Chapter 7
Interactive Multimedia for Technology-Enhanced Learning with Multimodal Feedback

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Abstract. Musical performances are generally physically demanding with high degree of control (mental and motor) and accuracy. This chapter presents the i-Maestro (www.i-maestro.org) project which explored interactive multimedia environments for technology-enhanced music education. It discusses one of the key requirements for an interactive musical robot which is to analyze and provide feedback/interaction to a “performance”. This Chapter also serves as an example application of a musical robot in educational contexts. Music is not simply playing the right note at the right time. The multitude of interconnecting factors that influence and contribute to the nature of the playing is not easy to monitor nor analyze. Musical instrumentalists often use mirrors to observe themselves practicing. This Chapter briefly introduces the i-Maestro project and focuses on a gesture interface developed under the i-Maestro framework called the 3D Augmented Mirror (AMIR). AMIR captures, analyze and visualizes the performance in 3D. It offers a number of different analyses and feedback to support the learning and teaching of bowing technique and gesture.

7.1 Introduction

The i-Maestro project [19] explores novel solutions for music training in both theory and performance, building on recent innovations resulting from the development of computer and information technologies, by exploiting new pedagogical paradigms with cooperative and interactive self-learning environments, gesture interfaces, and augmented instruments. The project specifically addresses training

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support for string instruments among the many challenging aspects of music education. Starting from an analysis of pedagogical needs, the project developed enabling technologies to support music performance and theory training, including tools based on augmented instruments, gesture analysis, audio analysis and processing, score following [10], symbolic music representation [2], cooperative support [3] and exercise generation [40].

This Chapter focuses on the i-Maestro 3D Augmented Mirror (AMIR) module which utilizes interactive multimedia technologies to offer online and offline feedback for technology-enhanced learning for strings.

7.2 Related Background

Instrumental gesture, body movement and posture are all significant elements of musical performance. The acquisition, analysis, and processing of these elements is part of an expanding area of research into new musical interfaces, which can be further grouped with research into Human-Machine Interaction (HMI). Over recent years there has been a noticeable increase in the number of conferences, workshops and research workgroups related to this area such as the International Conference on New Interfaces for Musical Expression (NIME), International Computer Music Conference (ICMC), Digital Audio Effects Conference (DAFX), COST287-ConGAS, “Gesture Workshop” (International Workshop on Gesture in Human-Computer Interaction and Simulation) and others.

Although there is a great deal of research in the area of new musical interfaces, the use of these interfaces in music pedagogy applications is at its beginning and of an experimental nature. The i-Maestro tools aim to build on innovations and technologies emerging from the fields and utilize them in a pedagogical context. A complete overview on all related areas would be beyond the scope and available space for this Chapter. Hence the following sub-sections review several selected issues and focus on a number of related pedagogical applications.

7.2.1 Musical Gesture

There is much speculation over a comprehensive definition of gesture in music [7], although a large part of current research into new musical interfaces deals in some way or the other with gesture. Sometimes confusion arises from the fact that gesture is often used in the description of musical content, for example the phrases in a lyrical interplay between two instruments might be referred to as gestures. In the context of i-Maestro we are interested in the physical gestures that are exhibited by musicians during string performance. These can be defined as body, instrument and bow movements, which may be small or large (e.g. the movements of the body as a whole).