

CASE FOLLOW-UP STUDY THE PATIENTS UNDERGOING METALIC HEART VALVES REPLACEMENT THROUGH PHONOCARDIOGRAPHIC ANALYSIS

Semra Kemaloğlu¹, Sadık Kara²

¹ Erciyes University, Biomedical Device Technology Department

² Erciyes University, Dept. of Electronics Engineering Faculty.

E-mail : ksemra@erciyes.edu.tr, kara@erciyes.edu.tr

Abstract: In this study, the synchronous pursuit of hearts sounds together with ECG signals have been realized. For this purpose pre-operative and post-operative clinic data related with the patients with heart valve diseases has been recorded through a computer. Thus, an auxiliary method has been provided to determine the patient's health situation.

Heart sounds have been obtained using a transducer insulated from its surroundings and ECG signals using surface ECG electrodes. The heart sound and ECG signals have been amplified and filtered independent of each other. After this process, these signals have been converted into digital data to be transferred to computer via I/O card.

Thus, the results of heart sounds and ECG signals have been monitored and stored in computer by a software developed in Delphi Programmer Language. However, signals have been transferred in frequency domain and power density spectrum was drawn in order to minimize possible errors in the medical diagnosis from sound signals stored in time domain. Also, the durations of heart sound signals have been determined and power density field has been calculated so that graphs can be compared together.

The realized system has been tested over heart valve patients at Cardiology Department in Erciyes University Gevher Nesibe Hospital.

Keyword: heart sounds, heart sounds and computer

I. INTRODUCTION

More than 40 theories have been developed relevant to existence of heart sounds and murmurs[1]. The heart sounds are produced by the flow of blood into and outside of the chambers and by the movement of myocardial walls and by opening and closing of the valves in general.

The listening to heart (occultation) is one of the most precise tests of the functional accuracy of heart. In addition, variations and murmurs in heart sounds are generally obvious signs. These variations and murmurs can be determined before appease symptoms and finding depend on important variations of pressure in the cardiovascular system[2].

A metallic sound produced from the movement of the metals is heard as a result of the metals contacting with each other in the metallic valves replaced. Valve movement is depraved owing to a clot settling between or surrounding two metals. When valve movements are depraved, heart sounds are also depraved.

Since this phenomenon affects primarily heart valve sounds, the analyses of the sounds may be the first diagnosis step. In the diagnosis of valve dysfunctions unspecific methods such as, the evaluation of patient's clinical, the physical examinations, pulmonary graphs are still used. In addition to these methods, specific methods such as, echocardiography, fluoroscopy, magnetic resonance and angiographies are also used. But, none of these methods is a method to evaluate valve sounds. The valve sounds of patients are listened to using stereoscope only during the physical examination. Yet, this phenomenon is instantaneous data with no evidence which depends on the experience of doctor.

II. PURPOSE AND METHOD

In our country rheumatic heart valve diseases are commoner than those in the western countries. *Anticoagulant* medical treatment methods have to be applied to patients with mechanical heart valve in order to delay blood clotting during life. Blood clotting is delayed giving by administering *comedian* to the patient[3, 4]. The clots, which may occur in the periphery of the valves because of the fact that this agent often requires lifelong usage and may be used in wrong ways in later periods of life, not only may be driven to vital organ, e.g. a clot driven to the brain may give rise to paralysis, but also may impair valve movements. Sometimes impaired valve movements may require the patient to undergo another operation. When valve movements begin to be impaired, first an impairment occurs in the sounds of opening and closing, and eventually the process goes on until complete inactivity occurs in the valves.

The heart sounds may be impaired because of settling clots even if valves movements are normal. The phonocardiographic records must be obtained after and before the valves replacement the patient so that to do an accurate assessment of the situation. Imaging heart sounds together with ECG signals will be become more useful in order to minimize potential errors can be done in determining durations and positions of heart sounds.

In this study, the heart sounds have been taken using a transducer insulated from its surrounding, and ECG signals using surface electrodes. The heart sounds have been

Report Documentation Page

Report Date 25 Oct 2001	Report Type N/A	Dates Covered (from... to) -
Title and Subtitle Case Follow-Up Study the Patients Undergoing Metallic Heart Valves Replacement Through Phonocardiographic Analysis		Contract Number
		Grant Number
		Program Element Number
Author(s)		Project Number
		Task Number
		Work Unit Number
Performing Organization Name(s) and Address(es) Erciyes University Biomedical Device Technology Department		Performing Organization Report Number
Sponsoring/Monitoring Agency Name(s) and Address(es) US Army Research, Development & Standardization Group (UK) PSC 802 Box 15 FPO AE 09499-1500		Sponsor/Monitor's Acronym(s)
		Sponsor/Monitor's Report Number(s)
Distribution/Availability Statement Approved for public release, distribution unlimited		
Supplementary Notes Papers from 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, October 25-28, 2001, held in Istanbul, Turkey. See also ADM001351 for entire conference on cd-rom., The original document contains color images.		
Abstract		
Subject Terms		
Report Classification unclassified	Classification of this page unclassified	
Classification of Abstract unclassified	Limitation of Abstract UU	
Number of Pages 4		

obtained from over apex region[5] and ECG signals through DI derivation[6]. These signals have been amplified by passing from through instrumentation amplifier sections separately[7, 8]. After this process, these signals were filtered against noises with high frequency and were transferred to a computer using planned I/O card.



Figure 1 A graphic synchronous of heart sound and ECG signal obtained from healthy subject

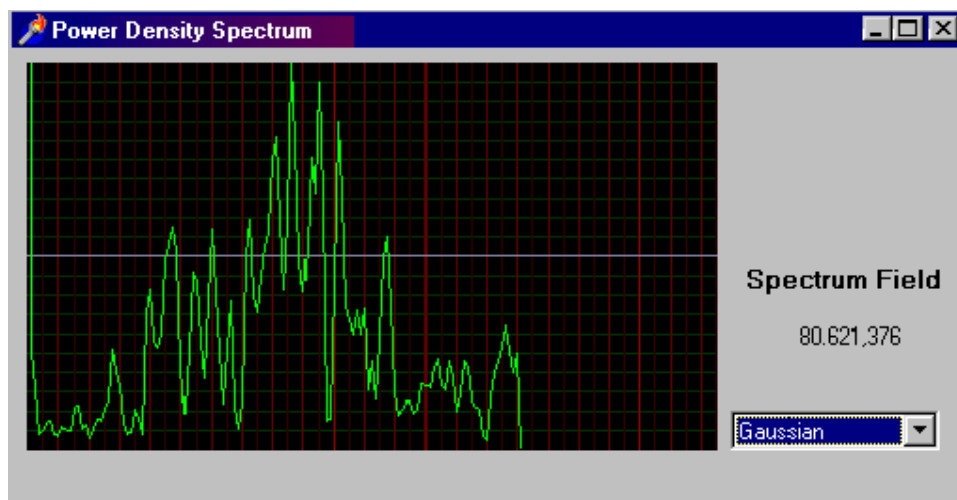


Figure 2 The Power spectrum density graph of this heart sound signals



Figure 3 The synchronous graphic of heart sounds and ECG signals of a patient with aorta narrowing and coroner artery disease

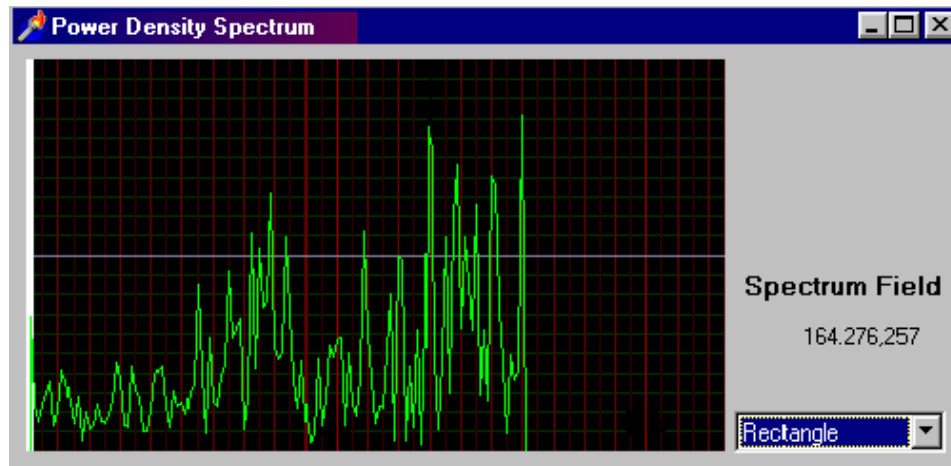


Figure 4 Power spectrum density graph of this patient

The synchronous graphics of heart sounds and ECG signals have been drawn in computer by a software prepared in Delphi programming language. Besides, the data base related to patients has been formed. However, signals have been transferred in frequency domain in order to minimize possible errors in the medical diagnosis from sound signals stored in time domain, and power density spectrum has been drawn. Therefore, durations of heart sound signals have been determined and field of power density spectrum has been calculated. Thus, an

intragraphics comparison can be made in durations these signals.

A graphic synchronous of heart sound and ECG signal obtained from healthy subject is given in figure 1. The Power spectrum density graph of this heart sound signals is given figure 2.

In drawing power density it is possible to choose various windowing types. Gaussian windowing type was selected in figure 2. The synchronous graphic of heart sounds and ECG signals of a patient with aorta narrowing and coroner artery

disease is given figure 3. Power spectrum density graph of this patient is given figure 4.

III. RESULTS

The heart sounds in this study have been drawn synchronously with ECG signals and the data base of the patients have been prepared. ECG signals have helped cardiology doctors to determine the position of heart sounds. In taking ECG signals, it has proven to be adequate to use only a derivation type (DI). Power spectrum density has been drawn by transferring frequency domain so that more clinical data can be obtained from sound signals recorded in time domain. The durations of graphs can be calculated because these signals have been drawn over a scaled screen. In drawing power spectrum density, various windowing types can be used and spectrum field can be calculated. Also, all the information concerning the patients have been filed in computer in case classic faults.

With the realization of this system, records have been taken from patients awaiting operation for heart valve disease and the accuracy of these records have been compared with the clinical data and tested. Figure 1 presents records regarding a healthy subject and figure 3 the records regarding a patient who have aorta narrowing and coronary artery disease. The murmurs in the patient determined by listening method have been seen as noise in signal. The expected murmur type in aorta narrowness and coronary artery disease is systolic ejection murmurs and these murmurs are heard during the systole and the diastole.

In the completed part of the study, obtaining signals, determining their durations, drawing power spectrum density, calculating spectrum field and establishing data base concerning patients has been done.

REFERENCES

- [1] McKusick, '*Cardiovascular Sound in Health and Disease*', Baltimore: The Williams & Wilkins Company, 1958.
- [2] Robert F. Rushmer, M. D., '*Cardiovascular Dynamics*', W.B. Saunders Company, 1976
- [3] Hardman JG, Limbird LE, Molin off PB, Ruddon RW, Gilman AG, '*The Pharmacological Basis of Theurapeutics*', The McGraw Hill Companies, USA, s: 1346-1351, 1996
- [4] Braunwald E., '*Valvular Heart Disease*', W.B. Saunders Company, USA, s: 1007-1077, 1992.
- [5] Cengiz Körpe, '*Kalp Seslerinin Değerlendirilmesi*', İTÜ, Master Thesis, 1985
- [6] Dr. A. Halit Erol, '*Elektrokardiografi*', Ankara, 1988.
- [7] Mehmet Korürek, '*Tıp Elektronikinde Tasarım İlkeleri*', İstanbul, İTÜ, 1996.
- [8] Howard M.Berlin, Frank C.Getz, Jr, '*Fundamentals Of Operational Amplifiers And Linear Integrated Circuits*', Merrill Publishing Company, 1990.