Almost all respondents are either percussionists, pi-

Table 3: **Musical Education**

Do you play any other instruments, acoustic or electric? How has this informed your performance/compositional technique regarding the Lightning/Radio Baton?

1	acoustic mallet percussion, movement training in theatre/circus skills
2	piano, percussion
3	piano, conducting
4	guitar, trumpet, piano, voice, dataglove, theremin, laptop
5	percussion

anists, and/or conductors and admit their approach to these percussion-inspired interfaces owes a great deal to their acoustic instrument training. Performer 2 finds that "realizing when (and when NOT) the gestural repertoire of the Lightning fits percussive technique and sounds sent me off on a path of exploration that continues today". Performer 5's percussion training has raised his expectations of the performance behaviour of the Radio Baton in terms of strike latencies. Performer 1 recognizes that the emphasis in mallet percussion on proper mallet placement in space has influenced his approach to the Lighting. He also mentions the theatrical nature of playing the Lightning. Finally, Performer 4 notes that musicality can be transferred: "the more musical you are, the more musical your music and your performance of ANY instrument". Contrasting these answers with those from **Table 2** suggests acoustic musicians can take enactive interfaces beyond their usual performance settings, all the while drawing on their acoustic instrument training.

Table 4: **Role**

What role have you played in the development of the Lightning/Radio Baton?

1	Lightning I repairs, primary technician for beta-testing, preset development, soldering and assembly of Lightning II, circuit board layout for Lightning III
2	none
3	none
4	composer/collaborator
5	none

Regarding the answers in **Table 4**, although only Performer 1 explicitly worked on the development of these interfaces, all respondents had close relationships with the controller designers. Performer 2 eventually collaborated with the Don Buchla to build other controllers and Performer 3 had several conversations with Buchla about possible design improvements to the Lightning. Performer 4 has worked closely with Max Matthews; his "musical use of the system influenced the design of the hardware and the features of the software." It is interesting to ask whether being in close contact with the designer kept the musicians motivated to continue using the interfaces.

Table 5: **Approach**

Do you approach the Lightning/Radio Baton as an instrument or a controller?

1	both
2	instrument
3	gestural controller
4	instrument
5	both

The answers to this question can be viewed from two perspectives. The first revolves around the nature of a gestural controller in the schema of a DMI. In Performer 2's own words:

"A controller is a device that transduces a physical gesture to a defined control signal. The signal is then sent to some sound-producing apparatus. A musical instrument is...a device or system...for real time musical performance... concerned with expressive and reliably repeatable control of...musical parameters."

In this sense, Performers 2 and 3 utilize the sound engine of the Lightning with its mapping abilities in many of their performances and therefore use it as an instrument. It is impossible to do so with the Radio Baton as it does not have it's own sound engine, thereby rendering it a gestural controller by default. Performer 4 substantiates this by mentioning "the Radio Baton is what turns my laptop into a musical instrument."

The second perspective is more philosophical in nature involving the question of when does a gestural controller become a musical instrument. Performer 1 feels the Lightning is "a controller that only becomes an instrument after a lot of practice". This is echoed by Performer 2's remark that "almost anything can be an instrument in the hands of an accomplished player". This would seem to support the claims regarding expertise in [7] in which time spent practicing is essential. However, Performer 5 approaches these terms as states of operation which can be intermingled in a performance: "I use it in both modes, sometimes simultaneously and always jumping from one mode to the other. To me it would not be worth playing if it couldn't occupy both roles."

For Performer 2, each different mapping scheme creates a new instrument. As evidenced in the responses in **Table 6**, these interfaces can take the (conceptual) form of many existing and novel control paradigms which do indeed resemble completely different performance practices. From Performer 4 "It is NOT a percussion controller - that limits its function, subtlety, and role to

Table 6: **Mapping**

What have been some of the more successful mapping strategies you have employed with the Lightning/Radio Baton? Do you find certain paradigms or mapping strategies more easily 'fit', for example as a percussion controller or "an expressive tape player"?

1	virtual conductor, mallet keyboard, large drums, diatonic scales played with horizontal movement and button switch, use and tuning of sound engine presets
2	percussion controller, control of continous parameters spatially, piano controller, layers, use and tuning of sound engine presets
3	virtual conductor, max patches and external synths
4	conductor, soloist, improvisor, timbre sculpting, note-based, remixing, spatialization, triggering
5	flying over surface to trigger events, image/video controller

something too primitive and simple. The construction does influence its perception, but not it's use or potential."

Table 7: **Modifications**

Is there anything you would change (or have changed) about the Lightning/Radio Baton in terms of ergonomics, technical performance, etc.?

1	**Would change**: strike latency time of 40 ms
2	**Would change**: software for editing presets, wireless connection between head and sound engine, haptic feedback in wands
3	**Would change**: sensing of wand position in all 3 dimensions, more ergonomic wand grip, change wand to one resembling conductor baton
4	**Have changed**: software has allowed for all necessary changes
5	**Have changed**: foam moved to surface, batons changed to modified drum sticks, computer interface through audio interface

The changes proposed by the Lightning users shown in **Table 7** run the gamut between performance, usability, and ergonomic improvements. Performer 5 has improved the Radio Baton such that he satisfied with the performance of it. His main problem now is just to "create sounds that are vivid and malleable". Performer 2 has invented his own notation for scoring his Lightning performances, as well as a symbolic notation for modifying and creating presets on paper.

4. Conclusions

Several interesting points seem to emerge from the responses. It is evident that gestural controllers can be designed well enough to sustain the interest of musicians. Given access to the designer, the musician will suggest design changes or even undertake the changes themselves, thereby prolonging the life of the controller.

Also, there seems to be a correlation between the physical interface of these controllers and the acoustic musicians it attracted. As the sample for this questionnaire is much too small to make any large generalizations, it is still noteworthy that percussionists and conductors were drawn to baton-based interfaces. Also, this did not limit the performance contexts in which they were used. Respondents included many different types of performance contexts including video and spatialization control.

Mapping is at at least as important to musicians as the physical interface, and even more so over the long term. Using a different mapping strategy results in a new control paradigm to explore. This ability to change such an elemental part of the instrument seems to be part of the appeal of this type of musical interface.

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