Chapter 16
Digital Auscultation System of Traditional Chinese Medicine and Its Signals Acquisition: Analysis Methods

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ABSTRACT
Digital auscultation of Traditional Chinese Medicine (TCM) is a relatively new technology which has been developed for several years. This system makes diagnoses by analyzing sound signals of patients using signal processing and pattern recognition. The paper discusses TCM auscultation in both traditional and current digital auscultation methods. First, this article discusses demerits of traditional TCM auscultation methods. It is through these demerits that a conclusion is drawn that digital auscultation of TCM is indispensable. Then this article makes an introduction to voice analysis methods from lin-
ear and nonlinear analysis aspects to pattern recognition methods in common use. Finally this article establishes a new TCM digital auscultation system based on wavelet analysis and Back-propagation neural network (BPNN).

INTRODUCTION

Traditional Chinese Medicine (TCM) is a world-renowned cultural achievement. It has been playing an important role in Chinese people’s lives since ancient ages. TCM diagnosis methods can be categorized into four basic means, observation, listening, interrogation, and pulse-taking. Observation means observing facial expression, color or shape of the patient. Listening means detecting changes of patient’s voice. Interrogation involves asking patients and their family about disease development, current symptoms, and circumstances related to the diseases. Pulse-taking is palpating his (her) pulse (Xu, 2006).

TCM auscultation is the diagnostic tool commonly known as listening. As is known to all of us, voice is generated by the speech organs which reflect different body status. So we can identify people’s body status from their voice (Wang, 1997). Human’s brain is an automatic system of information extraction, analysis and identification. Brain commands ears to capture sound signals, and these signals are sent into brain for processing. Sound signals, together with memory and experiences, are used to make judgment. Yet, this manual approach meets some problems when used in medical field in which high accuracy is needed. The most typical problems are as follows: (Mo, 1996)

1. First, different individuals may feel or react differently about the same sound or voice. Therefore, auscultation done by human lacks unified standard.
2. Second, it takes a long time to learn TCM auscultation. An inexperienced TCM doctor cannot diagnose as correctly as those with rich clinical experiences.
3. Third, people’s organs will recess, so are ears, and this makes it difficult for an aged TCM doctor to auscultate correctly.
4. Finally, a noisy environment may mask sound or voice, thus cause misdiagnosis.

Considering all these problems, it has become an imperative job to make auscultation accurate and standardized. Effective approach towards this aim is to establish an objective digital auscultation system. This new approach can also serve to increase the efficiency of TCM auscultation (Liu, 2008).

Before solving this problem in traditional TCM auscultation methods, an introduction to TCM signal analysis methods and pattern recognition methods is given. This article will introduce these methods about both basic theory and application in common use.

ANALYSIS METHODS AND FEATURES

In TCM digital auscultation system, there must be features extracted from the signals (voice) for pattern recognition. Generally speaking, voice signals’ features are changeable, and this is so called “an unstable process”; but in a small amount of time, the features are relatively unchangeable, so voice signals can be considered as a stable process in a small time interval.

Signal analysis method can be divided into two kinds: linear and nonlinear analysis.

Linear Analysis

In linear analysis method signals are separated into several small intervals. There are several linear
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