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Chapter II

A Survey on Various Applications of Artificial Neural Networks in Selected Fields of Healthcare

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Abstract

This chapter gives an overview of artificial neural networks as instruments for processing miscellaneous biomedical signals. A variety of applications are illustrated in several areas of healthcare. The structure of this chapter is rather oriented on medical fields like cardiology, gynecology, or neuromuscular control than on types of neural nets. Many examples demonstrate how neural nets can support the diagnosis and prediction of diseases. However, their content does not claim completeness due to the enormous amount and exponentially increasing number of publications in

this field. Besides the potential benefits for healthcare, some remarks on underlying assumptions are also included as well as problems which may occur while applying artificial neural nets. It is hoped that this review gives profound insight into strengths as well as weaknesses of artificial neural networks as tools for processing biomedical signals.

Introduction

Until now, there has been a tremendous amount of interest in and excitement about artificial neural networks (ANNs), also known as parallel distributed processing models, connectionist models, and neuromorphic systems. During the last two decades, ANNs have matured considerably from the early "first generation" methods (Akay, 2000) to the "second generation" of classification and regression tools (Lisboa et al., 1999) to the continuing development of "new generation" automatic feature detection and rule extraction instruments. Although it is obvious that ANNs have already been widely exploited in the area of biomedical signal analysis, a couple of interesting, and for healthcare reasons, valuable applications of all generations of ANNs are introduced in the following chapter. The selection of applications is arbitrary and does not claim completeness. The chapter is structured rather by medical domains than by type of neural nets or type of signals because very often different types of neural nets were compared on the basis of the same set of data, and different types of signals were chosen for input variables. According to the interdisciplinary character of modern medicine, this structure cannot be totally disjoint and will display some overlappings. However, due to the enormous amount and exponentially increasing number of publications, only a coarse stroboscopic insight into a still growing field of research will be provided.

Cardiology

The versatility of applications of ANNs with respect to their input variables is displayed in the field of applications related to heart diseases. Instead of using electrocardiographic (ECG) data (for a more comprehensive overview of ANN and ECG, see Chapters III-V), laboratory parameters like blood (Baxt, 1991; Baxt & Skora, 1996; Kennedy et al., 1997), angiography (Mobley et al., 2000), stress redistribution scintigrams, and myocardial scintigraphy (Kukar et al., 1999) as well as personal variables including past history (Baxt, 1991; Baxt &