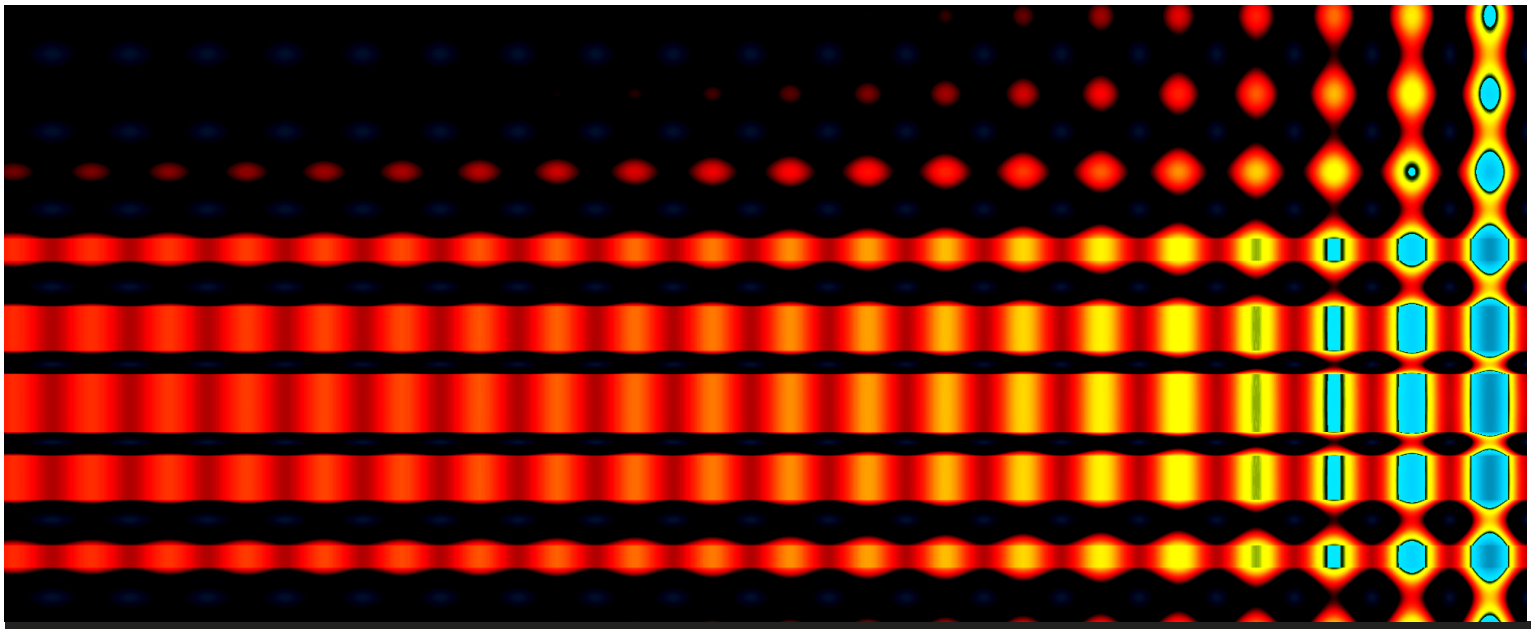
January 2021 | Vol. 1

ACOUSTIC EMISSION WORKING GROUP [AEWG]

Annual Newsletter of Acoustic Emission Developments and Ideas!



WELCOME NOTE FROM THE AEWG EXECUTIVE COMMITTEE!

2020 brought many challenges and uncertainties into our lives. We recognized the importance of communication and the community engagement in these challenging times. Using the digital platforms, we aim to increase the communication and the dissemination of Acoustic Emission-related research, publications, meetings, instrumentation and news. We are happy to announce an annual AEWG newsletter.

We would like to thank the contributors to this first edition of AEWG digital newsletter. We will continue to increase the communication and the collaboration among AE researchers, practitioners and manufacturers in digital platforms. Content of newsletter:

- The outcomes from the first virtual AEWG meeting with over hundred participants from all over the world
- Announcement of AEWG-63
- Worldwide AE Research News
- Data sharing platform to increase the collaboration among AE researchers
- Updates on AE Books, Publications and Journal of Acoustic Emission
- News from AE Manufacturers
- News from AE Users
- Data sharing platform to increase the collaboration among AE researchers

The first meeting of Acoustic Emission Working Group (AEWG) was held in Idaho Falls, on February 8, 1968.
The first issue of Journal of Acoustic Emission was releases in 1982.

Newsletter Designed by: Sarah Malik, Drexel University

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NEWS FROM AEWG-62: 1ST VIRTUAL AEWG MEETING

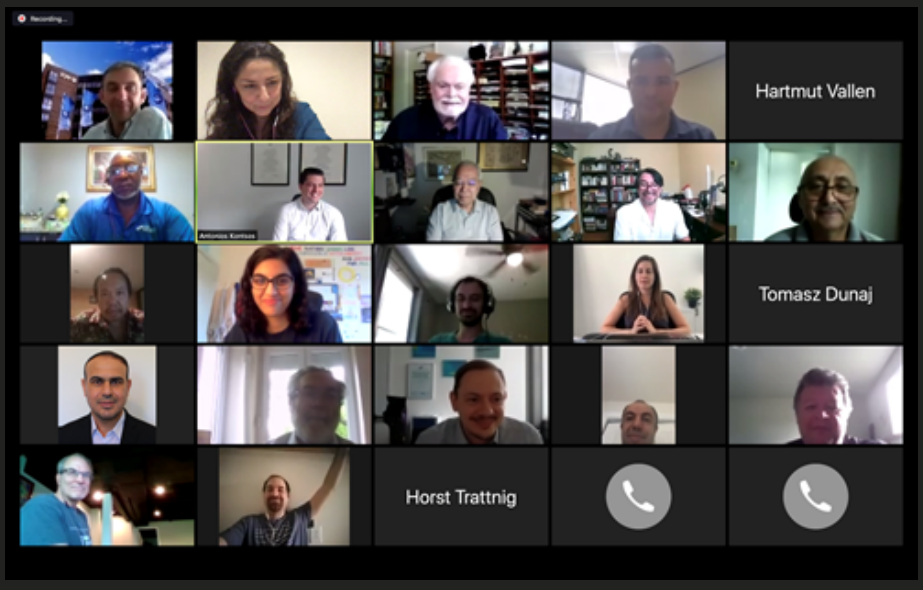
AEWG Goes Virtual!

We are passing through unprecedented times of modern life. To stay connected with our community and promote discussions, promotions and collaborations in these challenging times, we hosted AEWG-62 on a virtual platform. We had thirty one asynchronous technical presentations and three live sessions including two panel discussions and AEWG business meeting.

31 Asynchronous Technical Sessions
&
3 Live Sessions

Panel 1: The use and challenges of AE for online monitoring for essential systems led by Dr. Antonios Kontsos

Panel 2: Status of AE Standards led by Dr. Valery Godinez



First Page of Zoom of AEWG 62

Further Information at
AEWG News
at http://aewg.org/
IIIAE News at http://iiiae.org/

UPDATES FROM AEWG-62

AEWG Business Meeting
Led by Didem Ozevin

Updates

- We welcomed new AEWG members: Dr. Obdulia Ley, Dr. Hossain Saboonchi, D.r Miguel Gonzalez Nunez, Dr. Behnoush Golchinfar.
- Four AEWG membership applications were submitted: Dr. Mohammed Hameed Sabhan Al-Tofan, Dr. Jason Ongpeng, Hermann Schubert and Angela Angulo
- There was no Adrian Pollock StudentAward winner in AEWG-62.
- Dr. David Kosnik was appointed as the AEWG Archivest. The AEWG acknowledged all the contributions of Tom Drouillar over the years as the AEWG Archivest.
- The Fellow Award in AEWG Bylaws was amended to reduce five years of active member-ship to be eligible
- The cash award for Adrian Pollock Student Award was increased to $600
- A new Google G-suite was set for AEWG as a way to store AEWG documents in a digital platform and assist the AEWG organizers with emails, registration and web-site designs

UPDATES FROM AEWG-62

Updates

Panel 1 Summary
The Use and Challenges of AE for Online Monitoring of Essential Systems Led by Antonios Kontsos

To kickoff discussions during this first ever virtual AEWG meeting, the AEWG Executive Committee hosted a panel on “The Use and challenges of AE for online monitoring of essential systems”. The discussion was led by Dr. Antonios Kontsos, Associate Professor in the Department of Mechanical Engineering & Mechanics at Drexel University and current Secretary of the AEWG Executive Committee. After defining what real-time/online monitoring is across different industries and using several
enabling components, several critical infrastructures were mentioned to highlight the importance for such monitoring operations. Commercially available tools for sensing, communication, storage and user interfaces were mentioned. In addition, the major challenges typically found when attempting to implement such real time monitoring solutions were discussed. Based on this context provided, the particular challenges to adopt AE for fully autonomous services were presented followed by a brief listing of the items that the AEWG community could address in the future including the development of alternative AE sensing technologies, the standardization of data formats, the development of new smarter processing algorithms and more. The discussion among the virtual participants during the panel and the responses to the survey that followed it validated the interest in this area and provided feedback on future AEWG discussion topics.

UPDATES FROM AEWG-62

Updates

Panel 2 Summary
Status of AE Standards
Led by Valery Godinez and Richard Gostautas

Mr. Richard Gostautas prepared a presentation on the subject of ASTM AE standards, which are under the jurisdiction of ASTM Subcommittee E07.04, which has 60 members. Dr. Godinez discussed potential new standards for AE applications for which guidelines do not exist, and how an Ad Hoc task force within AEWG could be established to further investigate where new standards are needed. He provided an overview of the 3 different categories for ASTM standards for AE Sensors & System Characterization and Verification. He also presented standards for the different Industry Sectors: Building and Construction, Industry Sector, Metals, Pressure Vessels/Piping, Composites. The panel outputs are the followings.

- Communication between ISO and ASTM regarding AE standards can be improved.
- Dr. Miguel Gonzalez is participating in ISO and looking for volunteers to become members of the US AE expert group in ISO.
- There are several articles in ASME BPV Section V and Section X related to AE examination. Dr. Godinez invite people to join the ASME BPV Section V Working Group AE of which he is the current Chairman.
- It is recommended to develop acceptance criteria in AE standards considering amplitude-distance correction. It is noted that the experience of the AE practitioner plays a big part in the pass/fail criteria using established codes.
- The collaboration between academics and practitioners to develop standards is emphasized.
- AEWG participants are encouraged to join ASTM, ASME, ISO AE committees.

AEWG-63
SEPTEMBER 13-15, 2021
HOUSTON, TX

Thank you to Stress Engineering for Hosting!

We are pleased to announce that AEWG-63 will be hosted by Stress Engineering in Houston, Texas. The tentative schedule is as follows:

September 13, 2021
(Monday) – Primer on Acoustic Emission in Oil and Gas Industry at AM, Welcome reception & Social at PM

September 14, 2021
(Tuesday) – Technical presentations, panel discussions, session for vendor presentations, dinner at PM

September 15, 2021
(Wednesday) - Technical presentations, panel discussions, AEWG business meeting ending by 5:00pm, tour

We aim to have an in-person AEWG-63 meeting. We will update you once we learn more about the progress of pandemic.

WORLDWIDE AE RESEARCH UPDATES

Research Spotlight

AE Research Overview

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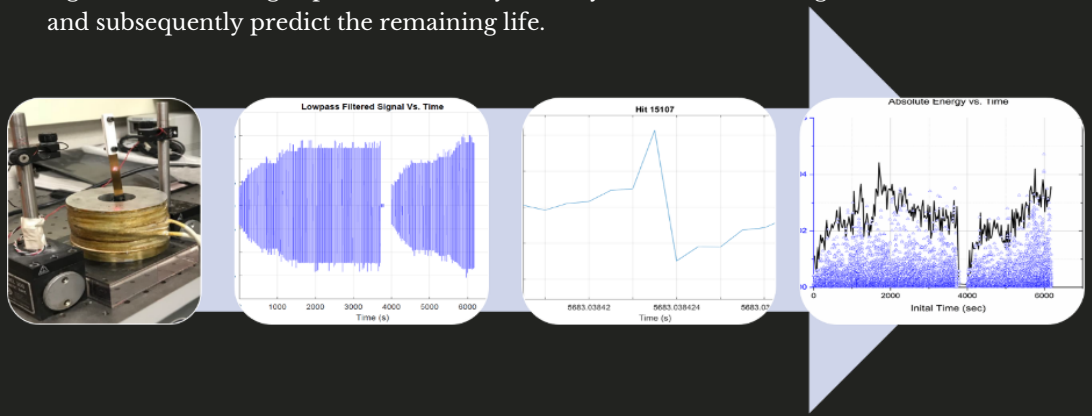
The Mechanical Behavior of Materials Group (MBMG) uses Acoustic Emission (AE) combined with other Nondestructive Evaluation (NDE) Methods to understand material response to external loads.

Current work is being done to understand the damage evolution of coal particle reinforced polymers subjected to tensile and bending loads. Other work is focused on using AE to detect the onset of fatigue cracking for both Navy and Airforce applications. MBMG is working with the Airforce Research Lab Turbine Engine Fatigue Facility is working on ways to monitor turbine component life. In our current work we are investigating thin Ti64 materials subjected to bending fatigue to identify the onset of fatigue crack growth. A single laser vibrometer sensor is being used with a combination of frequency filtering to monitor both AE activity and Vibrational Resonance. Further, Machine Learning algorithms are being explored to reliably identify the onset of crack growth and subsequently predict the remaining life.



Work flow process for extraction of AE data from a Laser Vibrometer Setup

WORLDWIDE AE RESEARCH UPDATES

Research Spotlight

AE Research Overview

PROF. MARKUS SAUSE AND SINAN KALAFAT
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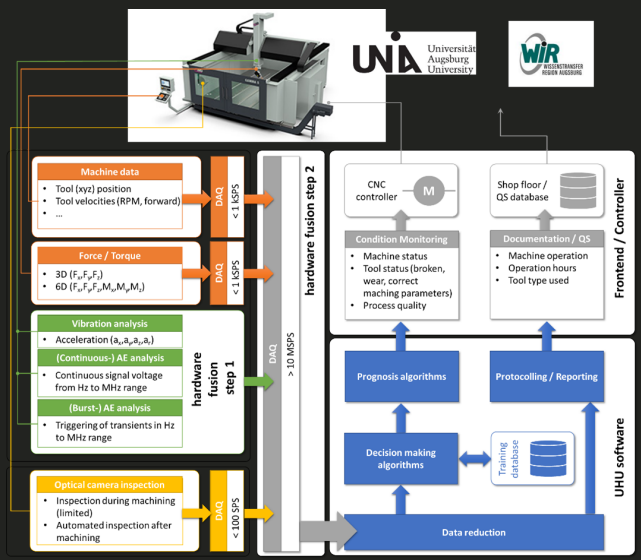
Machining of fiber reinforced composites remains a challenging process at the end of the value chain. Malfunctions of machinery and bad surface quality cause a tremendous loss of value and need to be reduced to increase competitiveness in lightweight applications. Monitoring of machining steps can be carried out by many different techniques and strategies all with their unique benefits and drawbacks. These provide information about machining hours, wear status of the tool, potential malfunctions of the system and can estimate the quality of the machining process. The team at University of Augsburg recently presented an approach to fuse different sensing systems on the hard- and software side to combine the information of different systems that provide a consolidated basis for the analysis of the machine status, tool status and machining quality. To this end results from a sensor fusion approach to measure acoustic information during the machining was published and a software framework that was developed to provide a blueprint for real-time capable solution for feedback control was established together with the company BCMtec



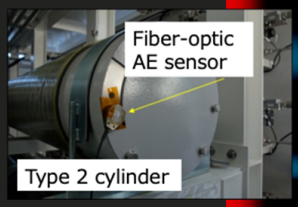
Flow Chart of Acoustic Monitoring Methods Hardware Fusion Steps for Machining of Fiber Reinforced Materials

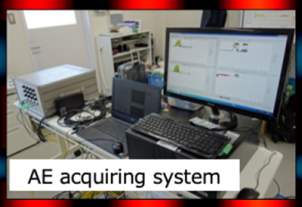
WORLDWIDE AE RESEARCH UPDATES

Research Spotlight

Japanese Society for Non-Destructive Inspection is developing the standard for AE testing of Type 2 composite cylinders for hydrogen refueling stations

Yoshihiro Mizutani
Associate Professor, Tokyo Institute of Technology
Director, The Japanese Society for Non-Destructive Inspection





Fuel cell vehicles (FCVs) are attracting attention as a means of reducing carbon dioxide emissions. In Japan, FCVs are now manufactured by Toyota and Honda. As of July, 2020, 131 hydrogen stations for FCV currently exist in Japan. The Japanese government plans to increase the number of stations to 320 by 2025 and to 900 by 2030. An FCV is filled with hydrogen from an accumulator (containing pressure cylinders) via a pre-cooler and dispenser at a hydrogen station. Most accumulators in Japan are now Type 1 or Type 3 cylinders. Type 1 cylinders are made completely from low-alloy steel, and Type 3 are composed of composite cylinders constructed from thin aluminum liners and carbon fiber reinforced plastic (CFRP). The surface of a Type 3 aluminum liner is fully wrapped with CFRP. In recent years, Type 2 cylinders have begun attracting attention, as these vessels are lighter than Type 1 and have a longer life cycle than Type 3 cylinders. A Type 2 composite cylinder is a low-alloy steel cylinder with a CFRP overwrap in the hoop direction. The dominant failure for Type 2 composite cylinders is assumed to be the fatigue of the low-alloy steel liner, and inspecting the fatigue during service is required. To keep the inside of the cylinder clean, inspection from the outer surface rather than open inspection is required. Therefore, the AE test is gaining attention for its ability to detect fatigue cracks in low-alloy steel liners of Type 2 cylinders. The Type 2 cylinder is designed to ensure that the stress generated in the liner remains below the fatigue limit, and even if fatigue cracks do occur in the liner, a long time is required for them to penetrate. Therefore, we plan to detect fatigue cracks by conducting AE testing during the periodic self-inspection of cylinders.

The Japanese Society for Non-Destructive Inspection (JSNDI) publishes a society standard called the Non-Destructive Inspection Standard (NDIS). Six standards are already included in NDIS for AE testing, but the new standard will be the first standard for composite cylinders. AE testing and analysis, which will yield the back data for the standard, have nearly been completed as part of a national project. The committee for the standard will be set up in April, 2021 and will publish the standard within the next few years.

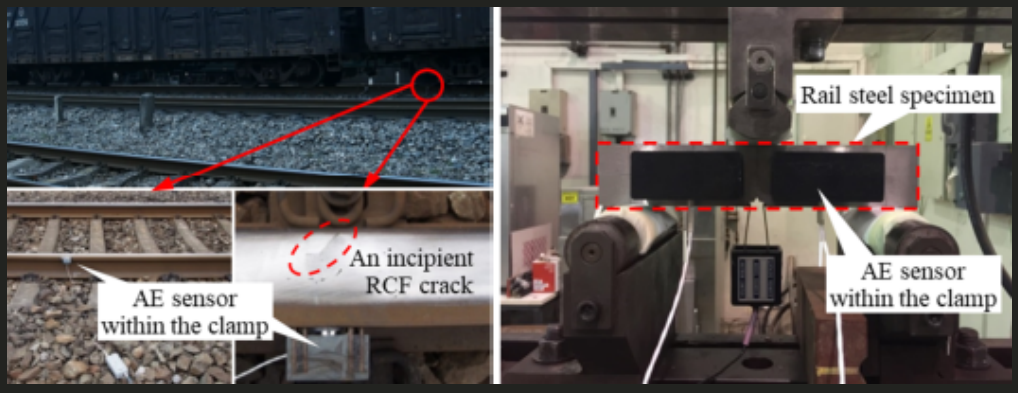
WORLDWIDE AE RESEARCH UPDATES

Research Spotlight

Rail Crack Monitoring using Acoustic Emission

AE Research Overview
DAN LI
ASSOCIATE PROFESSOR,
SCHOOL OF CIVIL ENGINEERING
HEFEI UNIVERSITY OF TECHNOLOGY, HEFEI 23009, CHINA

Fatigue cracks are one primary type of rail defects that would result in operational down- time and catastrophic failures. Rail crack monitoring aims to identify fatigue cracks in advance allowing timely repair to be carried out to ensure a safe and smooth operation of the railway system. Acoustic emission (AE) monitoring of rail cracks in the field typically with complex cracking conditions, high noise, and mass data was investigated. A novel crack identification index based on Tsallis synchrosqueezed wavelet entropy (TSWE) was first developed, where synchrosqueezed wavelet transform (SWT) was introduced to explore the time-frequency characteristics of AE waves and Tsallis entropy was adopted to quantify the local variation of wavelet coefficients more accurately. Field tests were carried out at an incipient rail crack with trains running at operating speeds. Time-TSWE efficiently detected and located the crack by extracting the crack-related transients in AE waves. Furthermore, the mechanisms of AE waves, including noise, impact, and crack propagation, were explored through filed tests and laboratory fatigue tests. AE waves indued by different mechanisms were found to show various patterns of energy distribution in the time-frequency domain. A multi-branch convolution-al neural network model was brought forward to automatically classify the three types of AE waves by taking into account their SWT plots in various time-frequency scales. The proposed rail crack monitoring method is able to detect not only surface cracks, where both impact-in-duced and crack propagation-induced AE waves would be identified, but also internal cracks where only crack propagation-induced AE waves would be captured.



Field and Laboratory Fatigue Testing

AE DATA REPOSITORY

Share & Access AE Group Data!

ACOUSTIC EMISSION DATA REPOSITORY

Structural Health Monitoring (SHM) has always faced a data management problem as it involves an immense source of time-driven information.The concept of a shareable digital repository provides a unique way of solving SHM's shareability issue by creating a single cloud-based platform to warehouse data. The purpose TAMG's Data Sharing Initiative is to develop a worldwide acoustic emission data hub. The hub would be composed of raw data, processed data, academic literature, experimental procedures, processing code, and ASTM standards.

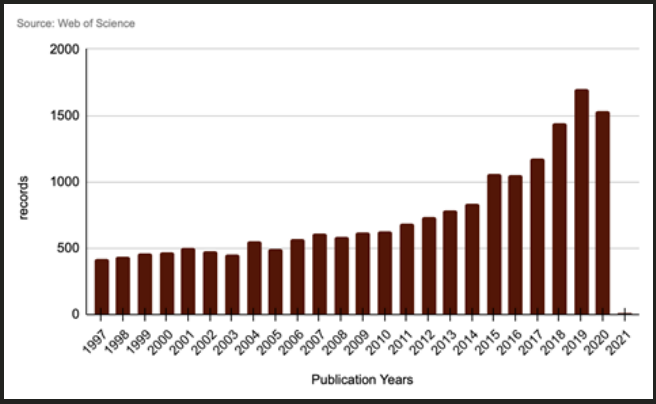
Led by:
Dr. Antonios Kontsos & Sarah Malik
Drexel University

- Create an account: https://figshare.com/
- Request access: https://bit.ly/2XFROJx
- Wait 3-5 days for access approval
- Log in to Figshare and accept invite
- Start uploading your data (any file accepted) with respective testing details (examples in Figshare titled 'Monotonic Testing' and 'Compact Tension Fatigue Testing with AE')

UPDATES ON AE PUBLICATIONS, BOOKS AND JOURNAL OF AE

Publications

Number of AE publications show an increasing trend in recent years according to the analysis of the Web of Science. Most of the papers are published by researchers in the USA, China, England, Japan, Germany, France, Russia and India. The AE papers are typically published at materials science and mechanics related journals.



Journal of Acoustic Emission is an international journal designed to be of broad interest and use to both researcher and practitioner of acoustic emission. It was first published in 1982 and volume 37 was just published in 2020. It has published and continues to seek original contributions of all aspects of research and significant engineering advances in the sciences and applications of acoustic emission. The journal has also published reviews, the papers presented at meetings, and technical notes. All the volumes are available for free download at aewg.org. These are organized volume by volume and individual articles are referenced as nn-xxx with nn indicating volume and xxx the starting page number. Authors index and list of contents are also available. All the articles are also available from ndt.net site, which can be located by putting keywords in Google. The latest volume 37 includes a tutorial article by Alan Beattie on source localization. Volume 37 also includes selected articles from a Latin American conference, E-GLEA10. These were translated by the authors into English, except one paper is in Spanish (on the history of AE in Argentina). This gives a glimpse of AE activities in Latin countries from two continents. The current editors are Marvin Hamstad and Gerd Manthei. A new AE textbook is in preparation led by Dr. Ronnie Miller and Dr. Joseph Rose. The first volume will have state-of-the-art topics including AE sources, wave propagation, finite element modeling, machine learning methods, instrumentation and software, source localization and standard applications. The second volume will include cutting-edge AE applications.

NEWS FROM AE MANUFACTURERS

Technology

MISTRAS' line of wireless systems offers users complete Acoustic Emission (AE) testing and monitoring solutions in portable devices, reducing the need for bulky equipment and cabling. Wireless AE systems provide users with improved mobility, while retaining full AE testing capabili- ties. A prime example of this product line is the 4-channel microSHM. MISTRAS have been im- proving the capabilities of this system by adding features such as (below). These features make the microSHM a true IoT AE device. MISTRAS will demonstrate the new version of the system together with other exciting new AE products at AEWG 63 in Houston, TX.

- Weather-Proof Packaging
- Inertial Measurement Unit
- Multiple Unit Time Synchronization
- Power Management
- Built- in Cybersecurity
- Software Remote Updates
- Activation Control Software
- Cloud Management
- Monitoring Web Portal

清诚科技 QINGCHENG COMPANY

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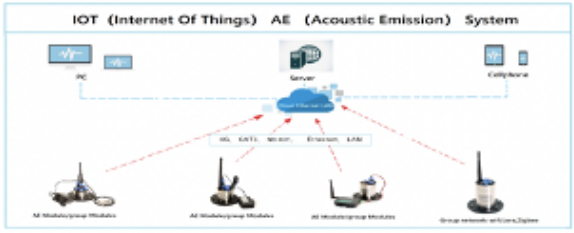


- Output to server: module built-in or outside by 4G/CAT1/NB-IOT/Ethernet/LAN. OR output to group router then to server: module built-in or outside by WIFI/Lora/Zigbee.
- Battery built-in or outside power supply. Sensor built-in or outside.

RL1: Timing acquisition: 1second to 100 hours, repeat from 1 day to 3 months. Output: rms/ASL/Energy, Alarms:3X3 levels automatic to cellphones.

RAE1: Trigger acquisition and timing acquisition. Output: Waveform, AE hit parameters (Arriving time (synchronous for location)/Amplitude/counts/duration /rms/ASL/Energy. Alarms: intensity alarm 4 levels for all AE Hit parameters and 4 levels for activities, automatic to cellphones.

Application example: Valve leakage, bridge wire rope breaking, damage & lubrication condition of rotating machinery, tool wear, etc.

RAE1/RL1 IOT-AE Module

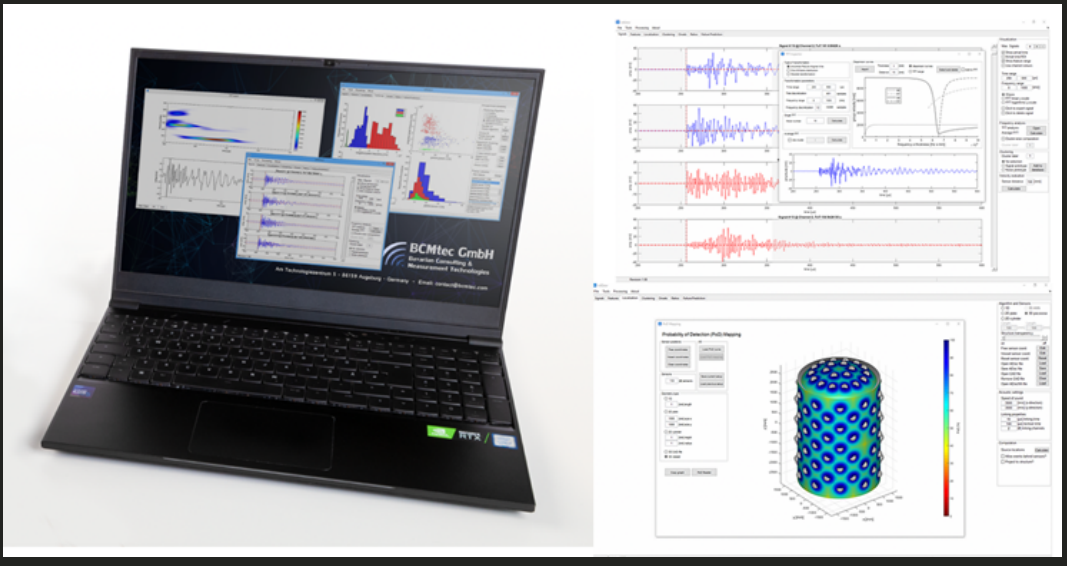
NEWS FROM AE MANUFACTURERS

Technology

nAExtor - next generation acoustic emission analysis software

The nAExtor software was developed to set a new standard in acoustic emission analysis. It offers a range of useful tools for processing acoustic emission data, based on state-of-the-art analysis techniques. nAExtors main features include:

- Native import of formats from different devices or industry standards (e.g. DTA/TDA/WFS, TRIDB/TRADB, ASCII)
- Visualization of relationships in the datasets.
- Calculation of time-frequency representations.
- Localization of acoustic emission sources with classical methods or with neural networks.
- Supervised and unsupervised pattern recognition with artificial intelligence methods.
- Calculation of damage onset values.
- Evaluation of component condition based on cyclic criteria (Felicity ratio, Shelby ratio, ...).
- The nAExtor software package can be downloaded at https://en.bcmtec.com/naextor and is free to use after registration.
- BCMtec – process control far beyond predictive maintenance



NEWS FROM AE USERS

AE SHM Application

MISTRAS recently completed a project consisted in the deployment and commissioning of AE monitoring systems and sensors on three bridges across the state. This 9-month duration project saw two contracts being executed, one to establish monitoring for the Varina-Enon bridge in Hopewell, VA and a second contract to monitor the Lord Delaware and Eltham bridges in West Point, VA. This is the first time a levelized design is implemented with three different levels of detail for the localization of potential damage in different components. A total of 751 AE sensors were deployed
across the three bridges:

- Eltham and Lord Delaware Bridges: Monitoring of Concrete box Girders
  - 280 DaisAE nodes, 8 base stations, 28 PowerHubs, 282 AE sensors
- Varina Enon Bridge - Monitoring Concrete box Girders, Cable stays and Pylons
  - 18 Sensor Highway III, 2 Samos Express 64, 2 Samos Express 96, 469 acoustic emission sensors

This hefty project of installing the systems and sensors required several MISTRAS teams to come together.

The large number of systems, sensors, and other hardware required several MISTRAS teams such as Field Services, Infrastructure Subject Matter Experts and AE specialist to come together under the leadership of the Asset Monitoring Group to successfully complete the project This important work will help to ensure safety for the more than 70,000 people that cross these bridges daily, via a state-of-the-art monitoring web application that provides 24/7 coverage of these three critical assets.

CONTACT AEWG

Contact AEWG if you have any comments, questions and news to share in next issue via email

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