Chapter 6
Natural Human–Computer Interaction with Musical Instruments

George Tzanetakis
University of Victoria, Canada

ABSTRACT
The playing of a musical instrument is one of the most skilled and complex interactions between a human and an artifact. Professional musicians spend a significant part of their lives initially learning their instruments and then perfecting their skills. The production, distribution and consumption of music has been profoundly transformed by digital technology. Today music is recorded and mixed using computers, distributed through online stores and streaming services, and heard on smartphones and portable music players. Computers have also been used to synthesize new sounds, generate music, and even create sound acoustically in the field of music robotics. Despite all these advances the way musicians interact with computers has remained relatively unchanged in the last 20-30 years. Most interaction with computers in the context of music making still occurs either using the standard mouse/keyboard/screen interaction that everyone is familiar with, or using special digital musical instruments and controllers such as keyboards, synthesizers and drum machines. The string, woodwind, and brass families of instruments do not have widely available digital counterparts and in the few cases that they do the digital version is nowhere as expressive as the acoustic one. It is possible to retrofit and augment existing acoustic instruments with digital sensors in order to create what are termed hyper-instruments. These hyper-instruments allow musicians to interact naturally with their instrument as they are accustomed to, while at the same time transmit-
**INTRODUCTION**

Music today is produced, distributed and consumed using digital computer technology in each of these stages. In a typical scenario the process starts with musicians recording individual tracks using their respective instruments at a recording studio. These tracks are stored as digital waveforms which are then mixed and processed using digital audio workstation (DAW) software by one or more recording engineers. The resulting music track is then digitally distributed typically through either streaming services like Spotify and Pandora or online music stores like the Apple iStore or Google Play. Finally music listeners hear the music typically using their computers or smart phones. Despite these amazing advances in technology that have made practically all music accessible to anyone with an internet connection, the way musicians typically interact with computers is still primitive and limited in many ways especially when contrasted with how musicians interact with each other.

These limitations in human-computer interaction (HCI) in the context of music making can be broadly be classified as being caused by two factors. The first is related to hardware and is that we still mostly interact with computers using a keyboard and a mouse. The situation in music is not much different with the primary digital instruments being keyboards (the music kind) and other essentially digital controllers such as sliders and rotary knobs. The amount of control and expressivity these digital control afford is nowhere close to that afforded by...
Digital Rights Management Technologies and Standards

[www.igi-global.com/chapter/digital-rights-management-technologies-standards/24562?camid=4v1a](www.igi-global.com/chapter/digital-rights-management-technologies-standards/24562?camid=4v1a)