E-NEWSLETTER

June 2020 issue

THE SOCIETY OF ACOUSTICS SINGAPORE

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Year of Registration: 1989

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CONTENTS

I.CONFERENCE NEWS

. The 27^{7h} International Congress on Sound and Vibration(ICSV27) will be held in Prague.Czech Republic from 12 to 16 July 2020.

Woon Siong Gan will be organising three structured sessions on:

1. **Nonlinear acoustics and vibration**
2. **Acoustic metamaterials & phononic crystals: fundamentals and applications**
3. **Sound propagation in curvilinear spacetime**

Please visit www.icsv27.org for more informations.

Due to the coronavirus situation, the ICSV27 will be postponed to July 2021, but will still be held at the same hotel in Prague. Please visit www.icsv27.org for further informations.

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.

Please note that Acoustical Laboratory Pte Ltd has moved to the following new address:

WE HAVE MOVED
TO OUR NEW OFFICE AT

318 Tanglin Road, #01-56, Phoenix Park Campus,

Singapore 247979.

OUR CONTACT NUMBERS REMAIN UNCHANGED.
Tel: (65) 6465 6212 Fax: (65) 6465 6223
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III.INTERNATIONAL ACOUSTICS NEWS

Woon Siong Gan was recently elected as a Director of the International Institute of Acoustics and Vibration(IIAV) for the period 2018 to 2022.

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

V.ARTICLE

The following paper is a brief version of the paper to be presented at the ICSV27, Prague, July 2021.

Transport Theory in Acoustics and Vibration

Woon Siong Gan

In 1966 during the course of his PhD work in the physics department of Imperial College London, Woon Siong Gan coined and invented the name transport theory in condensed matter physics[1] . In the past, transport theory is only used in nuclear science, as neutron transport theory for the design of nuclear reactor. Today transport theory is the key foundation of the theoretical design of materials. Its status in condensed matter physics is equivalent to that of the Yang Mills theory in particle physics. During the ICSV26 in Montreal in July 2019, after the presentation of my paper 50th anniversary of the transport theory in condensed matter physics[2], Dr Alain Le Bot, Directeurde recherche,Laboratory of tribology and dynamics of systems, CNRS,Lyon,France and author of the book Foundation of Statistical Energy Analysis in Vibration, Oxford University Press, 2015[3], mentioned to me that transport theory is also used in acoustics and vibration and that the statistical energy analysis(SEA)[4,5] is a transport theory. His book also has a book review by G. Maidanik, one of the founders of statistical energy analysis. He mentioned that it is only a difference of scale. . In acoustics and vibration it is of the macroscopic scale and in condensed matter physics it is of the microscopic scale. In fact C H Hodges and J Woodhouse in Theories of noise and vibration in

transmission in complex structures,Rep.Prog.Phys.49,107-170,(1986)[6] also mentioned that statistical energy analysis, the most famous method in acoustics and vibration is a diffusive transport theory.This shows the broad scope of transport theory which not only can be used in condensed matter physics but also can be used in acoustics and vibration.

The application of transport theory in acoustics and vibration is an example of the introduction of statistical mechanics into acoustics and vibration. The application of fluid mechanics and Navier-Stokes equations in acoustics and vibration have already reached the limit. One has to go beyond fluid mechanics to reach the next level of research.Other examples such as the interpretation of turbulence and sonoluminence[7,8] as second order phase transition are also examples of the application of statistical mechanics in acoustics and vibration.

Statistical energy analysis(SEA) is a method for predicting the transmission of sound and vibration through complex structural acoustic systems. It is particularly useful when there are thousands of vibration modes involved with in the huge complex structures and statistical approach has to be used. Here the structural vibrational behaviour of elements(subsystems) is analysed statistically. It is used in high frequency vibration problems for vibration prediction but can also be used for predicting noise levels of new designs such as that for cars.

The usual modal analysis using finite element analysis for analysing the vibration response of complex system such as for the aircrafts and space shuttles has limitations as the engineer is interested in frequencies which lie very far up the modal series of a large complex structure. While the finite element approach is

very suitable for predicting the first few modes of such a structure, the accurate description of modes far up the series will involve matrix equations of very large dimensions. If one wishes to predict N modes the dimension must obviously be at least N. For good accuracy it must be considerably larger than this the higher modes are never very accurate because of the piecewise construction of the finite element modal displacements. In any case, the individual modes high up the series become increasingly sensitive to details of the physical structure under investigation,to such an extent that they may be influenced by the deviations from ideal design which inevitably occur in construction. Thus the modal pattern predicted from the ideal design may not even be relevant in detail to the actual structure-shipbuilding or aircraft as manufactured. Equally , one is unlikely to know the fine details of the vibration source accurately enough to calculate the modal amplitudes excited. What the vibration engineer would therefore like is a method which enables him to understand certain broad features of the vibration distribution and transmission without knowledge of the detailed modal structure or the fine details of the excitation. The reason that such an approach is often possible is that far up the modal series the modes are dense in frequency, and a source of disturbance will often excite many of them. This may happen because the source is of a broad-band nature, or it may happen even for a narrow-band source if the resonances overlap strongly in frequency. The distribution of vibrational energy through the structure, which is what we are often interested in, is the sum over these modal responses, and it may have a simpler behaviour than the amplitude of individual modes. Thus a detailed calculation of all the excited modes may sometimes give us a vast amount of information we do not really need. However, we

should note that, particularly in the case of a narrow-band source, the statistical behaviour must be studied in addition to the average response: as we shall see later, the fluctuations about the average can be large.This gives rise to the concept of the use of statistical mechanics and hence the method of statistical energy analysis(SEA).

Sofar only the concept of entropy is used in SEA. In this paper, we expand into the use of partition function, the most important parameter in statistical mechanics into SEA. Partition function was introduced by Ludwig Boltzmann , the founding father of statistical mechanics. For a classical discrete system, the partition function is defined as:

$$Z = \sum_i e^{-\beta E_i}$$

where Z = partition function , $\beta = 1/k_B T$, k_B = Boltzmann's constant, and E_i = total energy of the system in the response in the respective microstate.

In physcis, a partition function describes the statistical properties of a system in the thermodynamic equilibrium. Partition functions are functions of the thermodynamic state variables, such as temperature and volume.Most of the aggregate thermodynamic variables of the system, such as the total energy, free energy, entropy, and pressure can be expressed in terms of the partition function or its derivatives . The partition function is dimensionless and is a pure number.

Partition function has the singularity behaviour during phase transition such as magnetization . The study of this singularity behaviour is useful for the understanding of the region

surrounding the critical point of phase transition. An example is the Lee Yang zeros[9] for the studying of the singularity behaviour of the partition function. The partition function is a polynomial and each term of the polynomial has a zero in the denominator that gives rise to the divergence or singularity towards infinity.

Partition function is introduced by Woon Siong Gan for describing the singularity behaviour of transport properties which are relevant for the interpretation of turbulence and sonoluminescence[7,8].

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VI. PRODUCTS AND SERVICES FROM OUR MEMBERS

In the following we would like to introduce Geonoise Asia Co Ltd, an acoustical consultancies and services company based in Bangkok, Thailand.

Geonoise Asia Co Ltd is a group of independent acoustical engineers with offices in Thailand, Malaysia, Indonesia, Vietnam, Hong Kong, India and The Netherlands.

Our fields of expertise are Building Acoustics, Environmental Acoustics and Industrial Acoustics. Geonoise Asia also has an in house laboratory for material testing(impedance tube, anechoic

chamber) as well as a laboratory for calibration of sound level meters, microphones and calibrators with ISO17025.

We are equipped with the latest and most advanced instruments for noise registration, analysing and prediction such as Norsonic and SoundPLAN.

Please contact Michel Rosmolen: mrosmolen@geonoise.asia for further informations.

VI. ACOUSTICAL NEWS

The National Environmental Agency of Singapore has launched a SGD 2 million new foundation to further encourage construction companies to use machineries with lower noise levels to provide a more quiet and pleasant living environment.

This new fund entitled Quieter Construction Innovation Fund will be for a period of two years and will replace the current Quieter Construction Fund which will expire on 31 March 209. This new fund will assist construction companies to purchase , rent machineries or to use new methods to reduce the noise generated during construction and to enable the nearby residents to enjoy a more peaceful living environment.

The local construction companies can begin to apply for this fund from 1 April 2019 onwards. Each application is capped at three hundred thousand Singapore dollars. It will be different from the current framework. Those applying for reducing piling noise and demolition noise equipment and can have maximum eight thousand Singapore dollars assistance for application under two hundred Singapore dollars. For application exceeding half a million Singapore dollars will have a maximum three hundred thousand dollars subsidies. The condition is that these

noise reducing equipment must be able to produce a 10 decibels noise reduction.

To rent piling and demolition noise reduction equipment and materials can be entitled to a nine thousand to fifty thousand Singapore dollars assistance.

Up to end of February 2019, the current Quieter Construction Fund has approved 126 applications and provided a total of 5.1 millions dollars to 112 construction sites. It is anticipated that by the expiry of this fund, the total fund allocated will reach a level of 7.5 million dollars.

VI.REPORT ON CONFERENCES

The Regional Conference on Acoustics and Vibration (RECAV) organised 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.

VII. BID FOR FUTURE INTERNATIONAL CONFERENCES

The Society of Acoustics(Singapore) will be hosting the ICSV28 in Singapore in July 2022 at the Marina Bay Sands Hotel.

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.)

Disclaimers

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President: **Woon Siong Gan**
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