E-NEWSLETTER

Jan 2016 issue

THE SOCIETY OF ACOUSTICS SINGAPORE

Official Address:5 Derbyshire Road, #04-05, Singapore 309461
Tel: 67913242 and Mobile No. 90932730 Fax: 62990485
E-mail: wsgan@metaultrasound.com
Website: www.acousticssingapore.com

Registration No: 0331/1989
Year of Registration: 1989

President: Dr Gan Woon Siong
Secretary: Prof Y F Zhou
Treasurer: Dr Antonio Alvarez

CONTENTS

I CONFERENCE NEWS

The 23rd International Congress on Sound and Vibration(ICSV23) will be held in Athens, Greece from 10 to 14 July 2016.

Woon Siong Gan will be organising two structured sessions on:

1. **Nonlinear acoustics and vibration**
2. **New acoustics, based on metamaterials**

Please visit www.icsv23.org for more informations.

rt

II. ANNONCEMENTS

The Society of Acoustics will be sending out invoices to members with outstanding membership subscriptions. Members are encouraged to make payment in support of the Society.

The E-Newsletters will be made available to industrial contacts in an effort to promote the activities of the Society.

The Society is also exploring the possibility of organising talks and other professional events in collaboration with acoustic societies of other countries.

Membership Certificates will soon be made available to all members who had made full payments of membership dues

The Society aims to increase membership by inviting all persons, including those from the institution of higher learning and other related societies such as the Institute of Architects, Singapore and the members of the mechanical engineering division of the Institution of Engineers, Singapore who are qualified in the various field of Acoustics to join our Society.
We are especially keen to invite students to join our society and we are establishing the Youth Chapter soon.

III. SUCCESSFUL GRANT AWARD FOR OUR MEMBER

Condition Monitoring of Gas Pipelines in Critical Locations using Ultrasonic Guided Wave Technology

Host Institution: Nanyang Technological University (NTU)

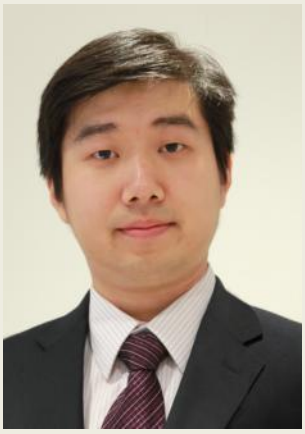
Project Background:

In the gas industry, it is essential to monitor the change of wall thickness of the pipeline, in order to estimate the corrosion rates of the pipe networks for cost effective operation, and be able to send advanced warning signal for possible gas leakage. Conventional thickness evaluation process requires manually scanning of probes over the whole structure, which is tedious and challenging for remote locations. Therefore there is a strong motivation to develop an advanced monitoring system which can be permanently installed in critical locations in the pipeline network, and continuously monitor the wall thickness change of pipelines around these areas.

Outcomes and Benefits:

In the proposed work, ultrasonic guided wave technology will be explored in conjunction with tomography principles to establish a condition monitoring system for critical areas in the pipe network which are particularly susceptible to corrosion/erosion. The project aims to integrate the physics and modelling techniques together with the development of the advanced electronics. Compared to other NDE techniques, the system is able to sending early warning signal immediately when thickness of a region is below a threshold; accurately measuring the corrosion rate; and saving huge cost of setting up measurement in difficultly accessible regions.

Principal Investigator:



Dr. David Fan obtained his PhD from Imperial College London and he is now an assistant professor in School of Mechanical and Aerospace at NTU. His research motivation is to solve real inspection and monitoring problems in industry, achieved by conducting thorough scientific research. He has collaborated with varies industries including Rolls-Royce, Shell, Petrobras, Sembcorp, Keppel etc for different research and consultancy projects. Dr. Fan has published many papers in top journals, and his research work has gained worldwide recognition, including being awarded “Bob Chiver’s Prize” from Institute of Physics in the UK in 2010.

IV. MEMBERSHIP SUBSCRIPTION

Fellow	S$70
Member	S$50
Associate	S$30
Student	S$15
Corporate	S$200

FEE BASED ON ANNUAL RATE

FOR MORE INFORMATION PLEASE CONTACT: Dr.Gan at email: wsgan@metaultrasound..com

Application form: ( ) Member ( ) Associate

1) Name: _____

2) Address: _____

Fax: _____ E-mail: _____

3) Degrees (Institutions and dates):

_____

4) Employment (with dates):

_____

5) Signature & Date: _____

V.ARTICLE

SOUND REPRODUCTION

by Sonny C Y Lim, January 2016

INTRODUCTION

To understand Sound Reproduction, we need first to explain the physiology and psychology aspects on the human auditory system.

As a matter of fact there is no Good or Bad sound, it is only good sound and noise. It can be established for both speech and music which if not intelligible or defined respectively are useless garbled noise. Similar to badly installed sound reinforcement system where listeners in the audience cannot understand what is being said.

Good Sound should be articulated for speech and pleasant for music, if either of them requires high degree of concentration by the brain to process the sound, then it should be considered as noise. That is the reason noise (bad sound) disrupts the listening process both in intelligibility of speech and the enjoyment of music, during which the brain stops the concentration power through fatigue and “shuts” down, only good sound will prevail without brain intervention. Very often you would hear audience mentioning “I cannot understand on what are being said after a while” or “the music is so stressful towards the end”.

To assist the human auditory system in perceiving and determining good sound, it requires the three important acoustic related facets stated below:

1) **Building acoustics** – that is sound treatment to any surface causing
   echoes or sound reflection.

2) **Electro-acoustics** – design of the audio system to help with proper sound directionality and coverage.

3) **Psycho-acoustics** – provide ideal sound quality for the human auditory anatomy in a relaxed listening environment.

HUMAN AUDITORY SYSTEM

Sound is a mechanical phenomenon of air-modulation transmitted through the air itself dependant greatly on acoustics of the room and placement of the speakers to achieve the ideal sound rein-enforcement. The process is important for any venue, room size and purpose, even outdoor sound
system requires careful planning..

When the sound waves reaches the ears and perceived by the auditory system they are converted into neural action analysed by the inner ears and processed as aural-stimuli to the brain, which identify time delay, tonal, frequency and intensity in loudness. The sound should be easily processed by the brain, known as psycho-acoustics, and the brain makes the final assessment in determining good sound from noise. The human auditory process should be relieved from the difficulty of having to compensate for poor sound quality, which is in fact noise. As the brain has limited tolerance and time factor of processing power, after a while it will shut down and leave the listener stressed and confused with the noise.

The human auditory system is neither linear in loudness nor frequency perception. Figure 1 illustrates the human auditory perception “footprint”
and psychological characteristics. These phenomena cannot be ignored to determine the designing of good acoustics and sound system.

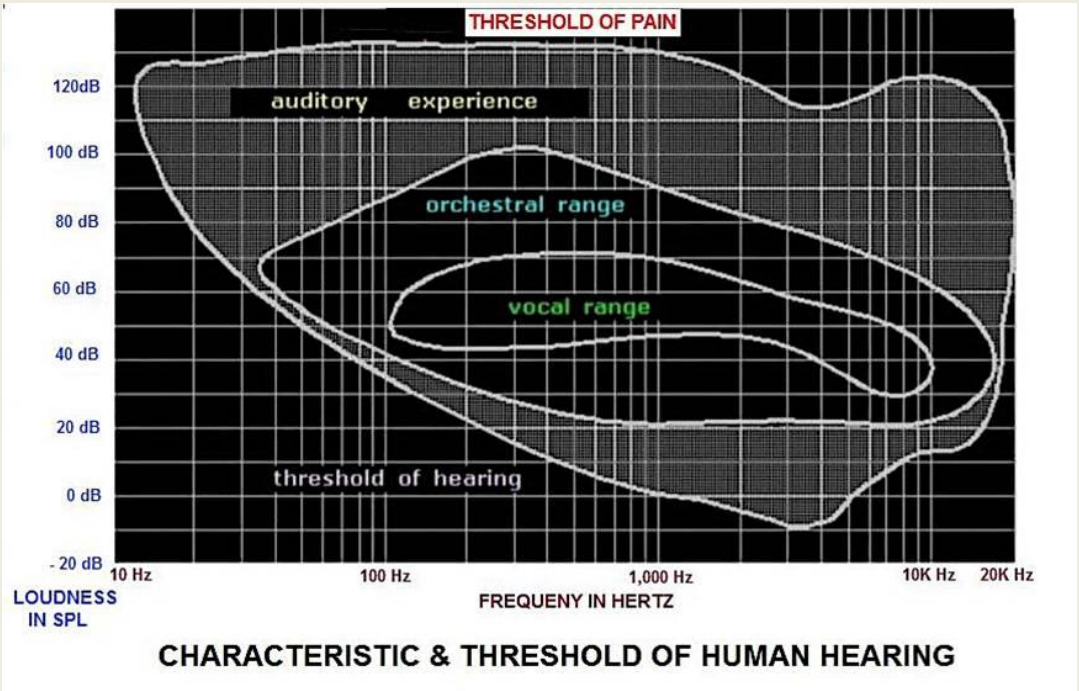


Figure 1

The non-linear frequency and loudness can be observed from Figure 2 in graphical format. The graphical curves in Figure 2 illustrate the frequency response and loudness perception curves required by the human auditory system in order to perceive the sound at different frequency range. It clearly display the human auditory system deficiency in the low frequency and loudness perception. (The numerical quantum in Phons is normally used for biological analysis and decibels (dB) is used for engineering reference.)

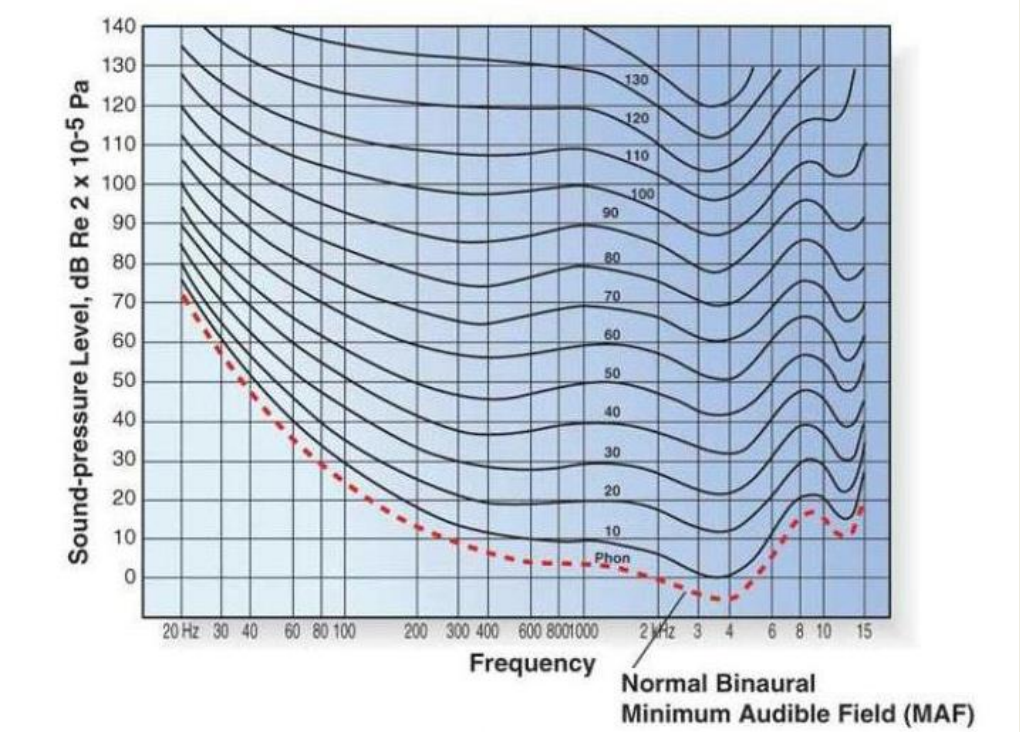


Figure 2

For this reason when listening to recorded music the bass frequency needs to be increased to improve the sound tonal balance and quality. To simplify the curve a single graphic representation is shown in Figure 3 on the human auditory sensitivity perception.

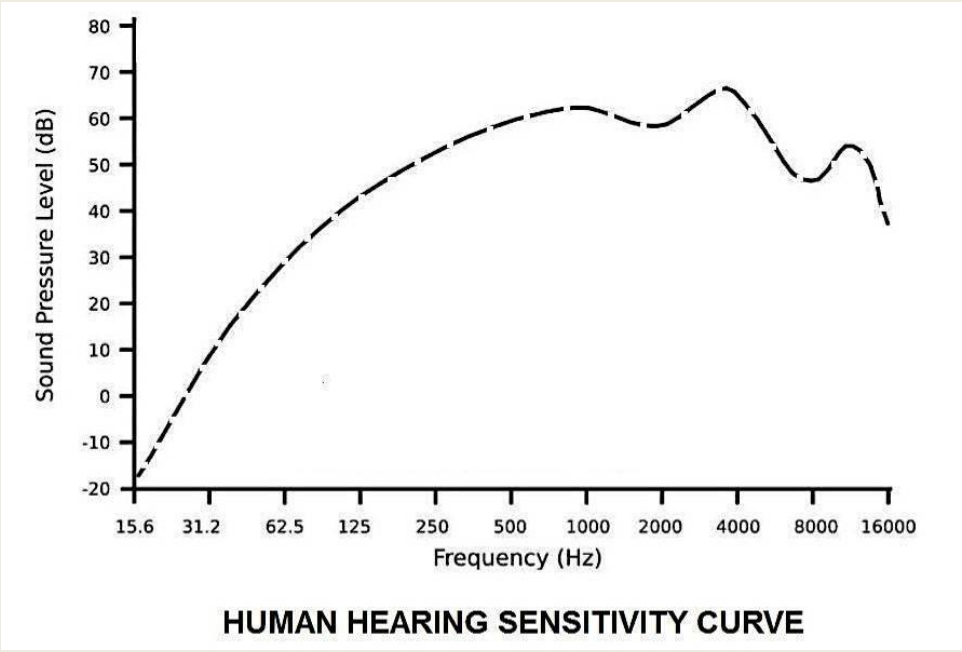


Figure 3

PSYCHO-ACOUSTICS IN AUDIO ENGINEERING

Therefore, in exact opposite, the frequency response and loudness on the reproduction of the audio signal curve has to be in reverse to compensate
for the deficiency as illustrated in Figure 4, providing extra boost in the low frequency. This will automatically equalise the human auditory system to perceive a “flat” response curve as analysed and described in detail in
Figure 5.

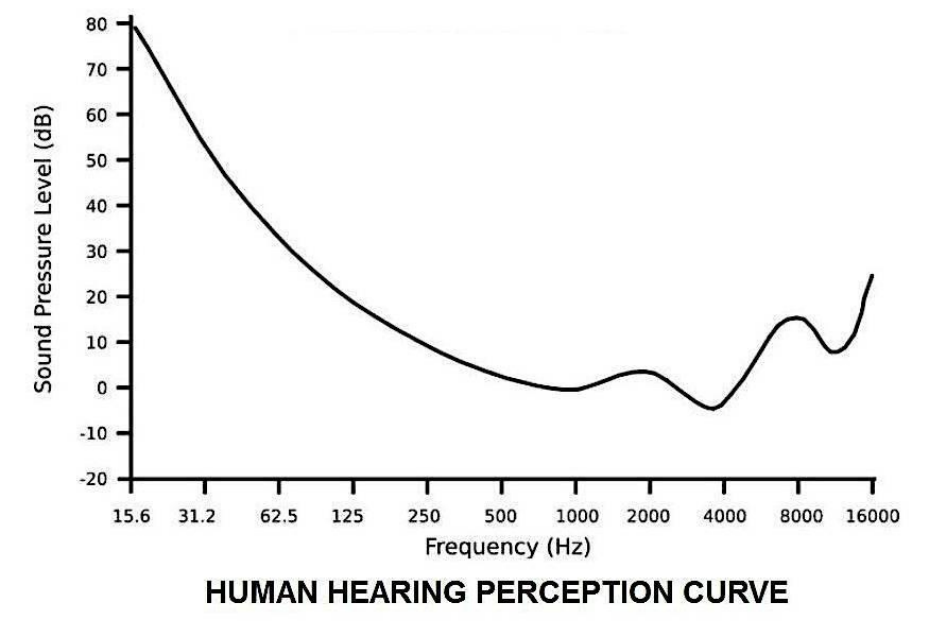


Figure 4

During the era of analogue recordings, based on the Recording Industry Association of America (RIAA) response curve for recording, the “Loudness” or “Contour” controls was incorporated into amplifiers to equalise for the human psychological auditory perception. Today this is done by the audio processors and loudspeakers, a good example on loudspeakers is the waveguide concept adopted by several speaker manufacturers. The effect is to tune the port or waveguide to resonate at the desired frequency to increase the bass frequency response of the loudspeaker in an enclosure. I will not go into the pros and cons of this technology, but it serves the psychological requirement.

The detailed technical characteristics and explanation on the sound process and psychological perception for the human auditory system are illustrated in Figure 5.

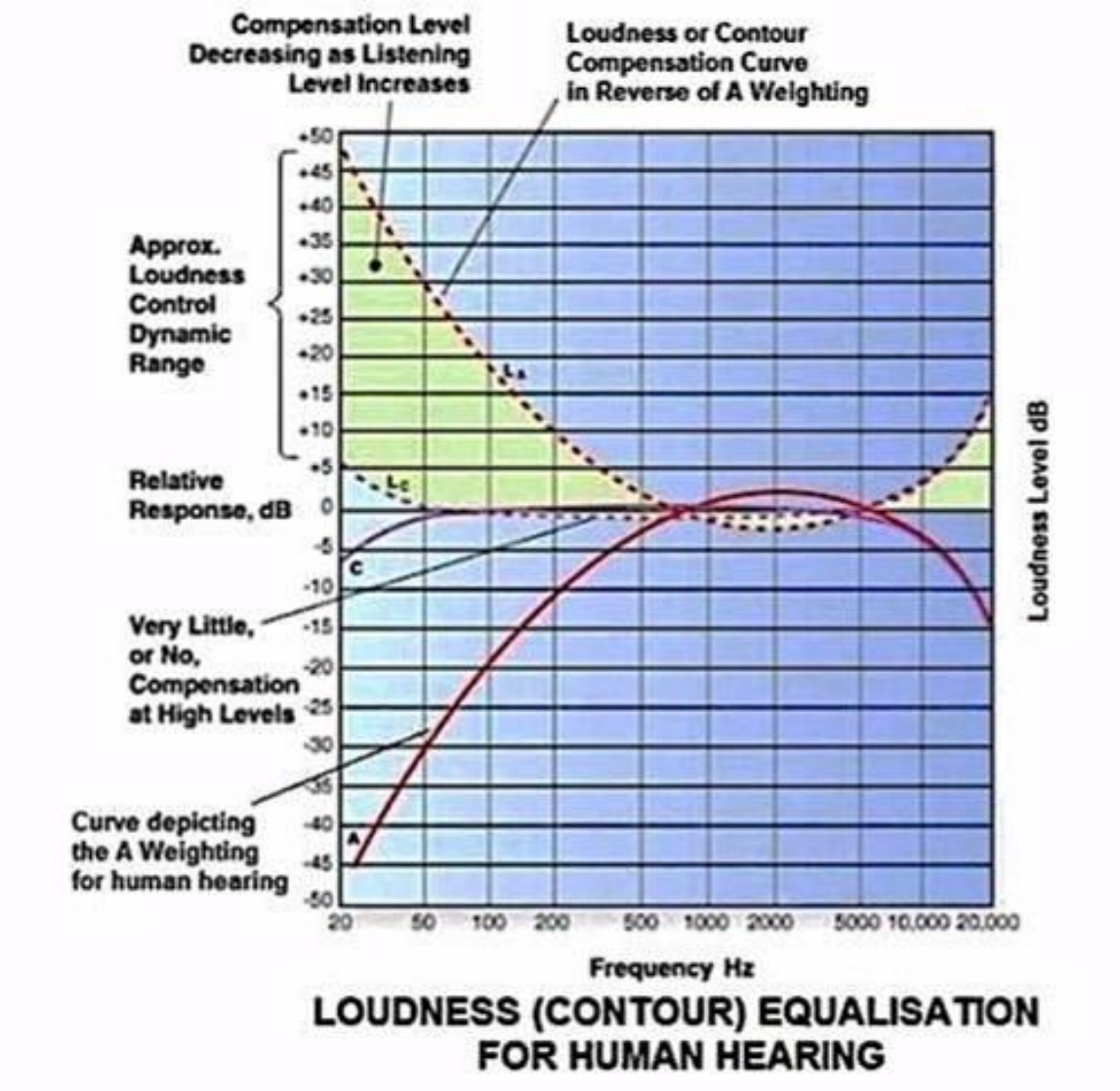
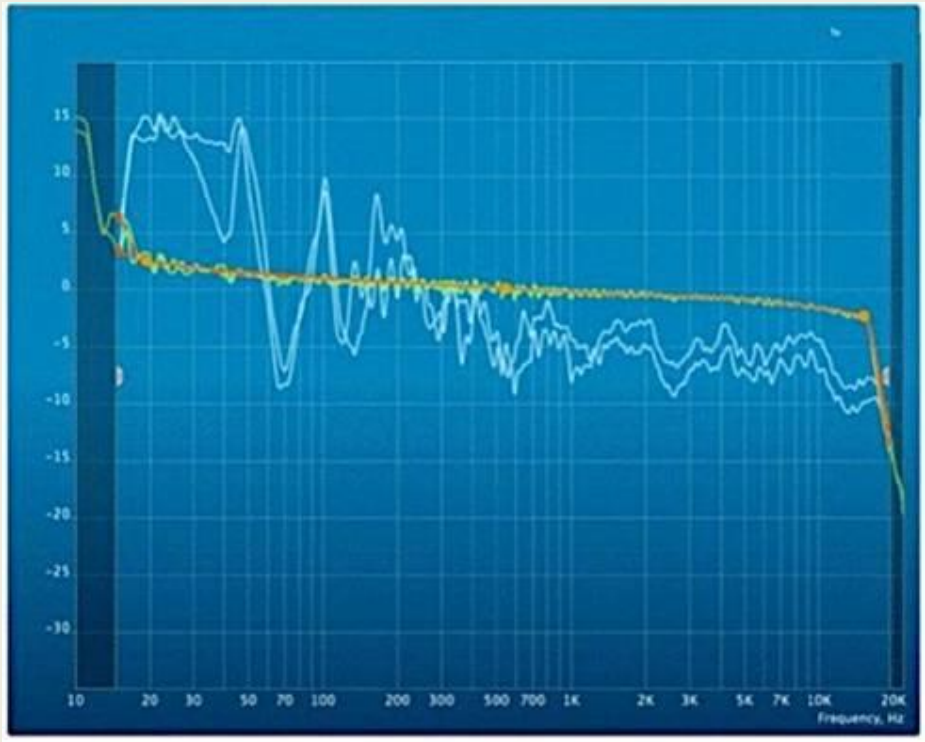


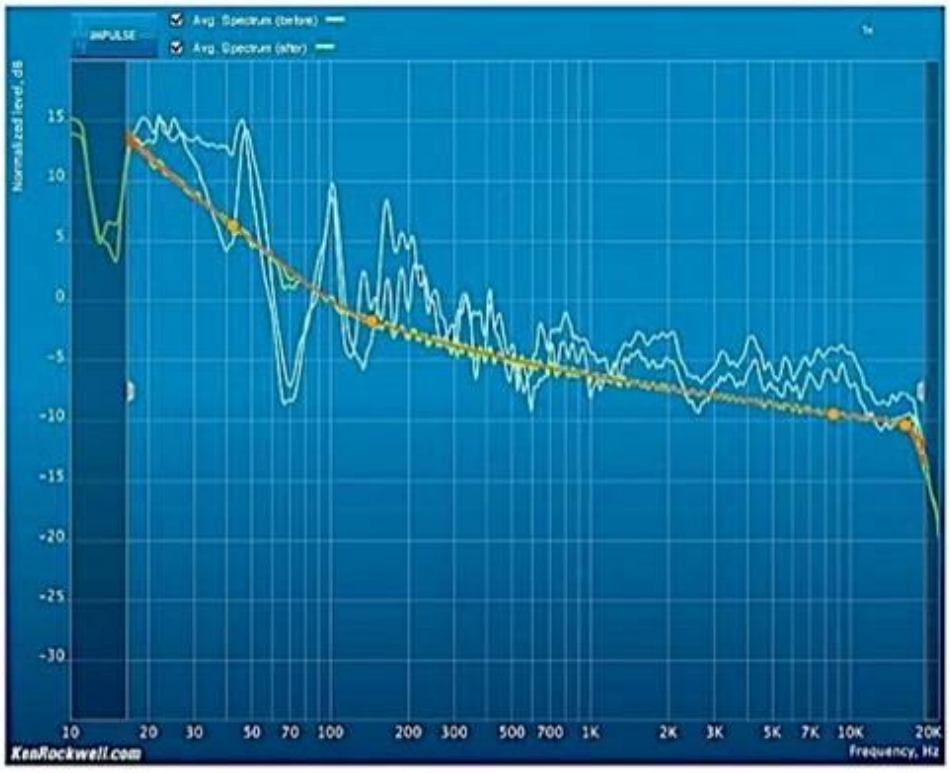
Figure 5

Today, recording industries throughout the world realise the significance of the factor in order to attract music enthusiast in buying their recordings, they incorporate the “contour” compensation into their recordings. The following diagrams Figures 6 and 7 illustrates the difference in the response curves for conventional and the latest recorded programmes, indicating that technical equalisation has been added on the psycho-acoustics requirement, to enhance the enjoyment in the music being listened to.



RECORDING CURVE ADOPTED BY RECORDING INDUSTRIES FOR AVERAGE HUMAN HEARING

Figure 6



RECORDING CURVE ADOPTED BY SOME INDUSTRIES FOR HIGHER PRE-EMPHASIS ON THE BASS RESPONSE

Figure 7

SOUND ON LIVE AND RECORDING

For recorded sound the electro-acoustics (ELA in short) technology in music originated in Western art music incorporating electric sound production into compositional practice. The initial development in electro-acoustic music was during the 20th Century in Paris, Cologne and Columbia Princeton Electronic Music Centre in New York. During the same period, recording industries explored various media to store recorded sound.

Music recording was discovered by Thomas Edison in 1877 and the first recording was made on wax cylinder from transmitting sound waves captured by a megaphone and acoustically vibrating a stylus to engrave the modulation on the wax coating. Playing back the recorded sound was the reverse of the recording process in Figure 8.

Figure 8

It was superseded by the 78 RPM single disc, which together with the gramophone revolutionised the record player industry during 1930. This opens up the innovation on acoustic megaphones and compact record players. The last acoustic gramophone player before the introduction of electro-acoustics record player is illustrated in Figure 8A. The acoustical sound-box is built into the cabinet, eliminating the megaphone horn.

Figure 8A

Electronic sound was introduced at the end of 1930, beginning of 1940, together with the “talkie” sound movie. This saw the electric turntable, valve amplifier and loudspeaker being introduced for domestic use. Together the Public Address System was introduced in the 1940 using mainly horns and low powered speakers for sound distribution.

In the middle of 1960 came the High Fidelity (Hi Fi) home sound system together with full frequency range valve amplifier and full range speaker system. This accelerated the introduction of the vinyl long play records and magnetic tape recorders

Recorded sound or music can be categorised in the following terminology:

1) Mono or Monaural - One sound channel.
2) Stereophonic or Stereo - two sound channels.
3) Binaural (stereo) was used till late 1970.
4) Quadraphonic - Four sound channels (used for short period).
5) Dolby 5.1, 7.1 and 9.1 (audio for home video)
6) DTS used mainly for cinema sound.

Although significant innovation in audio engineering have been made in the recording / playback technology and equipment with improved frequency response and dynamic range. Recorded sound can never equal the live vocal and music is due to the acoustic polar dispersion of the loudspeaker systems.

Live music has omni-direction polar dispersion characteristic as illustrated in Figures 9 and 10 of music instruments and orchestral arrangement respectively, no loudspeaker can provide the similar ambiophonic sound distribution polar pattern

Figure 9

Figure 10

Most loudspeakers with drivers on one single plane baffle as illustrated in Figure 11 can never provide the amount of sound dispersion required for
the complex ambiophonic effects of the musical instruments and orchestral
arrangement.

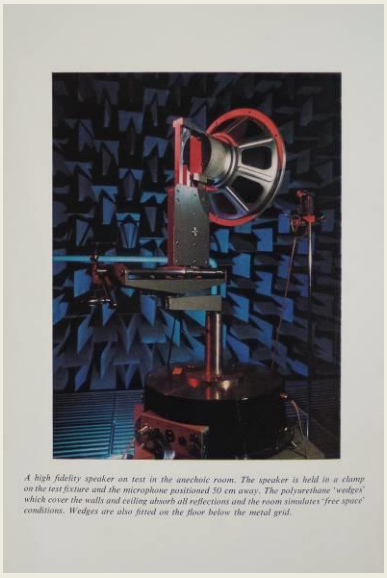
Figure 11

Although several experiments have been conducted with multiple delayed loudspeakers, by Philips in 1978 to emulate the live sound effects of concert hall, none has been successfully accepted as the standard reference. As the algorithm for sound harmonics and transient on the sound waves are too complex to replicate electro-acoustically.

In the late 1960 about 55 years ago, I realised that if a speaker system can be developed to depict the omni-directional polar dispersion characteristics of live instruments and orchestral sound, it may be able to emulate the ambiophonic sound effects in real time and acoustic “tonal colour”. With the help of Philips speaker design handbook and the engineering experience, I embarked on the project which took me over 3 years to complete.

Figure 12

In early 1970 Philips ELA Professional Division in Eindhoven, the Nederland published several books on loudspeaker tests, components and enclosure designs shown in Figures 12 and 12A



A high fidelity speaker on test in the anechoic room. The speaker is held in a clamp on the test fixture and the microphone positioned 50 cm away. The polyurethane 'wedges' which cover the walls and ceiling absorb all reflections and the room simulates 'free space' conditions. Wedges are also fitted on the floor below the metal grid.

A selection of the high quality and high fidelity loudspeakers which are used to build the recommended systems.

Figure 12A

I developed an identical pair of speaker system to provide the omni-directional sound dispersion of 190 deg (H) x 120 deg. (V) at +/- 3 decibels
in sound pressure level variation.

(Engineering Note: Normal single frontal plane baffle loudspeaker can only achieve +/- 10 decibels at 120 degrees. In audio engineering quantum 3 decibels is half of the acoustical power from a loudspeaker. At 10 decibels the acoustical power is approximately one third.)

This allows the speaker system to provide the dynamic range of acoustic instruments at the side polar angle of coverage. Figure 13 illustrate the speaker system without the front grille to show the drivers.

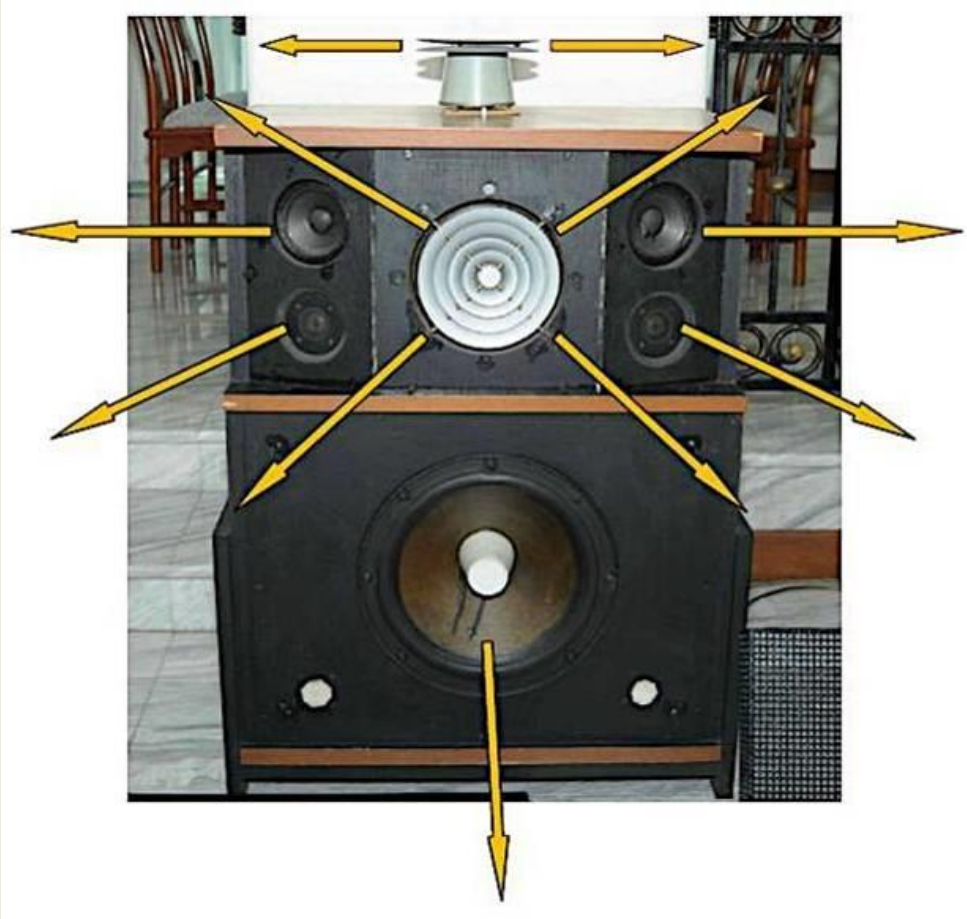


Figure 13

The mid-range and high frequency speaker section consist of two baffles angled at 35 degrees each comprising 5” mid-range speakers and 1.5 inch soft dome tweeters. To provide the additional imaging in the centre an 8 inch loudspeaker for the mid-low fitted with a 45 degrees “acoustic-lens” to further enhance the omni-directional sound coverage as illustrated in Figure 14.

Figure 14

To provide the high frequency omni-directional sound propagation, the Pioneer 360 degrees dispersion super tweeter is utilised and located on top of the cabinet in Figure 15.

Figure 15

For the bass reproduction, a single 12” high compliance driver sealed in an infinite baffle enclosure produces a flat bass response from 40 to 180 hertz,
illustrated in Figure 16. This allows the low frequency reproduction of the bass to be reproduced “flat” without any harmonics, resonance or “colouration”.

Figure 16

The speakers arrangement in the living room Figure 17 provides “life-like” sound reproduction from any seating location, the back walls deflect the
rear sound-wave to enhance the bass acoustical output..

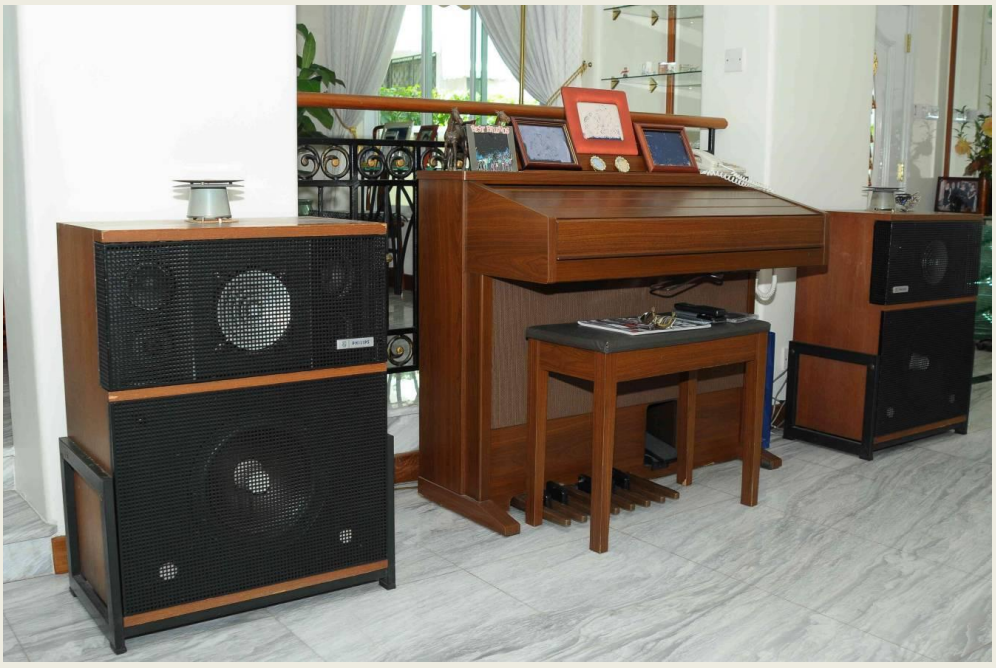


Figure 17

The passion for sound recording engineers to depict the realism in live sound recording for the living room existed from the mid 1970. Capitol Record industry released numerous vinyl record in plastic casing “Staged for Stereo” clearly publicise the determination and interest, long before digital recording is a reality. The cover note in Figure 18 and 18A are proofs of the idea and engineering effort put into the concept of emulating life-like sound recordings.

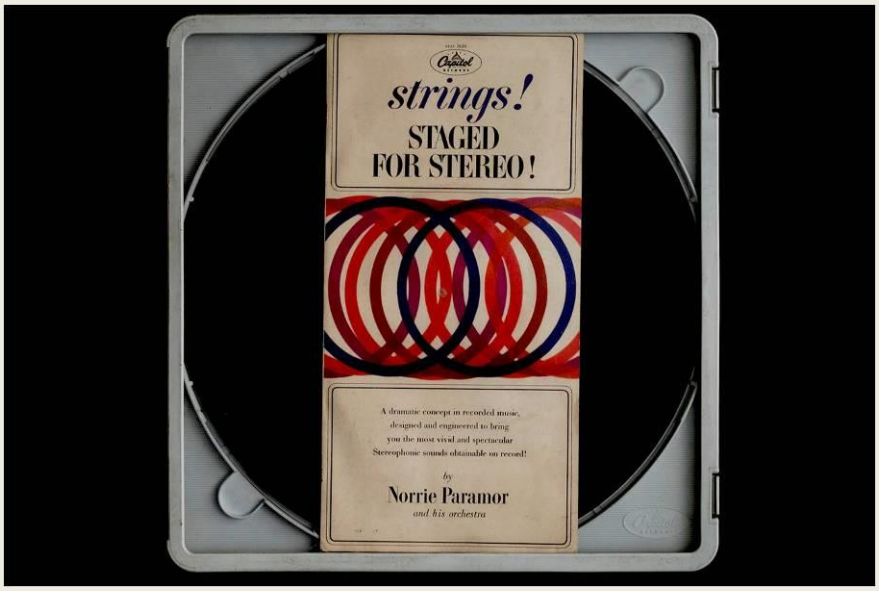


Figure 18

The special Long Play Record Album cover note also includes the technical information on engineering technique in production of the vinyl recording and orchestral arrangements.

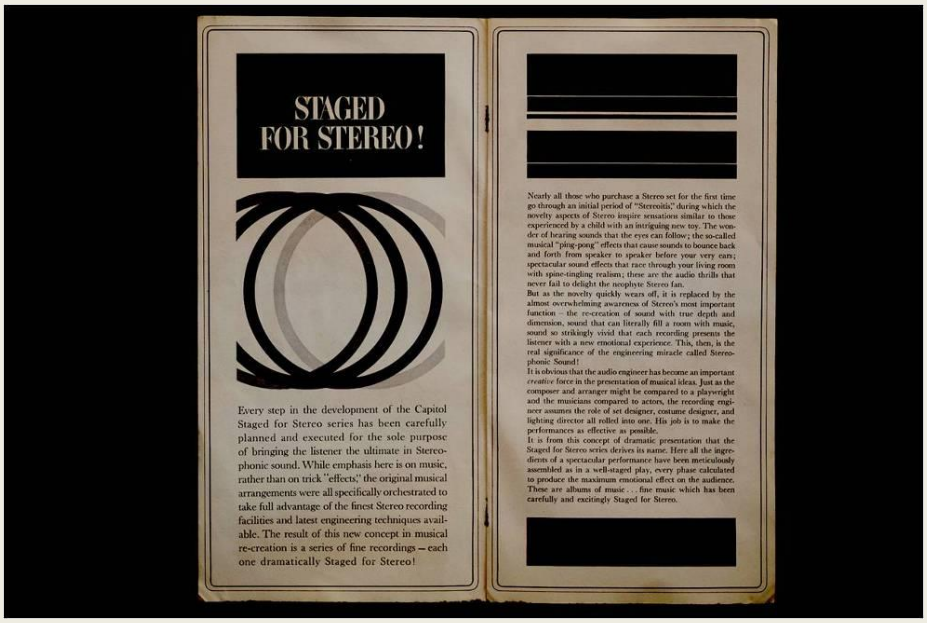


Figure 18A

What really touched me most are these concluding words said in the cover note on the Stereo Recording, which read:

"…….But the novelty quickly wears off, it is replaced by the almost overwhelming awareness of Stereo's most important function……."

…….”THE RECREATION OF SOUND WITH TRUE DEPTH AND DIMENSION…….”

CONCLUSSION

Evidences indicate that from way back in 1970, existed the passion and determination by recording and sound engineers to achieve the realism
in Sound Reproduction.

The last picture Figure 19 illustrates the progress made in audio engineer's dream on the possibility of achieving the full dynamic range in recorded sound.

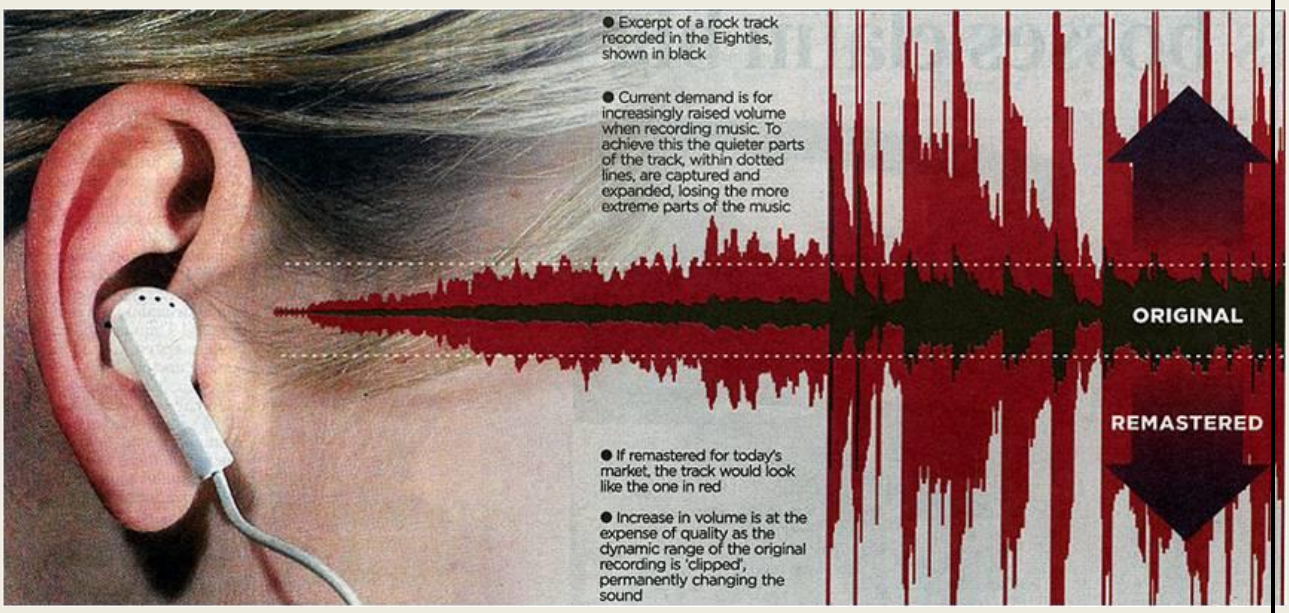


Figure 19

The technology in Electro-Acoustics has progressed significantly for audio recording in achieving the dynamic and frequency range to emulate live music and vocal performances.

We only need the right speaker system to do the job!

Acknowledgements on the articles and Images re-produced through the courtesy of:

Philips Industries, Nederland;
Wharfedale, United Kingdom;
HMV, United Kingdom
Dynacord, Germany;
Capitol Records, USA;
and
Wikipedia Encyclopedia.

VI.REPORT ON CONFERENCES

WESPAC 2015 Singapore-Extraordinary Success

The WESPAC 2015 Singapore was successfully held at the Grand Copthorne Waterfront Hotel in Singapore from 6 to 9 Dec 2015. There were in total 276 pre-registered participants from 25 countries. There were 8 keynote addresses and 14 full fledged exhibitors and 5 exhibitors with only posters and 3 sponsors including the Acoustical Society of America. The most encouraging sign is the strong participation with Singapore scoring the overall second place with 35 participants after the first place Japan with 95 registrations and the third was China with 32 participants.

The breakdown in field categories was as follows

1. **Architectural acoustics 132**
2. **Noise 119**
3. **Underwater acoustics 99**
4. **Signal processing in acoustics 80**
5. **Acoustical imaging 51**
6. **Railway acoustics 37**
7. **Engineering in acoustics 35**
8. **Structural vibration & acoustics 31**
9. **Acoustical metamaterials 26**
10. **Psychological acoustics 24**
11. **Musical acoustics 19**
12. **Ultrasonics 18**
13. **Speech communication 18**
14. **Physical & biomedical acoustics 11**

VII. BID FOR FUTURE INTERNATIONAL CONFERENCES

Riding on the success of Wespac 2015, the society is bidding to host the International Congress on Acoustics(ICA) in Singapore in 2025 and to host the International Congress on Sound and Vibration(ICSV) in Singapore in 2019.

Government Bodies

www.mom.gov.sg

www.nea.gov.sg

www.lta.gov.sg

Technical and Research Sites

Corporate Sites

www.metaultrasound.com

www.noisecontrols.com

(The Society welcomes interested parties to contribute relevant websites to the above e useful links. For more information, please contact us. Thank you.)

President: Woon Siong Gan
E-Newsletter compiled by: Woon Siong Gan