Clubs

There are three users' groups covering the main areas of acoustical metrology at NPL. The aim of these groups is to promote information exchange on calibration/testing techniques and also to provide information on proposed revisions of international standards.

Acoustical Standards Users' Group deals principally with transducers used for measuring sound in air and includes audiometry.
Contact: Janine Avison
Tel: 020 8943 6706
E-mail: janine.avison@npl.co.uk

Ultrasound Standards Users' Group deals with ultrasonic measuring devices primarily with medical applications.
Contact: Bajram Zeqiri
Tel: 020 8943 6806
E-mail: bajram.zeqiri@npl.co.uk

Underwater Acoustics Standards Users' Group deals with underwater acoustic transducers, hydrophones and sonar systems.
Contact: Stephen Robinson
Tel: 020 8943 7152
E-mail: stephen.robinson@npl.co.uk

Membership of all of these groups is free and their respective meetings are held biennially.

Training Courses

- Audiometric Calibration Techniques
- Calibration of Acoustical Instruments
- Output Measurements for Physiotherapy Ultrasound

If you are interested in attending any of these courses please contact:
Mike Goldsmith
Tel: 020 8943 6392
E-mail: mike.goldsmith@npl.co.uk

FORTHCOMING EVENTS

2 April 2001 NPL FREEMET meeting and training course. Subject: Measurement of the electrical properties of antennas in free space.
Contact: Sara Fletcher
Tel: 020 8943 6827 or
E-mail: sara.fletcher@npl.co.uk

5 April 2001 NPL Weighing and Density Group meeting.
Contact: Nicola Raymond
Tel: 020 8943 6449 or
E-mail: nicola.raymond@npl.co.uk

24 April 2001 NPL Laser safety in the laboratory (BS EN 60825-1) One-day training course.
Contact: Richard Stevens
Tel: 020 8943 6484 or
E-mail: richard.stevens@npl.co.uk

1 May 2001 NPL New laser safety standard (Amendment 3, BS EN 60825-1) One-day training course.
Contact: Richard Stevens
Tel: 020 8943 6484 or
E-mail: richard.stevens@npl.co.uk

1 May 2001 Institute of Physics, London NPL Analysis of Gases Awareness Club workshop. Subject: A new standard for the quality assurance of automated monitoring systems for industrial emission measurements.
Contact: Hansa D'Souza
Tel: 020 8943 6808 or
E-mail: hansa.d-souza@npl.co.uk

3 May 2001 Kempton Park Racecourse, Sunbury SSTC (Soldering Science and Technology Club) Spring meeting.
Contact: Deborah Lea
Tel: 020 8943 6065 or
E-mail: deborah.lea@npl.co.uk

9 - 10 May 2001 NPL NPL Communications Measurement Association bringing together the meetings of: The Ultrafast and Photonics Club FOTON (UK) (29th meeting of the Fibre Optic Technology Network) The Wireless Communications Forum.
Contact: Gareth Francis
Tel: 020 8943 7013 or
E-mail: gareth.francis@npl.co.uk

15 - 16 May 2001 NPL Temperature and Thermophysical Properties Awareness Club 'To Model or To Measure'.
Contact: Dr Bob Angus
Tel: 020 8943 6767 or
E-mail: tpac@npl.co.uk

12 June 2001 NPL Acoustics User Group meeting.
Contact: Janine Avison
Tel: 020 8943 6706 or
E-mail: janine.avison@npl.co.uk

12 June 2001 (provisional date, location to be confirmed) EMMA-Club in collaboration with the EPSRC Network. Topic: Low loss dielectric ceramics.
Contact: Bob Clarke
Tel: 020 8943 6156 or
E-mail: rnc@npl.co.uk

13 June 2001 NPL Joint RSC/NPL Analysis of Gases Awareness Club meeting. Subject: Process monitoring instrumentation: new developments and validation.
Contact: Hansa D'Souza
Tel: 020 8943 6808 or
E-mail: hansa.d-souza@npl.co.uk

13 - 14 June 2001 NPL Training Course: Obtaining time and frequency traceability using GPS.
Contact: Karen Hood
Tel: 020 8943 6582 or
E-mail: karen.hood@npl.co.uk

FURTHER INFORMATION

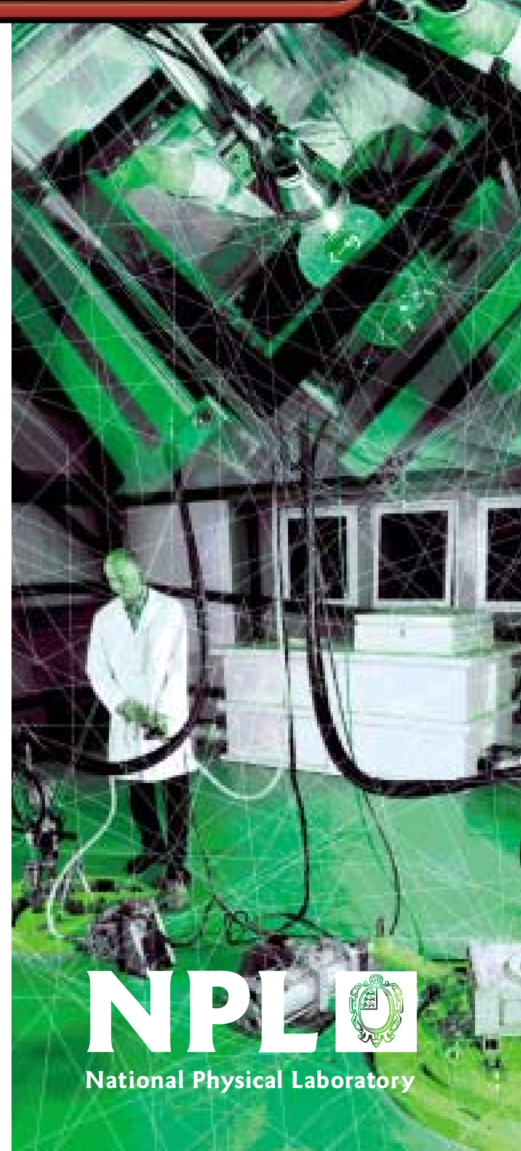
For additional copies of this newsletter, or for more information on any aspect of NPL's work and the range of services available from the Laboratory, call the NPL Helpline:

Tel: 020 8943 6880 Fax: 020 8943 6458 E-mail: enquiry@npl.co.uk
Switchboard: 020 8977 3222
Website: www.npl.co.uk
National Physical Laboratory
Queens Road, Teddington, Middlesex, TW11 0LW

3116/SEA/114k/0301

HOW DOES THIS SOUND....TO YOU?

ISSUE 10 SPRING 2001
NEWS FROM THE National Physical Laboratory
METROMNIA



The field of acoustics is one of the most varied within science. Sound is normally thought of as being airborne acoustic waves that are within the range of human hearing. But sound can also travel through different media and there is even sound that is above and below the range of human hearing, ultrasound and infrasound respectively.

Human response to sound varies from person to person, the thrash metal emanating from a teenager's room may not be every parent's cup of tea and although this may be partly due to the 'generation gap', musical taste varies widely, as we all know. In the extreme, there have been cases of violent neighbour disputes where people have cited the 'mental torture of continuous loud music' in defence of their actions.

This rich diversity in acoustics gives rise to a whole range of different applications: musical acoustics, architectural acoustics, environmental noise measurement, underwater acoustics and so on.....but let us begin with...

Medical Ultrasound

For most of us, there is a time in our lives when we suffer an illness or injury that requires hospital examination. In many cases, doctors will need to 'see inside' our bodies to investigate the cause of the problem. Traditionally, such examinations were carried out using X-rays; most of us will have seen the 'photographic' results these scans produce.

Increasingly though, other forms of imaging technology are being used, and one of these is ultrasound. The majority of expectant mothers will undergo at least one ultrasound scan during the course of their pregnancy; indeed, the term 'having an ultrasound' has become commonplace. In obstetrics, the use of ultrasound is preferred to X-rays for reasons of safety.

NPL National Physical Laboratory

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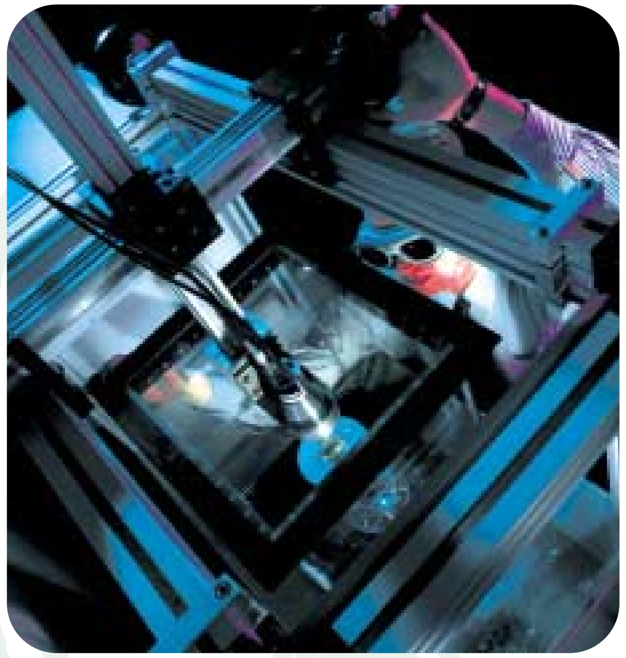


Measurement of an ultrasonic lithotripter using laser interferometry

The use of diagnostic ultrasound in medicine is actually much broader than this, with imaging techniques used all over the body; ranging from scans of the heel to check for osteoporosis, to high-resolution scanning of the eye. This diversity of application is due in many ways to the flexibility of the technology.

In comparison with X-rays, for example, ultrasound requires few special operating conditions, is readily transportable (some scanners are of a similar size to portable televisions) and yields near-instantaneous results. In most diagnostic scans, moving structures may be seen readily, and the flow of blood to vital organs can also be examined and monitored.

Higher power levels of ultrasound can be used to alter tissue through thermal and mechanical effects, hence the need for vigilance in sensitive obstetric applications. Such properties of power ultrasound are harnessed in therapeutic applications, to aid the healing of muscle and soft tissue injuries, and in an application known as lithotripsy, short bursts of high-intensity ultrasound can actually be used to shatter kidney stones, without the need for invasive surgery. High-intensity focused ultrasound is also used in the treatment of cancer with selected cells destroyed using sound waves. In scientific terms, the use of ultrasound is still a relatively young technology, with exciting developments and new applications (such as 3D imaging) being developed at an increasing rate.

Ultrasonic linear array scanner

With all medical ultrasound procedures, be they diagnostic or therapeutic, guidelines have been established which govern the levels of ultrasound energy that may be delivered to the human body in certain applications, a regulatory process that is ongoing. Over a period of 20 years, world-leading expertise in ultrasound measurement has been established at NPL, starting with the development of the membrane hydrophone, a device that is accepted as a 'gold-standard' measurement device worldwide. The capability that these devices provide allows NPL to play a key role in the process of formulating and maintaining specification and safety standards, which are arrived at through international consensus. In this way, and through further development of measurement methods, the exemplary safety record enjoyed by medical ultrasound will continue.

Noise and Health

The environment around us is full of noise - at work, in the street, in clubs and restaurants and at home. Excessive noise is known to damage our hearing, and legislation in the UK and EU is designed to prevent such damage. But attention is now turning to the potential dangers of noise at lower levels.

Environmental Health Officers have statutory powers to deal with noise and its effects

Environmental noise has several effects on humans. Since whether or not a person experiences such effects is strongly dependent on individual sensitivity to noise, policy on environmental noise needs to be based on scientific results in which the variations due to different sensitivity are taken into account. It is also vital that research studies use accurate measures of the noise exposure.

The most important effect in terms of the number of affected people is so-called annoyance, which can be determined from structured field surveys. Annoyance is strongly connected with specific effects such as the necessity to close windows in order to avoid sleep disturbance or interference with communication, listening to the TV, the radio or music. Additionally, there are a number of serious medical effects such as high blood pressure, mental stress, heart attacks and hearing damage that concern a smaller part of the population. Furthermore there are adverse effects on the learning capabilities of children. It is evident that people reporting noise-induced annoyance experience a reduced quality of life and this is a reality for at least 25% of the EU population. Between 5% and 15% of the EU population suffers serious noise-induced sleep disturbance.

Other effects which have been under investigation are: cardiovascular effects, ischaemic heart disease and psychiatric disorders. The mechanisms underlying these effects are very complex and it is extremely difficult to formulate causal relationships which definitively link noise to specific effects.

NPL is involved in this research in two ways, firstly by reviewing accumulated evidence in order to advise Government on implications for environmental standards, and secondly by collaborating with research teams to ensure that the quantification of the physical exposure in such studies is known as accurately as possible.

Reports on this work are either indexed on, or are downloadable from the NPL website.

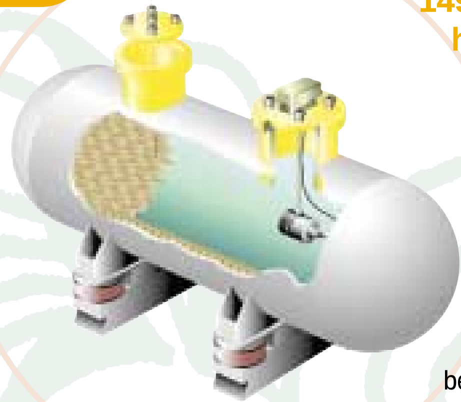
What do YOU think of Metromnia? We'd like to hear your views at:

www.npl.co.uk/npl/publications/metromnia/feedback.html

Underwater Acoustics

A little history

Man has long been trying to understand and exploit the transmission of sound in the sea. One early experiment is recorded in the notebooks of Leonardo da Vinci, who wrote in 1490: 'If you cause your ship to stop and place the head of a long tube in the water and place the outer extremity to your ear, you will hear ships at a great distance from you'.



The NPL acoustic pressure vessel, used for the calibration of sonar equipment

Such a method of listening to underwater sounds was still in use as late as World War I where a stereo effect was obtained by the addition of a tube to the other ear from the other side of the ship, enabling a crude estimate of bearing to be made. Possibly the first quantitative measurement in underwater acoustics was made in 1827 when Daniel Colladon and Charles Sturm measured the speed of sound in Lake Geneva by timing the interval between a flash of light and the sound from the striking of a bell underwater. Their surprisingly accurate experiment determined that sound in water travels around five times faster than in air.

Modern applications

Since sound travels much further in the sea than light or radio waves, it quickly found military uses in the early part of the 20th century, in particular for detecting enemy submarines. With the increase in the exploration and exploitation of the sea, the non-military uses have proliferated. Current uses include imaging using sonar (from sound navigation and ranging), for communication, for detecting fish, and for positioning divers or equipment under the surface. The technology used has also developed with many systems being highly complex. However, a crucial element is still the transducer which generates or detects the sound, and this requires traceable acoustic measurements to be made by a laboratory such as NPL, where it is even possible to simulate the temperature and depth in the ocean during testing in the NPL acoustic pressure vessel.

A tool for assessing environmental change

Our understanding of how sound travels in the sea has also developed considerably since the time of da Vinci. One very important influence is the fact that the speed of sound is not constant throughout the ocean but instead varies with temperature, depth and salinity. In fact, the balance between the opposing effects of temperature and depth leads to a minimum in the sound speed, typically at a depth of about 1 km. Sound rays emerging from a source placed at this depth will be bent back by refraction, trapping the sound in a channel known as the **SOFAR** channel (from sound fixing and ranging). Although at 1 km - 2 km it is only 0.03% of the Earth's radius, it forms a waveguide capable of guiding sound energy halfway around the planet. Oceanographers have recently used this remarkable feature of the oceans to develop an acoustic thermometer which can measure the average temperature of the ocean. Coded low frequency sound signals transmitted in the SOFAR channel have been detected 18 000 km away. The time taken for the sound to cover this distance can be used to estimate the average ocean temperature since the sound speed increases by about 4.6 m/s for every degree Celsius. Such large-scale measures of ocean temperature are not subject to local variations and are important indicators in the assessment of the extent of climate change.