IDEA GROUP PUBLISHING
701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.idea-group.com

ITB11841

This chapter appears in the book, *Artificial Neural Networks in Real-Life Applications*
edited by Juan R. Rabunal and Julian Dorado © 2006, Idea Group Inc.

Chapter XII

Music and Neural Networks

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Abstract

This chapter pertains to the research in the field of music and artificial neural networks. The first attempts to codify human musical cognition through artificial neural networks are taken into account as well as recent and more complex techniques that allow computers to learn and recognize musical styles, genres, or even to compose music. Special topics covered are related to the representation of musical language and to the different systems used for solving them, from classic backpropagation networks to self-organizing maps and modular networks. The author hopes that this chapter will disclose some significant information about this emerging but nonetheless important subfield of AI and at the same time increase some interest and allow for a better understanding of this complex field.

Introduction

Some 20 years ago, James McClelland and David Rumelhart (1986) commented on an apparent incongruity: In spite of the fact that more and more computationally powerful machines were available to researchers, human ability in specific tasks was still to be regarded as incomparable. Besides that, in connection with certain aspects, for example the recognition of forms, what machines could do (albeit improved with reference to miniaturization and computational power) was simply insignificant.

What makes people smarter than machines? They certainly are not quicker or more precise. Yet people are far better at perceiving objects in natural scenes and noting their relations, at understanding language and retrieving contextually appropriate information from memory, at making plans and carrying out contextually appropriate actions, and at a wide range of other natural cognitive tasks. People also are far better at learning to do these things more accurately and fluently through processing experience. What is the basis for these differences? ...In our view, people are smarter than today's computers because the brain employs a basic computational architecture that is more suitable to deal with a central aspect of the natural information processing tasks that people are so good at…we will show through examples that these tasks generally require the simultaneous consideration of many pieces of information or constrains. (Rumelhart & McClelland, 1986, p. 3)

McClelland and Rumelhart recognized the fundamental computational architecture of the brain (billions of units connected among them, the neurons) as well as in his ability to instantaneously contemplate abundant constraints and "splinters" of knowledge, one of the reasons for the absolute perfection of the human capabilities in managing information. Their lesson would have been able to induce, over the years, an extraordinary number of progresses in the development of intelligent systems; also, a significant part of the scientific community would have reread cognition from innovative perspectives, at such a degree that the saying "connectionist revolution" would have been adopted by some scholars (Medler, 1998).

In this chapter, we will take into consideration some fundamental aspects on the theme of music and ANNs, by introducing both the epistemological and methodological topics of this rather new area of knowledge (*music and artificial intelligence* and consequently music and artificial neural networks); subsequently, we will present a broad literature review, divided into the literature of early years and current literature. The necessity to distinguish between old and new literature comes from the rather different perspective depicted: more "low-level" oriented in the first years (as expected since representational issues — how to encode pitches, durations, etc. — were to be solved to begin with), more focused on the creation of broad models of musical cognition in the recent years (in the remarkable attempt to model high-level topics like the recognition of genres, musical style, etc.).

A discussion on ANNs and music also poses two fundamental questions to be addressed. These questions cross over the boundaries represented by the computational aspects of the paradigm. In fact, they appear to be closely linked on one hand to the possibility of using connectionism to articulate realistic models of musical cognition in general (thus achieving a better understanding of those aspects of cognition that seem so natural to human beings); on the other to the quest for the solution of problems not imitable (or at least hardly imitable) by traditional artificial intelligence (AI) techniques: Very much is needed, in fact, to embody complex, multidimensional, meaningful stimuli

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