THE SOCIETY OF ACOUSTICS SINGAPORE

E - NEWSLETTER

March Issue, 2024

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Registration No: 0331/1989
Year of Registration: 1989

CONTENT

I. CONFERENCE NEWS

1. **The First Online ASEAN International Acoustics Workshop.** Was successfully held online on the 9 May 2023,Tuesday with 52 participants from eight nationalities of UK, Russia, Spain, India, Indonesia, Malaysia, Singapore, and Thailand.

2. **The Singapore chapter of the IEEE Ocean Engineering Society** organized a Distinguished Lecture by Prof John R Potter on Listening at the Speed of Light: what could Distributed Acoustic Sensing do for you? on 21 September 2023 both online and physically at S2S Conference Room, Tropical Marine Science Institute, National University of Singapore. This lecture was also supported by the Society of Acoustics(Singapore).

3. **The Society of Acoustics(Singapore) also jointly organized with the Association of Vibration and Acoustics of Thailand** a webinar on the 6 October 2023. The title was Algorithm for calculation of the measured single fly-over aircraft noise and was given by Thapara Boonohoo and Krittika Lertsawat. It was highly successful with 26 participants.

II. ANNOUNCEMENTS

UPCOMING ELECTIONS DURING THE AGM

The SAS invites candidates to submit their interest for the following function:

- **President of the SAS**

Please send an email to : president@acousticssingapore.com and secretary@acousticssingapore.com

The Society of Acoustics(Singapore) 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 organizing zoom seminars/workshops and other professional events in collaboration with acoustic societies of the ASEAN 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. INTERNATIONAL ACOUSTICS NEWS

The 30th International Conference on Sound and Vibration will be held in Amsterdam from 8 to 11 July 2024. The conference website is www.icsv30.org. Woon Siong Gan will be organizing three structured sessions in this conference:
1.Structured Session on Nonlinear Acoustics & Vibration
2.Structured Session on Sound Propagation in Curvilinear Spacetime
3.Structured Session on Acoustic Metamaterials & Phonon Crystals: Fundamentals & Applications
The Society of Acoustics(Singapore) will be jointly organizing with the Association of Acoustics and Vibration Indonesia(AAVI) a joint webinar on the 22 April 2024,Monday,4-6pm Singapore time. The title of webinar is Development of Microperforated Panel Absorbers to be given by Dr Iwan Prasetiyo of the Institut Teknologi Bandung,Indonesia.

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. Woon Siong Gan at email: wsgan5@gmail.com

Membership application forms can be downloaded from the society website: www.acousticssingapore.com Please complete and email to wsgan5@gmail.com

IV. ARTICLES

The following article is a condensed form of the paper to be presented at the ICSV30, Amsterdam

TRANSPORT THEORY EXPLANATION & UNDERSTANDING OF VIBRATION THEORY

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Abstract
In this paper,transport theory is used for the explanation and understanding of vibration .This is an extension of the transport theory of condensed matter physics with the scale extended from the microscopic region to the macroscopic region.Transport theory has two components:particles interaction which in this case is the coupled oscillation leading to heat generation and heat transport and the singularities studies which in this case is resonance.
Keywords: no more than five words (transport theory,singularities,resonance))

1. Introduction

The usual vibration theory includes the theory of free vibration, forced vibration,coupled vibration, random vibration,and coupled oscillation. In this paper,transport theory[1]is used for the explanation and understanding of vibration theory. Transport theory[1] in condensed matter physics was coined and invented by Woon Siong Gan in 1966 during his PhD works at the physics department of Imperial College London. To apply transport theory to vibration theory is just the extension of the scale used in condensed matter physics which is of microscopic dimension to macroscopic dimension. The statistical energy analysis(SEA) of vibration in fact is a transport theory.[2]. Transport theory has two components. One is particles interaction studies which in the case of vibration is coupled oscillation which will lead to the generation of heat and heat transport. The other component is singularities studies which in the case of vibration studies is the explanation of resonance as a form of singularities of the vibrating system. This paper will be the application of transport theory to vibration studies by focusing on these two components.

2. Heat transport in coupled vibration---entropy in vibration

A practical example used to study heat transport in vibration is to study the coupled oscillation system consisting of very large number of oscillators.The usual theory used is statistical energy analysis(SEA). In the 1960s.Lyon and coworkers [2] found that sound and vibration flows from high energetic to low energy energetic regions exactly as heat does in solids. This result is the foundation of statistical energy analysis, a statistical theory of sound and vibration and is a transport theory. Under certain conditions,vibrational energy may be assimilated to heat,it becomes possible to apply Clausius definition of entropy and therefore to introduce a vibrational entropy as well as a vibrational temperature. The vibrational temperature T=E/kN where E=vibrational energy and N=number of modes,and k=Boltzmann's constant. The occurrence of entropy[3] in statistical energy analysis is not only a logical requirement for a complete and coherent derivation of statistical vibroacoustics but it is also necessary to understand the exact link between statistical energy analysis and non-equilibrium thermodynamics beyond their apparent analysis. To introduce entropy in statistical vibroacoustics, one must first specify the dynamical system. A sub-system is a packet of N modes with increasing natural frequencies ωi ,i=1,……,N. The Hamiltonian

$$H(q1,\ldots\ldots qN,p1,\ldots\ldots\ldots pN)= \sum mi\ 2\ N\ i=1\ \omega i\ 2qi\ 2 + 1\ 2mi\ pi\ 2 \qquad (1)$$

where qi= the modal reflection and pi=impulsion. In phase space,the trajectory is determined by the functions qi (t),pi (t),i=1,……..,N,solutions of the equation of motion. A microstate at time t is therefore given by the values, , .,i=1,……..,N. This is what is provided by by a deterministic method such as finite element method. But in statistical vibroacoustics,forces are random and it is impossible to predict the microstate. The position $q1,\ldots\ldots qN,p1,\ldots\ldots\ldots pN$ becomes a random vector in phase space and one must abandon the idea of determining it exactly.The exact repartition of vibrational energy over modes is therefore not known. What is claimed in statistical energy analysisis that we are not interested in the exact repartition of vibrational energy over modes but only in the knowledge of the number of modes N and the total vibrational energy E of such system. A macrostate is therefore given by the value of the total vibrational energy E and the number of modes N. In statistical mechanics, the state of a system is only known by its probability density of presence ρ in phase space. This distribution ρ must indeed verify the renormalization condition

$$\int \rho d\Gamma = 1 \qquad (2)$$

where dΓ=d$q1$……dqNd$p1$……dpN is the infinitesimal volume in phase space. The mean vibrational energy E is

$$\int \rho H d\Gamma = E \qquad (3)$$

The entropy attached to a distribution ρ is defined by

$$S = -k\int \rho \ln(\rho h^N) d\Gamma \qquad (4)$$

The presence of Planck's constant h is necessary for dimension reason in the argument of the loh function. The problem is to maximise ∫ of equation (4).under the constraints (2) and (3). It leads to the canonical distribution

$$\rho\ (q1,\ldots\ldots qN,p1,\ldots\ldots pN) = \exp(-\beta H)\ Z \qquad (5)$$

where Z= partition function.

3. Vibration resonance to be explained by partition function and singularities .

3.1 Derivation of Partition Function for Resonance and Lee Yang Zeros

E and the number of modes N. In statistical mechanics, the state of a system is only known by its probability density of presence ρ in phase space. This distribution ρ must indeed verify the renormalization condition

$$\int \rho d\Gamma = 1 \qquad (2)$$

An important part of transport theory is the singularities property of the transport property at the critical point of phase transition. Resonance is a singularity phenomenon of the vibration system. At the resonance frequency, the amplitude of vibration will tend to infinity .The use of partition function to study singularity at the critical point of the critical phenomenon will enable the study of the region surrounding the critical point and not just the critical point alone. An example is the study of the singularity of the partition function at the critical point of magnetization,,a phase transition. This is known as the Lee Yang theory[4] and the distribution of the Lee Yang zeros at the region surrounding the critical point of phase transition will show the tendency and the trend towards phase transition and enable the prediction of phase transition. In this paper, the partition function method,likewise the distribution of the Lee Yang zeros surrounding the critical point of resonance will enable the prediction of resonance. The cased of forced vibration will be used The intensity of vibration which is vibrational energy equals the square of the amplitude of vibration will be determined. First the partition function of vibration will be derived. The partition function is defined as

$$Z = \exp(-Ei\ /kB\mathrm{T}) \qquad (6)$$

where Ei = free energy=Hamiltonian for the case of vibration,and kB= Boltzmann's constant.

For an equilibrium system in the canonical ensemble,all statistical information about the system is encoded in the partition function

$$Z = \sum i \exp(-\beta i\, Ei) \quad (7)$$

where the summation runs over all possible microstates,Ei=the energy of a microstate,and βi=1/kBT = inverse temperature. The free energy can also be written as

$$Ei = -\beta i - 1 \ln[Z] \quad (8)$$

The Lee Yang zeros may be connected to the cumulant of the conjugate variable Φ of the control variable q. For brevity,one sets β=1 in the following. Using that the partition function is an entire function for a finite-size system, one may expand it in terms of its zeros as

$$Z(q) = Z)(0)e\ cq \prod k\ (1 - q/qk) \quad (9)$$

where Z(0) and c are constants, and qk is the kth zero in the complex plane of q. The corresponding free energy then reads - -

$$(q)= \ln[Z(0)] + cq + \sum k \ln(1 - q/qk] \quad (10)$$

Differentiating this expression n times with respect to q,yields the nth order cumulant at

. $$<>=\partial q\ n\ [-F(q)] = - \sum (n-1)!\ (qk-q) \quad , n>1 \quad (11)$$

Furthermore, using that the partition function is a real function, the Lee Yang zeros have to come in complex conjugate pairs,allowing us to express the cumulants as

$$<>= -(n-1)!\sum 2\cos(narg\{qk-q\})\ (qk-q)\ k\ n\ , n>1 \quad (12)$$

where the sum now runs only over each pair of zeros. This establishes a direct connection between cumulants and Lee Yang zeros. Moreover, if n is large,the contribution from zeros lying far away from q is strongly supressed,and only the closest pair q0 of zero plays an important role,one may then write

$$<>= -(n-1)!\ ,\ 2\cos(narg\{qk-q\})\ (qk-q)\ n\ n>1 \quad (13)$$

This equation may be solved as a linear system of equations,allowing for the Lee Yang zeros to be determined directly from higher-order cumulants of the conjugate variable[5].

$$[\ 2Re[q - q0]\ /q - q0/\ ] = [\ (h - 1)\kappa n\ (-)\ h\kappa n{+}1\ (-)\ ]\ /\ [\ 1 - \kappa n\ (+)\ n\ 1 - \kappa n{+}1\ (+)\ n{+}1\ ] \quad (14)$$

where $\kappa \pm$ = << $\Phi n{+}1$ >> << Φn >> The application of the Lee Yang zeros is to control the resonance of the vibration system because the distribution of the Lee Yang zeros of the vibration system is useful to study the trend towards resonance of the vibration system. Using the transport theory or partition function explanation of vibration resonance, the Lee Yang zeros are distributed in the region surrounding the critical point where resonance took place and where the partition function is zero..When partition function is zero, then free vibration energy becomes infinity and it also yields negative entropy at least within the system. . 4. Conclusions Transport theory is used for the explanation and understanding of the vibration theory. Vibration involves heat transport and is explained in terms of vibration entropy. The resonance phenomenon in vibration is explained and understood as a singularity phenomenon.

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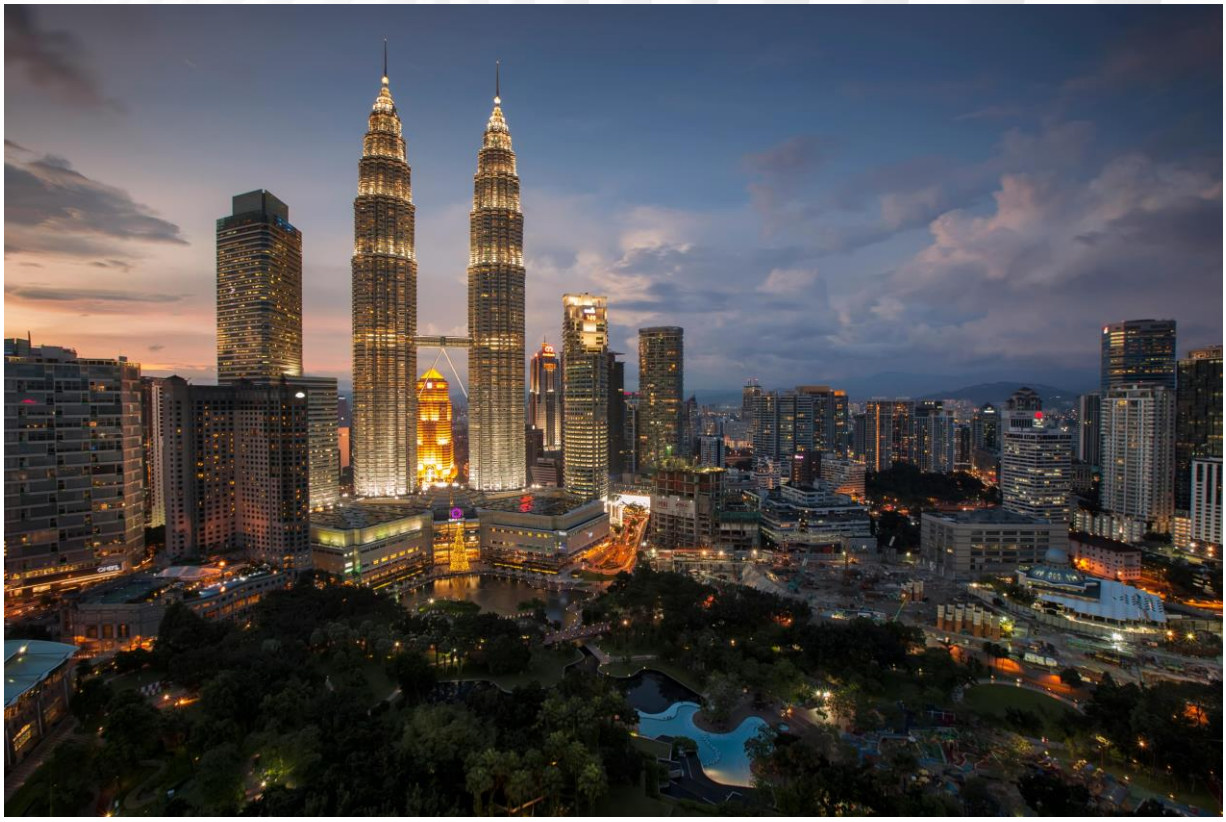

Developing a nationwide environmental noise map database – the implemented methodology and the potential benefits to Malaysia

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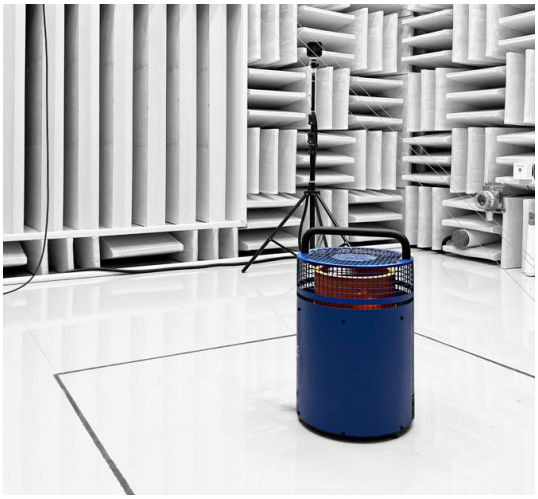
VI. PRODUCTS ON ACOUSTICS

Acoustic Laboratory Thailand

Acoustic Laboratory Thailand

NSC-TISI-TIS 17025
CALIBRATION 0468



ALT (Acoustic Laboratory Thailand) just achieved ISO17025 for calibration of sound and vibration instruments.

Thailand's Acoustic Laboratory (ALT) proudly announces its achievement of ISO 17025 accreditation, a prestigious recognition of its commitment to excellence in acoustic testing and measurement. This accreditation underscores ALT's dedication to providing high-quality services and further solidifies its position as a trusted leader in acoustic testing within the region.

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Measure vibrations of small components & microstructures

MSA-060 Micro System Analyzer

The MSA-060 Micro System Analyzer from Polytec enables a non-contact and extremely precise investigation of the vibration behavior of MEMS and microsystems as well as a detailed analysis of the component dynamics of precision mechanical components and the reliability of electronics. This compact and modular optical vibration measurement system offers an entry-level solution for the Micro System Analyzer family and supports the determination of resonance frequencies and vibration amplitudes. In addition, it visualizes the vibration shape of samples over the entire surface, enabling comprehensive analysis.
The performance of sensors and actuators in MEMS depends heavily on component behavior. The MSA-060 provides important insights for optimization and bridges the gap between design, simulation and manufacturing. Equipped with different magnifications, the MSA-060 enables versatile non-contact vibration analysis.

The powerful data acquisition with VibSoft-PRO extends the measuring system with a reference channel and signal generator. An optional xy-table can be integrated, which enables the scanning of entire sample surfaces. The system delivers real-time vibration data with picometer resolution over an extended bandwidth of DC to 24 MHz.
In micro- and nanotechnology, the precise characterization of components and structures is of crucial importance. The MSA-060 helps to improve the performance and reliability of these devices by providing accurate vibration data, which is essential for the development and optimization of MEMS and microsystems.
The compact measuring head used in the MSA-060 allows measurements on macroscopic structures in addition to the wide range of applications in microsystems technology. For this purpose, the measuring head can easily be operated with a lens for larger working distances on a standard stand. This flexibility is certainly much appreciated in training and teaching.

In addition, the MSA-060 offers a user-friendly interface and intuitive operation that enables engineers and researchers to quickly and efficiently acquire and analyze high-quality data.
Overall, the MSA-060 Micro System Analyzer is a powerful solution for full-field vibration measurement of small components and microstructures. With its ability to provide precise and detailed vibration data, it contributes significantly to improving the performance, reliability and efficiency of MEMS, microsystems and precision mechanical components.
region.

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VII. ACOUSTICAL NEWS

The ASEAN Acoustics Commission was founded in March 2023. It comprises of the national acoustical associations and societies from Indonesia, Malaysia, Singapore, and Thailand. This is for the purpose of regional cooperation in parallel with the WESPAC(Western Pacific Acoustics Commission). Members of the individual acoustical associations and societies of the comprising countries will automatically become individual members of the Acoustics Commission with no additional membership fees needed. The Acoustics Commission will organize regional acoustical conferences and publish an e-newsletter periodically.

VIII. REPORT ON CONFERENCES

The Regional Conference on Acoustics and Vibration (RECAV) organized by the Society of Acoustics(Singapore) and the Association of Acoustics and Vibration Indonesia(AAVI) was successfully held in Bali, Indonesia from 27 to 28 Nov 2017. There were 110 presentations from 14 countries with 60% of them from Indonesia. There were also some 18 exhibition booths. This reflected strong local participation and the international nature of the conference.

The 28th International Congress on Sound and Vibration(ICSV28) jointly organized by the International Institute on Acoustics & Vibration(IIAV) and the Society of Acoustics(Singapore) was held successfully as a hybrid event with 160 physical participants and 201 online attendance. It was held at the Marina Bay Sands from 24 to 28 July 2022

The ICSV28 was successfully jointly organized by the Society of Acoustics(Singapore)(SAS) and the International Institute of Acoustics and Vibration(IIAV) in July 2022. SAS would like to thank all members of the local organizing for their efforts in bringing this conference to great success especially to Dr Venugopalan Pallayil, the General Chair who has sacrificed time with his family and worked during the weekends.

IX. BID FOR FUTURE INTERNATIONAL CONFERENCES

The Society of Acoustics(Singapore) will be bidding for hosting the ICA 2031 in Singapore in 2031.

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Government Bodies

www.mom.gov.sg www.nea.gov.sg www.lta.gov.sg

Technical and Research Sites

Corporate Sites

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

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