Composing for the Digital Dance Interface

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Abstract
The DIEM Digital Dance Interface developed by the authors is a wireless interface which uses bending sensors worn by a dancer to measure angles of limbs. Our work involved developing a hardware interface for interactive dance as well as creating several compositions and performances. We have found that allowing a dancer to control aspects of musical performance presents a challenge well worth meeting. In our presentation the Digital Dance System will be demonstrated and examples of the authors' work with interactive dance will be shown on video.

1 The Hardware Interface
The DIEM Digital Dance System [1] is an interface designed especially for interactive dance. The dancer wears up to 14 bending sensors that measure the angles of the dancer's limbs. The bending sensors are connected to a small wireless transmitter worn by the dancer on a belt. Battery life for reliable performance ranges from 6 to 8 hours. The variations in electrical current of the sensors are multiplexed using a 14-channel multiplexer and then amplified by a single operation amplifier.

Sensor data is transmitted to a receiver unit, which functions as a standard MIDI controller device and can be connected with a MIDI cable to any MIDI interface or device. The receiver unit sends standard MIDI controller values (controllers 71 - 84) for each sensor. Controller values between 0 and 127 for all 14 sensors are sent out the MIDI port of the receiver unit about 32 times per second. The wireless transmitter employed supports two frequencies, allowing the use of up to two units at one time. The working range is 30 meters for indoor use and 120 meters for outdoor use.

The DIEM Digital Dance System

The sensors measure limb angles ranging from 0° to 120° and can be worn on any part of the body that bends. The sensors are mounted on individual elastic sleeves for the elbows and knees. Small pockets for the sensors are sewn onto the type of elastic supports used for sports injuries. A similar support with an open heal is used for the ankles. The dancer need only wear the number of sensors necessary for a particular performance. These sensor-sleeves can be easily hidden by a tricot or costume during performance.

DIEM Digital Dance Bending Sensor

Though designed as a dance interface, the system can also be used for other performance purposes. An instrumentalist's elbows and wrists might be used to control an effects processor or sampler. Or an actor on stage might control stage lighting with his fingers or knees. The interface has been made commercially available on a limited basis.

2 Use in Dance
The Digital Dance System was developed in collaboration with several different choreographers and dancers and tested with two different software compositions written by Wayne Siegel (see the article Two Compositions for Interactive Dance in the present publication). Many challenges and problems arose, often leading to modifications to the hardware interface, choreography and
composition. For example, in Wayne Siegel’s composition Movement Study, for solo dancer and computer, sensors were originally worn on the dancer’s wrists, elbows, knees and ankles. For choreographer/dancer Helen Saunders, the wrist movements necessary to control the music were aesthetically unappealing. The flex sensors on the wrists were consequently moved to the two index fingers, allowing precise control of the music with more subtle movement.

In designing hardware and composition software for interactive dance, trade-offs between generalized and specialized interfaces needed to be considered. General interfaces (e.g., a computer mouse) are easy to use and do not require much practice to master. But they do not allow for any high level of sophisticated performance (e.g., controlling multiple, independent parameters). Specialized interfaces (e.g., an F-16 aircraft or a violin) often require months or years of training before they can be used effectively. On the other hand, they enable the experienced user to accomplish highly sophisticated tasks. Knowledge and training can to some degree be transferred from one interface to another; if you already know how to ride a bicycle, changing make and model will require only a small amount of training compared to learning to ride a bicycle for the first time. We found that the more a dance interface allows the dancer to use existing performance techniques to access sophisticated control, the less adaptation and specialized training this interface will demand. If a dance interface in itself requires highly specific movements on the part of the performer, it will greatly restrict the dancer’s freedom of movement within the context of a performance.

3 Dancers’ Reactions

In the three years (1995-1998) that the authors worked on the Digital Dance Research Project, the interface developed was used by five different choreographers and five different dancers. All of the dancers were very positive about working with the system. The direct relationship between movement and music gave them a feeling of freedom while dancing. They were all very enthusiastic about working with the system, even in the early stages of development when the prototype was cumbersome and at times unreliable. In addition to gaining control of musical performance, some of the dancers found that the system increased their awareness of how they move when they dance. In a television interview prior to the first performance of Movement Study Helen Saunders stated:

“What I really like about it is that you can use the computer as an instrument and for the first time the dancer is in charge. You can just be there and do it yourself as you feel it at that time. It gives you a new kind of freedom.” [2]

References
