THE SOCIETY OF ACOUSTICS SINGAPORE

E - NEWSLETTER

December Issue, 2023

SAS

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Registration No: 0331/1989
Year of Registration: 1989

CONTENT

I. CONFERENCE NEWS

I. The ICSV28(28th International Congress in Sound and Vibration) was successfully held in Singapore as an hybrid event with 160 physical participants and 201 online attendants.

II. 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.

III. The Singapore chapter of the IEEE Ocean Engineering Society organised 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).

IV. 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 Thapana Boonchoo and Krittika Lertsawat. It was highly successful with 26 participants.

II. ANNOUNCEMENTS

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 organising 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

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:
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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 in Acoustics-Transport Equation for Acoustic Multiple Scattering

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Abstract
Transport theory in condensed matter physics was invented by Woon Siong Gan in 1966.It is now the backbone theory of condensed matter physics. In the 1990s transport theory was introduced into acoustics with the change of the microscopic scale for condensed matter physics to the macroscopic scale for acoustics. In acoustics, transport theory can be applied to acoustic multiple scattering, reflection of sound wave from rough surfaces, reflection and transmission of sound wave from rough interface and sound propagation in random media. Interfaces

Key Words: transport theory, reflection and transmission, multiple scattering, rough surfaces, random media.

1. Introduction
Transport theory in condensed matter physics was invented by Woon Siong Gan [1] in 1966. It was applied to acoustics in the 1990s. But statistical energy analysis (SEA)is also a transport theory and so is also an example of the application of transport theory to acoustics. These applications are with the scale enlarged from the microscopic scale used in condensed matter physics to the macroscopic scale used in acoustics. These will be classified under the following four headings:

2. Application of Transport Theory to Underwater Acoustics

Transport theory can be applied to underwater acoustics, to shallow water sound propagation and reverberation that can account for the effects of multiple forward scattering from waveguide boundary roughness and volume heterogeneity such as internal waves. Shallow water propagation model based on transport theory can be extended to include reverberation and it was found that sea surface forward scattering could have very important effects on reverberation level at mid frequencies, e.g. at 3KHz. Transport theory results support the development of an effective surface reflection loss model that can approximately account for effects of surface forward scattering in ray-level or mode-based propagation and reverberation codes.

Accurate propagation and reverberation modelling is important for many prediction methods that are important for Navy application and for underwater acoustics systems development. Transport theory is much faster than full wave approaches that use a Monte Carlo method with many rough surface realization. Also, any number of forward scattering interactions can be accounted for as the field propagates along the waveguide. Because transport theory has shown the importance for sea surface forward scattering in accurately modelling shallow water reverberation at mid frequencies, it becomes imperative to develop an approximate way to include these effects into traditional ray-based or mode-based reverberation codes.

Work in transport theory propagation and reverberation modelling should lead to improved simulation capability for shallow water propagation and reverberation in which multiple scattering from rough boundaries is properly taken into account. This capability should be particularly important in the mid-frequency range where multiple scattering effects can be important, yet where modal description can be used. Transport theory propagation and reverberation modelling has the potential to be even faster than tracing yet be able to account for scattering effect outside the scope of other efficient modelling methods.

3. Application of Transport Theory to Diffraction Tomography

Diffraction tomography is an inverse problem. So the application of transport theory to diffraction tomography will be under inverse transport theory. Many important recent results were reported in inverse transport theory when scattering is taken into account. Neglecting multiple scattering allows one to obtain stable and explicit reconstruction of the scattering and absorption coefficients in geometry of practical interest. Several presentations reported on recent results in the numerical simulation of forward and inverse transport problems. Although many numerical methods have been proposed to solve transport equation, the solution of inverse transport problems require specific treatment.

Stability of inverse transport problem comes from the fact that singularities in the object we wish to reconstruct propagate to the available data. In transport, such singularities are singularities in the angular and spatial variables. It is notoriously difficult to capture such singularities numerically. Deterministic numerical transport solutions are expensive and have difficulties handling complex geometries.

4. Transport Theory for Acoustic Waves with Reflection and Transmission at Interfaces

Here transport theoretic boundary conditions are derived for acoustic wave reflection and transmission at a rough interface with small random fluctuation. The Wigner distribution is used to waves to energy transport in the high frequency limit, and the Born expansion is used to calculate the effect of the random rough surface.

Wave propagation in weakly fluctuating random media over distances long compared to the wavelength can be described by the energy transport equation. Near boundaries and interfaces the waves undergo coherent or partially coherent reflection and transmission as the interfaces are smooth or randomly rough. Starting from the acoustic equations, we derive systematically, boundary conditions for the radiative transport equation. This equation is asymptotically valid away from the boundaries and the interfaces

The asymptotic limit that leads to radiative transport corresponds to weak fluctuations and high frequency wave, with correlation length of the inhomogeneities comparable to the wavelength. The Wigner distribution [2] is used to analyse this limit. The main result of this work is the derivation of the transport boundaries, for reflection and transmission at a rough surface. The boundary conditions are intuitively clear. They combine coherent or specular reflection and transmission, and incoherent or diffuse reflection and transmission, in the form of a linear input-output relation.

5. Transport Theory of Sound Propagation in Random Media

This is about sound propagation in random and its scattering by inhomogeneities. Transport theory is used to treat this problem. The scattering mean free path is a central quantity in transport theory as it also represents the mean distance between two scattering events for multiply-scattered waves. Transport equation describes the ensemble average propagation of energy density in a random medium. They may be derived from wave equation by considering the statistical mean of Wigner distribution of the wavefield in the limit where temporal and spatial scales are both well separated. This means that one considers the slow temporal modulation of fields that rapidly oscillate at the central frequency. Analogously, in the spatial domain one imagines wave packets with a slowly varying envelope that modulates the amplitude of short wavelength oscillation. Based on statistical physics and mathematical approaches, the form of the transport equation can be given by

$$\left(\frac{\partial}{\partial t} + c\hat{k}\cdot\nabla_r + \tau^{-1}\right) e(t,r,\hat{k}) = \tau^{-1} \oint p(\hat{k},\hat{k}')\, e(t,r,\hat{k}')\, d\hat{k}' + S(t,r,\hat{k}) \qquad (1)$$

where c=wave velocity, $\hat{k}$ = propagation direction, $\tau^{-1} = cl^{-1}$ = the inverse scattering mean free time, $e(r, \hat{k}, t)$=specific energy density at position r and t, $\oint d\hat{k}'$=an integral overall propagation direction, $p(\hat{k},\hat{k}')$=scattering pattern(or phase function) and $S(r,\hat{k},t)$=energy source term. The specific energy density is proportional to the amount of energy propagating in direction $\hat{k}$ per unit volume and is related to the wavefield u by a Wigner-Ville transform .Equation (1) is classically interpreted as a local energy balance.

The time-frequency representation of e is key in transport theory since the scattering mean free time τ depends strongly on the frequency of the propagating waves. Similarly, the position-wavenumber representation enables one to take into account the angular dependence of the scattering.

On the left hand side of eqn (1),he inverse of the differential operator is the coherent energy propagator which describes the propagation of waves in between two scatterings. On the right hand side, the weighted integral with kernel p(kˆ,kˆ)is the scattering operator which models the randomization of the propagation direction . By iteratively solving eqn (1), one generates a multiple scattering series with increasing order of scattering. The complex solution is obtained by summing walks with no collisions (coherent energy), one collision (single-scattering term),two collisions(double-scattering term).

The multiple scattering process tends to randomize the direction of propagation in the random medium. Hence, we may expect that at sufficiently long lapse time, the specific intensity departs only slightly from isotropic

References

1. Woon Siong Gan, Transport Theory in Magnetoacoustics, PhD thesis, Imperial College London,1969.
2. L.Ryzhik,G.Papanicolaou,.B.Keller,Transport equations for elastic and other waves in random media, Wave Motion,24,1996,327-370.

. The feedforward algorithm can be denoted as [3]:

VI. PRODUCTS ON ACOUSTICS

1. TME Singapore

Using particle velocity measurement technique, it helps to identify the effective position to place the microphone so as to achieve optimum active noise cancelling performance of an ANC headphone.

Please click the link below to find more details about the product

CLICK HERE FOR DIRECT LINK

ALT
Acoustic Laboratory Thailand

ISO 17025 ACCREDITED LABORATORY

2. Acoustic Laboratory Thailand

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

Please click the link below to find out more

CLICK HERE FOR DIRECT LINK

3. Vescom B.V.

Please find below the information on the latest product from Vescom B V:

CLICK HERE FOR DIRECT LINK

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) 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.

The 28th International Congress on Sound and Vibration (ICSV28) jointly organised 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 attendances. It was held at the Marina Bay Sands from 24 to 28 July 2022.

THANKS TO LOCAL ORGANISING COMMITTEE OF ICSV28

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