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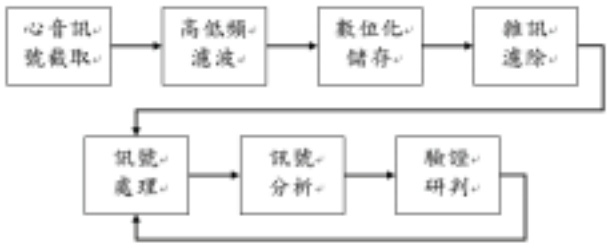
Abstract

In the past two decades, one of the most important developments in Biomedical Engineering is the technique of non-invasive recording. This brand-new technique can let us design & perform various complex experiments leading to the recording of highly precise electroencephalogram, electrocardiogram, electromyogram, magnetic resonance imaging (MRI) and functional MRI. The progress of biomedical signal analysis cannot keep up with the pass of novel technique pioneering. As a scientist, it is important to leave a highly reproducible analytic method as well as revolutionary biotechnological advances. Therefore, it is necessary to have a improved method to detect meaningful information from a complex 4-demensional data (including time).

Cardiac murmurs are audible turbulent sound wave in the range of 20 to 2000Hz originating form the heart and vascular system. Auscultation of the heart is a critical and definite skill required to identify and diagnose these murmurs. Experience is needed for the evaluation and detection of heart murmurs.

The purpose of this research is to evaluate the feasibility of acoustic signal processing technique in cardiac murmur analysis. The detection and classification of cardiac murmurs is a technique required by the experience cardiologist skilled and well trained in stethoscope auscultation. Therefore, the study proposed by this project is valuable for the development of automated detection and classification of cardiac murmurs in the future.

Keywords ¡G Cardiac Murmur, Auscultation , Acoustic Signal Processing



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- STM100
- Serial Interface card (for PC, PCMCIA)
- UIM100A + OUT100 (Monaural headphone)
- DA100B + TSD108(Contact Microphone)¡ A ¤ ⁄ ⁄ » „ †ch16w¡A GAIN=1000¡ALP=5000hz¡AHP=0.05hz¡C
- ECG100B + LEAD100S + LEAD100 + EL500 ¡ A ¤ ⁄ ⁄ » „ †ch1w¡A GAIN=500¡ALP=35hz¡AHP=0.05hz¡Af ECG ¶ q · œ " " –"k ƒp„ˇ¥¡C

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3M Littmann Cardiology III Stethoscope

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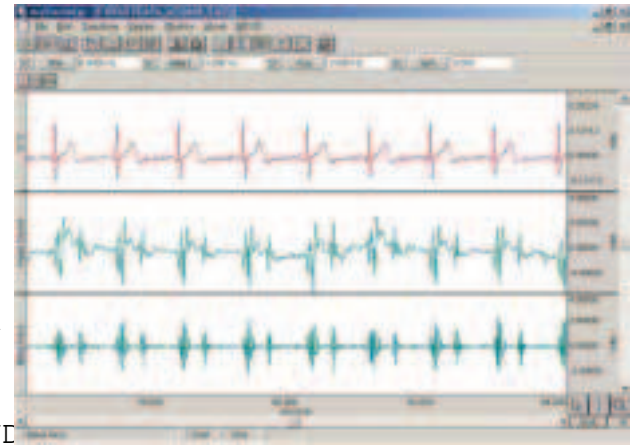

" 1 ‹ ª s„ ¶H"/" ¥»˜ '°

	一般正常人	心雜音病人
年齡(年)	25.95±10.00	71.16±11.90
男(人次)	17	22
女(人次)	3	9

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(3) fi W T„⁄ ‟R(Time-Frequency Signal Analysis)¡G¥ (2)' ‡ Bz– ø ‟”› ' ł ›T ,„‹ fi T„(Time Signal)¡ A ` A ¤ W ^—⁄‹ ^ fl ¶q⁄ SG¡A» ›n–N¤ ´ ·«ƒ W ¤ ⁄ ‟R¡CS › –NSQ¥¸ MATLAB ⁄⁄”¤ …˘ FFT ¶ ƒ Discrete Fourier transform(DFT)¡ A ´ ·«⁄‰ƒ¡‹ ¡G

$$X(k)=\sum_{n=1}^{N}x(n)*e^{-j2\pi(k-1)(n-1)/N},\quad k=1,2,\ldots,N$$

(4)fl ¶q› p ”»ŒP ¶q⁄æ›¨¡GS › · ¿ ‡]ƒ•‡⁄ ´ł› ¥´fi ¡Aƒ Łp⁄ ´ł› ‟” Wv‰ d⁄”⁄” fl ¶ q ,ß' ¤ ¥ƒ Wv‰ d⁄”⁄”fl ¶q• |‹ „ … W[¡ A ƒƒ»„⁄ æ , ß ⁄ @U¶¡fl‟¶q'M‟”fit †S¡Cfi g ¥´ł ‟” Wv‰ d ‡‹ø 150 ƒ 500HZ¡A„ ' ¤C⁄@› …¸¥»S › –˜¤œ‟”‡ Bz ƒp⁄U¡G

A.› p ”¥Œ50~500HZ ˇ¶¡‟”fl ¶q'M¡C

B.¥H¤C100HZ ‹ ˇ„¡A› Łp › SO ˇ¶¡‟”fl ¶q'M¡C

C.¤D¥X A.⁄¸ B.¤ ‟ ‟”⁄æ›¨¡A” ⁄S‹ fl ¶q ⁄æ¡C

(5) t ¦¸w¡Gƒ]⁄@fl ° ¥ ¿ ›»B¶ƒ‡⁄ ´ł› ‟”fl ŧw ‹ ¤ ¿W¥ ¥ ¯ ØA¥ B , g ‟ ·˜¤ ¸‟ŁŁ– ł¸ˇ (histogram)‹ ø†⁄‹ –‟”A⁄ SG¡ A ƒƒS„ › „` , ¤ˇ¥¸ t ¦¸w¤ ⁄ æß‡o¤ † ŒfiŸH‰T'w¤

‟ k ¦¸¯S‡O›¨(threshold or cut-off value)¡Cƒb ƒ„S › –˜¥¸† S (one-tailed) t ¦¸w¡A ª ⁄ • ·(significant level) P < 0.05¡C, ğ ¤B, ” ¥D fl ˇ¡B‟ ˝ °fl ˇ⁄„ ‹ Ư^⁄ˇ‟”P < 0.05 SY¤ ¥ ¯Øƒ‡¯ ª fi ŧS¡C

⁄T¡B„Œ¯ †‟G

fl ¶q⁄æ‟”› ƒp† †‟G†⁄‟ ƒp‟ 2 ' ¥ ¡ A ⁄⁄A01~A20 ‹ ⁄@fl ° ¥ ¿ ›»Hƒ ŒŁ˘¡ŒC01~C31 ‹ ƒ‡fi g ¥´ł ‟”fl ŧw, ŒŁ˘¡C‟ 3 ' ¥ ‹ ¥ ¿ ` ,s† »P⁄ ´ł› ,s† ƒbƒU Wv ˇ¶¡‟”fl ¶q⁄æ⁄S t ¦¸w †‟G¡G„Œ¯ †‟G¯ª¥ ¤ › ,s† ƒbƒU Wv ˇ¶¡¯ª¥ ¤ªƒ‡† ¸›p• ŃNq‟”fi ŧS¡C

‟ 2 150~500Hz »P¤C100Hz ˇ¶ ⁄S¡fl ¶q⁄æ †⁄‟

	編號	0~100HZ	100~200HZ	200~300HZ	300~400HZ
主動脈區	A01	2.4441E-03	2.6238E-01	2.9623E+00	9.6259E+00
	A02	5.7612E-04	4.2911E-01	3.5290E+00	4.1483E+01
	⋮	⋮	⋮	⋮	⋮
	A20	4.8296E-04	4.7897E-01	3.0448E+00	3.3883E+01
	C01	1.5918E-03	6.5049E-01	2.5054E+00	1.2883E+01
	C02	7.5795E-04	2.6024E-01	2.8803E+00	1.7510E+01
	⋮	⋮	⋮	⋮	⋮
	C31	1.0339E-03	8.6838E-01	2.8989E+00	4.8894E+00

‟ 3 ¤ ¥ ¯ØƒbD fl ˇ⁄S¡fl ¶q⁄æ‟”t ¦¸w

	頻率區間	t 統計	P(T<=t)
主動脈區	0~100HZ	-3.7560084	2.2956E-04
	100~200HZ	-4.44280289	3.0643E-05
	200~300HZ	1.67035236	5.1234E-02
	300~400HZ	5.86998008	3.9708E-06
	400~500HZ	6.94059868	2.2410E-07
	500~600HZ	5.35596972	6.5832E-06
	600~700HZ	5.57214035	3.2890E-06
	700~800HZ	5.95340294	1.9107E-06
	800~900HZ	6.79640161	1.6301E-07
	900~1000HZ	5.05318075	7.8856E-06

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