Proceedings of the Stockholm Music Acoustics Conference, August 6-9, 2003 (SMAC 03), Stockholm, Sweden

THE RADIO BATON AS CONFIGURABLE MUSICAL INSTRUMENT AND CONTROLLER

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ABSTRACT

The Max Mathews' Radio Baton (RB) has usually been applied as an orchestra conducting system, as interactive music composition controller using typical percussionist gestures, and as a controller for sound synthesis models. In the framework of the Sounding Object EU founded project, the RB has found new applications scenarios. Three applications were based on this controller. This was achieved by changing the gesture controls. Instead of the default batons, a new radio transmitter based on a thimble that fits the fingertips was developed. This new transmitter allows musicians' interaction based on hand gestures and it can also fit different devices. The RB and the thimble-based transmitter are used for the control of `apd` model implementing DJ scratching techniques. This new configuration of the RB allows DJs a direct control of sampled sounds maintaining hand gestures similar to those used on vinyl. In another application the sound model of a bodhran was controlled with a traditional playing approach. In this case the RB can be controlled with a traditional bodhran double beater with one thimble radio transmitter fitted at each end. This allows detection of the beater position on the RB surface, the surface corresponding to the membrane of the bodhran in the sound model. In a third application the thimble controller was used to move a virtual ball rolling along the elastic surface of a box placed over the receiving antennae of the RB.

1. INTRODUCTION

The Max Mathews' Radio Baton (RB) consists of an array of receiving antennae and two low-frequency radio transmitters working at two different frequencies. The receivers are placed in a way that allows the detection of the three-dimensional position of each transmitter. Position coordinates are converted into MIDI poly-aftertouch values which are accessible via a MIDI-output port placed on the RB control unit. The system can measure the position of each transmitter with a time resolution of 1 ms, and therefore it is possible to track movements in real time. This makes the RB a gesture controller suitable for musical applications. The RB has been produced in about 40 pieces until today. It has usually been applied as an orchestra conducting system, as interactive music composition controller using typical percussionist gestures, and as a controller for sound synthesis models [1, 2, 3].

Because of its versatility, the RB has found new applications scenarios in the framework of the Sounding Object project[1]. In this project three applications were based on this controller. This was achieved by changing the gesture controllers. Instead of the default batons, a new radio transmitter based on a rubber thimble that fits the fingertips was built. This new transmitter allows musicians' interaction based on hand gestures and it can also fit different devices.

[1]The Sounding Object project: http://www.soundobject.org

2. THREE APPLICATIONS OF THE RADIO BATON

In the following sections three applications of the RB are presented; (1) a DJ console, (2) a percussion instrument, and (3) a navigation system for sounding objects.

2.1. DJ scratching control

The Max Mathews' RB has been implemented as gestural controller for Skipproof, a `pd` patch for the simulation of typical DJ scratching techniques [4]. The RB original drumstick-like batons has been substituted by a newly developed radio transmitter fitting the fingertips and based on a rubber thimble.

The thimble controller allows the manipulation of the three-dimensional signal received by the antennae. The surface of the RB receiving antennae (XY-plane) has been divided into ten sectors. One sector, long as the width of the surface (visible on the left side in the right picture in Figure 1), is used for the detection of free hand movements over the surface. The remaining nine sectors are smaller and are used for mapping a pre-recorded scratch technique each. The vertical distance from the surface (Z coordinate) determines the repetition rate of a particular technique, the closer the distance the higher the rate.

This new transmitter allows control of sampled sounds based on hand gestures similar to those used on vinyl (see Figure 1). The user can add her/his own choice of sounds to be scratched. Skipproof can also be applied to the control of sound models, such as friction sound models.

The DJ console was played by a professional DJ in two public concerts at Centro Candiani in Mestre-Venice and at Kulturhuset in Stockholm, in year 2002.

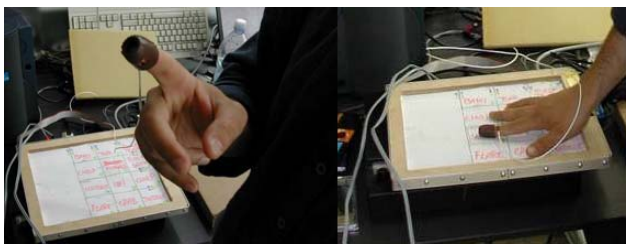

Figure 1: The thimble-based gestural controller for the Max Mathews' Radio Baton. It sends a radio signal from the fingertip to the receiving antenna.

2.2. Percussion instrument control

In another application, the RB was used as a traditional percussion instrument. The sound model of a *Bodhran* (see [5] for a detailed description of the model) was controlled with a traditional playing approach. The RB was controlled with a traditional *Bodhran* double beater with one thimble radio sender fitted at each end. This allowed detection of the beater position on the RB surface, the surface corresponding to the membrane in the sound model.

The surface with the receiving antennae was played with the beater as a "normal" *Bodhran* by the player. The position of each end of the stick versus the antennae controlled the playing position of the sound model, i.e. the distance from the frame of the drum (see Figure 2). The dampening and the fundamental frequency of the model was also controlled through other devices. It would be possible to control these parameters with the transmitters; for example the same low-frequency could be associated to the double beater ends and the other frequency could be used for damping. Also, one could imagine to play the beater at different heights from the receiver and associate the Z-coordinate to the fundamental frequency of the sound model.

The "radio bodhran" was played by a professional *Bodhran* player, Sandra Joyce, in a concert at Centro Candiani in Mestre-Venice, in year 2002 (see Figure 3).

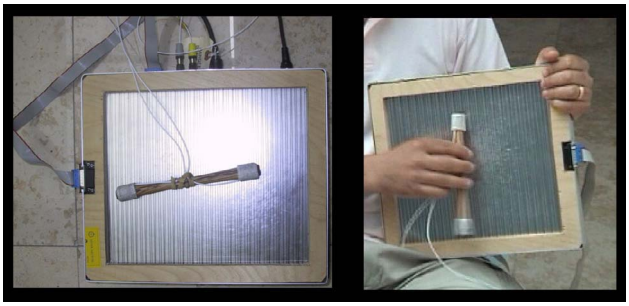

Figure 2: The Radio Baton transformed into a "radio bodhran". The thimble transmitters, shown also in Figure 1, are fitted to the two ends of a traditional double beater.

Figure 3: Sandra Joyce playing the Radio Baton transformed into a "radio bodhran" (see Figure 2).

2.3. Control of a sounding object

In a third application the thimble controller was fitted to a finger tip. The controller was used to move an "invisible" ball rolling along the elastic surface of a box placed over the receiving antennae of the RB, see Figure 4.

The interface is made of stretching material and by pressing the finger on the surface the user determines the target position for the "invisible" ball. This position, in terms of the X, Y, and Z coordinates, is feed to an impact sound model controlled with the mechanics equation of a rolling ball [6]. The ball will roll towards the position of the finger . With this interface, the user has both haptic and acoustic feedback when controlling the target position of the ball.

A visual feedback of the position of the ball, as a projection on the XY plane, i.e. as seen from above, is also possible and it is presented on the computer screen. The position is represented as a colored disk assuming colors in the red-range at high speed (hot ball) and blue-range at low speed (cold ball).

This particular setup was designed for an pilot experiment for testing the relevance of different feedback channels in the manipulation of sounding objects. This new interface allows users an interaction by using three different types of feedback:

- Acoustic; the sound model of the rolling ball
- Haptic; control of the position of the ball by pressing the elastic membrane with a finger
- Visual; graphical projection of position and speed of the ball

The main goal of the experiment was to investigate the degree of reality of the rolling-ball sound when controlled with this interface. Since the interface allows three different feedback, acoustic, haptic and visual, three different experiments were conducted. The three experiments were run in parallel at the same time so that 3 subjects at a time could listen to exactly the same sound stimuli, while receiving feedback on different perception channels. Main result of the pilot experiment was that subjects rated as more realistic those sounds corresponding to balls of smaller size and with lower damping. They also found the acoustic and visual feedback

Figure 4: Haptic interface for the control of the Radio Baton. The interface is placed over the receiving antenna. Finger position in the 3-dimensional space is detected in real-time.

easier to use compared to the haptic one. More details about this experiment can be found in [5].

3. CONCLUSIONS

The easy of use and versatility of the RB has been the driving force in the applications presented in this paper. The RB has revealed to be a useful sensor in very different applications. Both the DJ and the *Bodhran* player found the systems based on the RB of easy control and they both used them in live concert situations without extensive rehearsal training (less than one hour).

Many are the possible applications involving the RB, even in a non musical context, imagination been the only limit. For example it would be possible to use the RB as a navigation system based on gesture control; the radio trasnmitter, such as the thimble one, would be the pointing device and the antenna's surface the navigation area.

In the web repository of the Sounding Object project, it is possible to download videos excerpts of concerts in which the RB was used both as a DJ console and as a percussion instrument.

4. ACKNOWLEDGMENTS

Research presented in this paper was supported by the *Sounding Object* (SOb) EU project IST-2000-25287, `http://www.soundobject.org`.

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