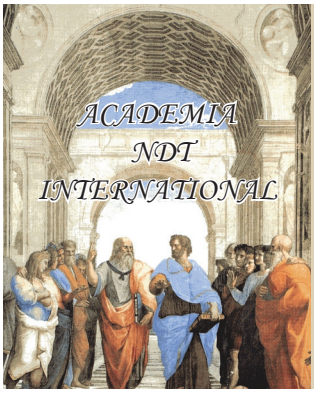


Lectio Materia

Newsletter of the

ACADEMIA NDT INTERNATIONAL

Science, Technology and Diagnostics in Non-Destructive Testing

Back to its roots but moving forward at a pace

It is now just over two years since the ACADEMIA NDT International was formally established and it is wonderful to be back in Moscow, the place where the ACADEMIA was founded officially on 10 March 2008.

In the time since its birth, the ACADEMIA NDT has achieved a great deal – most notably its membership has grown considerably and two memorable Special Lecture Meetings have been held, the first in Shanghai coinciding with the 17th World Conference on NDT and the second in Brescia, Italy, the official seat of the organisation.

The idea of the ACADEMIA NDT International emerged a few years ago, reflecting a need in the NDT community to have a body that is evidence of the science in the NDT field at the highest level. A Steering Committee was formed and met for the first time on 25 May 2007 in Opatija, Croatia.

The overall objective of the ACADEMIA is to foster research, development and education in the NDT field by engaging NDT professionals in a combined effort, thus attaining the goal of always seeking progress.

The main purposes and objectives of the ACADEMIA NDT International activities are as follows:

- To promote science, research and development encouraging the application of the findings in the field of NDT at universities, R&D centres and institutions and other relevant bodies throughout the world.
- To establish and maintain a network among scientists and technologists involved in the basic sciences, research and development for NDT methods, techniques, equipment and implementation advancement.
- To highlight the work of the research and development in NDT.
- To be mindful of the contributions from scientists and distinguished professionals in the NDT field, inviting them to ACADEMIA NDT.
- To attract the attention of international authorities, government and public organisations to the importance of the benefits that NDT provides.

The ACADEMIA is not in competition with NDT associations and institutions such as ICNDT or other regional NDT groups, nor with the national societies, but sees itself as an association complementary to all of these.

The membership of the ACADEMIA NDT comprises Full and Honorary members. At present there are 37 Full members (including 6 Council) and 7 Honorary members.

The Honorary members are as follows:

- **Professor Jerome Karle**, US Naval Research Laboratory *Nobel Prize 1985*
- **Professor Riccardo Giacconi**, Johns Hopkins University *Nobel Prize 2002*
- **Dr Isabella Karle**, US Naval Research Laboratory
- **Professor Anatoly K Gurvich**, Russian Academy of Transport
- **Yulij Viktorovich Lange**, Spectrum, Moscow, Russia
- **Professor Morio Onoe**, University of Tokyo
- **Academician Boris E Paton**, E O Paton Welding Institute, Ukraine.

The members to date come from more than 20 different countries: Australia, Belarus, Bulgaria, China, Croatia, Czech Republic, France, Germany, Greece, Hungary, India, Italy, Japan, Latvia, Lithuania, Moldova, Russia, Slovenia, Ukraine, the UK and the USA.

The ACADEMIA is proud to have no less than two Nobel Prize winners amongst its seven Honorary members – Professor Jerome Karle and Professor Riccardo Giacconi, who also presented a special lecture at the ACADEMIA meeting in Shanghai in 2008. A further Nobel Prize winner Professor Antonino Zichichi, one of the originators of the Large Hadron Collider at CERN, Geneva, presented a special lecture at the ACADEMIA General Assembly meeting in Brescia in May 2009.

Giuseppe Nardoni President, ACADEMIA NDT International

Giuseppe Nardoni, President of the ACADEMIA NDT International, has referred to the organisation as "the greatest gift we can make to the new generation of NDT."

"After more than 60 years of NDT," he said, "we have deepened our knowledge, we have made even more discoveries, we have built and refined equipment, we have pushed back the boundaries in the field of education and we have raised the standards of the norms and guidelines for the qualification and the certification of NDT personnel.

"All of these have served to improve the testing of materials and structures, which in turn has made a great and indispensible contribution to the safety and wellbeing of people."

2nd ACADEMIA NDT International Scientific Meeting

Science, Technology and Diagnostics in NDT

(Open to the public)

Thursday 10 June 2010

ALL WELCOME

14:00 – 17:30, Room 301, Expocenter, Moscow

See back page for lecture programme/agenda

Prof Dr -Ing habil Dietmar Eifler

Biography & Abstract

Professor Eifler studied mechanical engineering at the University of Karlsruhe and was awarded his PhD at this university in 1981 with a thesis about the cyclic deformation behaviour of quenched and tempered steels.

From 1991 to 1994 he was a Professor at the University of Essen. Since 1994 he has been a Professor at the Institute of Materials Science and Engineering at the University of Kaiserslautern. Actually, he is the speaker of the research centre 'Advanced Engineering Materials' at the University of Kaiserslautern. In 2008, he received the Academy Award of the Academy of Sciences Mainz and in 2009 he was elected as a full member of the Berlin Brandenburg Academy of Sciences and Humanities.

Professor Eifler is a member of several national and international scientific committees and advisory boards of international journals in the field of materials science. Current research activities are focused on the characterisation of the fatigue and cyclic deformation behaviour of low and high alloyed steels in different heat treatments, Ti, Al and Mg alloys as well as medical implant materials using mechanical, electrical, magnetic and thermal measuring techniques. On the basis of comprehensive mechanical, thermal and electrical fatigue data, the physically-based fatigue life calculation 'PHYBAL' was developed. This method requires only one load increase test and two constant amplitude tests for a fast and nevertheless precise calculation of S-N (Woehler) curves and was qualified for the fatigue assessment under constant amplitude and service loading as well. At present the investigation of the very high cycle fatigue behaviour (VHCF) of metallic materials using ultrasonic test facilities is a key issue.

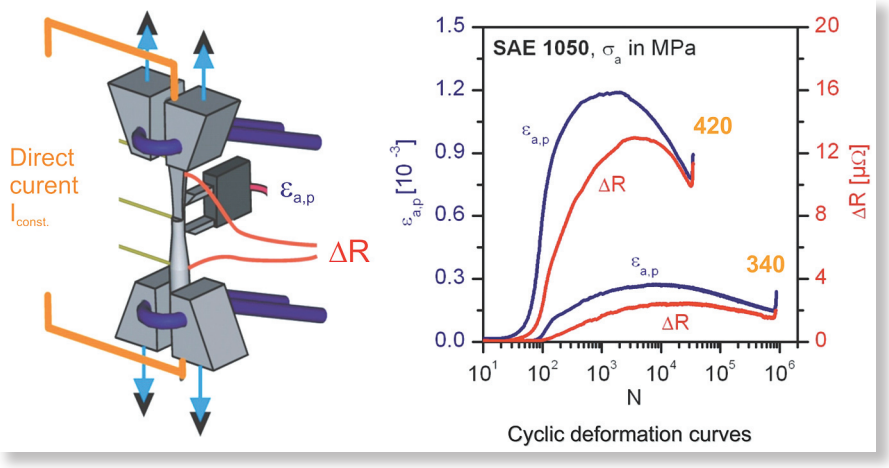
Additionally, innovative joining techniques such as ultrasonic welding of glass, ceramic, CFRP and metal to metal as well as friction stir welding of light alloys are important topics of the actual research projects.

Characterisation of the cyclic deformation behaviour of metals using resistivity measurements

D Eifler

Institute of Materials Science and Engineering, University of Kaiserslautern, Germany

The detailed knowledge of the cyclic deformation behaviour and the comprehensive understanding of basic fatigue mechanisms of metals are fundamentals for the systematic development of fatigue life calculation methods to ensure safe and economic operation conditions. In general, the material response to cyclic mechanical loading is described by the plastic strain amplitude $\varepsilon_{a,p}$ determined in mechanical stress-strain (σ-ε) hysteresis measurements. Complementary high-resolution electrical resistance ΔR measurements were performed for the detailed microstructure-related characterisation of the cyclic deformation behaviour of metals. The mentioned physical quantities are directly influenced by deformation-induced changes in the microstructure of the bulk material and represent the actual fatigue state. Related to a reference value of the virgin state, load-free electrical resistance $\Delta R_{load\text{-}free}$ measurements enable the detection of a proceeding fatigue damage during load-free inspections. Apart from the geometry, the electrical resistance depends on the resistivity, which is strongly influenced by the load- and cycle-dependent defect density of each individual material state, *ie* dislocation density and arrangement, micro-cracks, pores and vacancies. Especially for material and loading conditions leading to small cyclic plastic deformation, resistance measurements yield additional helpful information about the actual fatigue state. The applied mechanical and electrical measurements are qualified for the fatigue assessment under constant amplitude and service loading as well as for the physically-based fatigue life calculation method 'PHYBAL' on the basis of Morrow and Basquin equations. In this paper, specimens of the steel SAE 1050 (UIC R7) widely used in high-speed passenger traffic and specimens of the quenched and tempered steel SAE 4140 (42CrMo4) are regarded. The methods to assess the fatigue behaviour described in this paper were furthermore used for aluminium and titanium alloys.



Cyclic deformation curves

General Assembly Scientific Meeting

(Academia NDT International Members only)

Wednesday 9 June 2010

09:30 – 13:00, Room 301, Expocenter, Moscow

Professor Andrey V Smurov

Biography & Abstract

Andrey V Smurov gained a Master's Degree in Biology-Zoology from the Moscow State University in 1971 and was awarded a PhD from the same university in 1974 having written his thesis 'Spatial distribution of organisms – quantitative methods of description'.

He became an Associate Professor in 1986, a Doctor of Biological Sciences in 2003 and a Professor in the Department of Biology in 2006.

Professor Smurov is a Member, Presidium of Research and Methodological Council for the Ecological Education, Research and Methodological Association of Russian Universities and as such participated in the development of state educational standards in ecology and environmental protection. He is also a Member of the Ecological Council in the Parliamentary Assembly of Russia and Belarus.

He is a Member, Academic Council, MSU, Department of Biology, Chair, Academic Council, MSU Ecological Centre and Deputy Chair, Regional Committee for Awarding Scholarships, V I Vernadsky Ecological Foundation. Since 1989, Professor Smurov has been Director, MSU Centre for training and retraining of qualified specialists in ecology, rational use of nature and environmental protection (Ecocenter MSU). Since 2005 he has been Director of Research and Education at the Museum-Institute MSU of nature and natural history (Museum of Earth Science).

Professor Smurov has been leader and co-leader of numerous field trips, notably on board the research ship 'Academician Petrovsky', which undertook a survey of coral reefs in the Red Sea and Indian Ocean, and was also co-leader of a survey of coastal reefs and the quality of habitats of marine ground organisms in the south of Vietnam. Complex methods of eco-diagnostics defined that bottom deposits were toxic both for photosynthesis and heterotrophic marine organisms. The deposits contained dioxins, known as permanent organic pollutants and marker of short-lived toxic mixture, which composition and spectrum proved there was a connection with defoliants ('Orange agent') used in the US-Vietnam War.

He has also been involved with expeditions to the East-Ural radioactive trace and Chernobyl.

Professor Smurov is a Corresponding Member of the Russian Ecological Academy and since 2002 Vice-President Associate of ecological education and programmes. He was awarded Rank of Honour 'Veteran of Professional Service' in 2000, a special medal '250th Anniversary of Moscow State University' in 2005 and Rank of Honour 'The deserved worker of Russian Higher School' in 2009. He has published more than 100 papers, articles and books, including a series of textbooks on 'Biodiversity Conservation'.

Biological methods of ecological diagnostics for making representative predictions related to assessment of stability in ecosystem processes and environmental quality for a human being

A V Smurov

Ecological Centre, Moscow State University

Most sanitary-hygiene norms (MAC, MAL, and others) are obtained in experiments with animals and do not consider the effects of combinations of different substances and their possible transformation and distribution in the natural environment. Long experience showed that sanitary-hygiene norms are not a real border between danger and safety but they are more likely to evaluate a particular level of risk differing not only between different units of eco-systems but even between different groups of the human population.

The criteria being used for assessment of environment quality for ecological norms do not allow us to reach the necessary results and moreover, they make the situation more difficult. In general, the scheme of bio-diagnosis proposes a proper choice of key environmental parameters, key objects (bio-systems) and monitoring data on these parameters and possible disturbances of homeostatic states of key objects. If mechanisms of homeostatic processes are disturbed, the bio-system can get 'ill', which may lead to homeostasis instability at the higher levels of the bio-system organisation.

Such approaches for environmental quality assessment exclude subjectivism. If, for a example, photosynthesis mechanisms are disturbed, or environment is characterised by higher levels of mutagenic, immunogenic and teratogenic environment activity, or toxic for heterotroph organisms, it is evident that environmental quality cannot be accepted as normal, even if maximum allowable concentrations and ecological permissible levels are within their normal range.

Preliminary express diagnosis of environmental quality and bio-systems states in a number of cases can be made quickly enough using a quite limited standard set of parameters.

Dr A Velichko

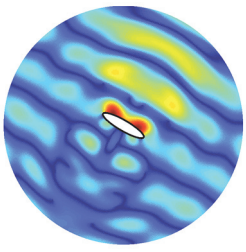
Abstract

Scattering and diffraction of elastic waves: from defect localisation to quantitative defect characterisation

Dr A Velichko

The application of ultrasonic arrays for non-destructive evaluation has seen a dramatic increase in recent years. The use of ultrasonic arrays provides great flexibility, as one array probe allows a given defect to be illuminated from a wide range of angles, and hence is capable of extracting significant information about the defect. The raw data set from an array contains the full matrix of time-domain signals from each transmitter-receiver combination. If such a matrix is collected then all imaging of the test structure can be performed in post-processing. Various synthetic focusing techniques have been developed, which allow sub-wavelength defects to be successfully detected.

However, in many cases detection alone is not enough and quantitative information about defect shape, size and orientation is needed. This information helps to estimate how a defect affects the structural integrity. In the presentation some techniques for quantitative defect characterisation using ultrasonic array data will be considered.



For relatively large defects (with size greater than two wavelengths) their characteristics can be obtained directly from the image. On the other hand, sub-wavelength defect characterisation is still a major challenge for non-destructive evaluation. In this case the problem of characterising a defect can be divided into two parts. From an array point of view, all available information about a defect is contained in its ultrasonic response in the full matrix of transmitter-receiver array data. In fact, this is the maximum possible amount of data corresponding to the defect that can be collected by the array in a particular position. Therefore, the first part of characterisation is the extraction of the raw array data for a particular defect from the full transmit-receive data matrix. The second part is processing the array data for a particular defect in order to characterise it.

The methods are illustrated by modelling and experimental results using 1D and 2D arrays for characterisation of various planar and volumetric defects.

Sotirios J Vahaviolos PhD

Biography

Dr Sotirios J Vahaviolos is President and CEO of the MISTRAS Holdings Group, the organisation that trades under the names of Physical Acoustics around the globe, NDT Automation, Vibra-Metrics, CONAM Inspection & Engineering Services Inc and Quality Services Laboratories, Inc.

Leading the markets of non-destructive computer-aided testing and inspection, the Group provides today's needed on-line condition monitoring of the world's industrial and public infrastructure by employing internet-based data acquisition information technologies.

Vahaviolos grew up in Greece, where as a child he ripped apart machinery and rebuilt it for fun. He came to the US to study engineering at Fairleigh Dickinson University in New Jersey and went on to get his MS and PhD in electrical engineering from Columbia University.

He started his career at American Telephone & Telegraph's Bell Laboratories, where the concept of acoustic emissions was developed in the late 1940s. When Vahaviolos came along 20 years later, he worked out computerised solutions to the long-standing problem of how to filter out irrelevant background noises during acoustic emission testing.

With the backing of several venture capital firms, Vahaviolos struck out on his own in 1978, to explore industrial applications for acoustic emission technology. AT&T gave him its blessing, in the form of a licence to use technology he had developed while working at Bell Labs; it also became his first customer.

Physical Acoustics at one time saw its sales grow more than 30% a year and before long it had a staff complement of 150 employees.

Today, the MISTRAS Group's products and services are used worldwide to secure the much-needed environmental safety of gas and oil pipelines, petrochemical pressure vessels and storage tanks, strategic components of nuclear and fossil fuel plants, metal and concrete bridges, aerospace vehicles, and many other structures.

Half of Physical Acoustics' income comes from outside the USA; Vahaviolos was one of the first foreign scientists invited by the Soviet Union to inspect the site of the nuclear power plant accident at Chernobyl.

"Some people thought I was crazy, listening to abnormal material sounds," Vahaviolos recalls, "but acoustic emission non-destructive testing is an industry now.

"And", he adds, "we believe very strongly that we can avoid catastrophes."

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14:00 – 17:30, Room 301, Expocenter, Moscow

AGENDA

14:00 – 14:30 **1. Lecture: 'Characterisation of the cyclic deformation behaviour of metals using resistivity measurements'**
Professor D Eifler (Germany)

14:30 – 14:45 **2. Lecture: 'Experimental results on diffraction in UT technique'**
Dr G Nardoni (Italy)

14:45 – 15:15 **3. Lecture: 'Scattering and diffraction of elastic waves: from defect localisation to quantitative defect characterisation'**
Dr A Velichko (UK)

15:15 – 15:45 *Coffee break*

15:45 – 16:15 **4. Lecture: 'Advanced NDT services and information technologies for the future'**
Dr S Vahaviolos (USA)

16:15 – 16:45 **5. Lecture: 'Biological methods of ecological diagnostics for making representative predictions related to assessment of stability in ecosystem processes and environmental quality for a human being'**
Prof A V Smurov (Russia)

16:45 – 17:30 **Discussion**

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