Abstract: - This paper propose to apply Wavelet Transform theory in the analysis of Electro Cardiogram Signals (ECG) for the detection of particular spikes present in the Chagasic ECG. These signals are non-stationary, having spectral features that change in time due to unpredictable events, a fact that makes Wavelet Transform suitable for signal analysis and segmentation. After the Wavelet pre-processing, Neural Networks are a useful tool for Automatic Classification of ECG and to provide experts with an inherent estimation of the probability of symptoms of Chagas infection.

Key-Words: - Wavelet Transform, Neural Networks, Chagas Disease, Cardiopathies, ECG.

1 Introduction
American Trypanosomiasis or Chagas’ disease is an important problem of public health affecting 20 million people in Latin America [1] and more than 90 millions are at risk [2,3]. Nowadays there has been a recent burst of interest on Chagas’ disease all over the world [2,4,5]. It is caused by the flagellate parasite Trypanosoma Cruzi. Chronic progressive heart disease develop in approximately 20 to 40% of infected persons. Chagas’ heart disease is one of the leading causes of sudden death after coronary heart disease. Approximately, half of the patients Chagas’ heart disease died suddenly. The mechanism of sudden death in Chagas’ disease include ventricular fibrillation or tachycardia, severe bradyarrhythmia, embolic complication and spontaneous ventricular rupture. Proarrhythmia is common due to the coexistence of heart failure and multiple electrophysiologic abnormalities including sinus node dysfunction, intraventricular and atrioventricular conduction abnormalities, severe multiform ventricular arrhythmia, abnormal Q waves and altered ST segment and T wave abnormalities. Thus the ventricular arrhythmias of Chagas’ heart disease are one of the most demanding models on which an ECG Automatic Detection and Computer Aided Diagnosis systems can be tested.

2 Problem Formulation
When Trypanosoma cruzi infection of the heart is demonstrate by pathologic examination of cardiac tissues or by xenodiagnosis, the diagnosis is certain. However the pathologic verification is rare. Therefore, diagnosis of cardiac involvement in Chagas’ disease is usually made when a combination of epidemiologic, serologic, and clinical criteria are present [1,2,6,7,11]. It is particularly important to use such a strict case definition in populations in which Chagas’ disease is uncommon, such as United States and Europe. Case definition criteria for diagnosis required a combination of epidemiologic, serologic and clinical criteria to be met [11]. These included [1] a history of residence in an area where Chagas’ disease was endemic [2] an unequivocally positive serologic test for Trypanosoma Cruzi [5] a clinical syndrome compatible with Chagas’ heart disease, and [6] no evidence of another cardiac disorder to which the findings could be attributed. Is for these reasons that the development of an ECG Computer Aided diagnosis would be extremely useful.

2.1 ECG signals
ECG signals are non-stationary signals, having spectral features that change in time due to unpredictable events, as in the case of atrial or ventricular arrhythmia. An arrhythmia results from an electrical signal in the atria or the ventricles being delayed or leading with respect to the normal pace at which the heart signals would occur in a healthy individual. These unpredictable events have the effect of altering the spectrum of the signal in a way that may make the analysis method unsuitable or inefficient if such a method were not to detect such events. A method that may be able to change its resolution in both time and frequency would therefore prove to be of great value. It is for this reason that the Wavelet Transform is suitable for signal analysis and segmentation.

Different parts of the ECG are commonly classified into PQRS and T waves. P waves result from atrial depolarisation as an impulse travels from the sino-
atrial node towards the atrio-ventricular node. The QRS complex results from ventricular depolarisation at about the same time at which atrial re-polarisation occurs, thus hiding the signal corresponding to atrial re-polarisation. Finally, the T wave appears as a consequence of ventricular re-polarisation.

Electrodes placed on the chest to measure the depolarisation and re-polarisation of the heart will see the signal changing from positive to negative waves with amplitudes and polarities depending on their position on the chest or the limbs, by means of which the standard ECG leads are recorded. Traditionally, cardiologists make clinical assessments of the state of health of a patient's heart by examining a chart on which the ECG has been traced. The accuracy of the diagnosis will depend on his or her expertise; indeed, the criteria used in ECG analysis is widely understood and proven to be effective.

3 Results

Time-frequency Wavelet analysis provides the following tools for the analysis:

3.1 Signal Decomposition

Signal can be decomposed in a set of subsignals, where one of them carries the relevant information and the rest of signals, can be discarded, improving the efficiency of the system processing the information.

3.2 Frequency-Time Analisys

Through different approximations in Time-Frequency the ECG signals can be analysed and compared, and parameters extracted for the automatic diagnosis and control of Chagas Heart disease.
4 Conclusion

Chagas’ disease is an important problem of public health affecting millions of people in Latin America. Therefore, diagnosis of cardiac involvement in Chagas’ disease is usually difficult and imprecise.

By applying the Wavelet Transform, together with Neural Networks, specific software can be developed in order to automatically detect the spikes present within the Chagasic ECG, together with detailed spectrogram of their various features. Since the decisions that software makes are in accordance with invariable rules, the analysis is both repeatable and reliable. Hence it may be seen as a valuable tool in the service of the trained cardiologist.

References:
