SIMoNET Structural Integrity Monitoring Network

http://www.simonet.org.uk

Report on 20th SIMoNET Meeting
"SIM for Composites, Transport & Offshore"

Held at UCL on November 12th 2009

Introduction

Dr. Paul Fromme introduced the seminar, welcoming those attending and briefly describing the background to the Simonet network. Brief details of the presentations are given below.

1. Bridge Monitoring Using Acoustic Emission

Jon Watson
Physical Acoustics

The presentation discussed the application of AE monitoring for detecting and assessing fatigue on a number of different steel bridges in the UK. The presentation examined a test set up and its application on both a large and small scale. The results were presented with conclusions. In addition some results were shown from follow up ultrasonic testing and other NDT.

2. Acoustic Emission (AE) Crack Detection in Landing Gears Undergoing Certification Tests

R. Pullin, K. M. Holford, M. J. Eaton and S. L. Evans
Cardiff School of Engineering;
K. Worden and J. J. Hensman
Dynamics Research Group, University of Sheffield

Messier-Dowty are world leaders in the design and manufacture of aircraft landing gear systems, structures and components. Each design requires certifying for flight by the airworthiness authorities and this process relies on information obtained from structural fatigue testing. Traditionally non-destructive testing (NDT) is used to confirm the integrity of the landing gear structure at key stages in the fatigue test regime. The NDT inspection requires the test to be stopped for a period of time to allow the structure to be dismantled and these periods of NDT can account for 25% of the total testing time. Acoustic Emission (AE) has been proposed to be used for monitoring the landing gear during the certification test in order to reduce the down time caused by conventional NDT inspections.

The presentation highlighted some of the recent advances in the acoustic emission (AE) technique as part of the above project and the new approaches that are crucial for the successful use of AE data for diagnostic purposes. These included enhanced location techniques and novel signal processing approaches. A number of case studies were presented on landing gear components undergoing fatigue testing to demonstrate the AE technique to a Technology Readiness Level 5.

3. Composite Monitoring using Acoustic Emission

Chris Rowland
Pancom

The talk showed that the Vallen Acoustic Emission (AE) equipment can be operated as a black box, providing the user with a GO/NO GO status for structural integrity testing of Carbon Reinforced Fibre Plastic (CRFP) structures. The criterion for the GO/NO GO status is based upon the Felicity Ratio (FR). It was explained that the FR is an indicator of the irreversible damage which has occurred in a structure when subjected to a load sequence. The FR is part of the acceptance criteria for AE examination of Glass-fibre Reinforced Plastic (GRP) tanks/vessels (standard ASTM E 1067). It was noted that the method of deriving the FR for CFRP materials has been tested against 8 years of AE data obtained from testing Formula 1 CFRP structures.

4. Infrastructure Integrity Monitoring - an overview of National Grid

Alan Hodder
National Grid

Alan Hodder explained that the National Grid (NG) is active within CIGRE and EPRI on the electricity side, PRCI, EGRG and UKOOPA on the gas side and via the Energy Networks Association generally. Condition monitoring and R&D are related to M&E equipment - e.g. dissolved gas analysis of the oils in large transformers is one of the main areas of condition monitoring of assets which are both high value and system critical in security of supply terms. He explained that much of the routine monitoring of linear assets - e.g. pipelines and OHL circuits - is by regular aerial survey (on pipelines), line walking, and thermal surveys (from helicopters) on OHL circuits. In R&D terms, NG holds a 'watching brief' on developments in a number of areas and support projects which are perceived to offer significant potential. Work with optical fibres to monitor transmission gas pipelines has been done at an R&D level and NG has participated in a limited number of remote sensing projects. NG has recently installed equipment to monitor earthquake activity at some locations on a pipeline.

5. Monitoring of Deepwater Riser Systems

Hugh Howells
2H Offshore Engineering Limited

The presentation explained that riser systems used in offshore drilling and production systems are subject to ever increasing design challenges from increasing water depths, more extreme fluid properties, demands placed on the supporting vessels and extended time in service. Many attempts to monitor riser systems have proved both costly and unreliable. However, against a background of ageing and novel systems, an increasing requirement to monitor the response in service has evolved, to ensure ongoing integrity. This has led to the development of more robust and reliable devices and systems for monitoring both of extreme loads and fatigue from wave loading and vortex induced vibration, which are used routinely. A description of the monitoring methods being used was given with an overview of how monitoring data is being used in integrity management of risers and further development of riser design tools.

6. Crackfirst Fatigue Monitoring Sensor

Alan Owens
Strainstall UK

The talk described a fatigue sensor system for welded joints in steel structures, capable of providing advance warning of the rate at which the design life is being consumed. The CrackFirst^{TM} sensor was designed for welded steel structures and patented in 1990. It consists of a thin shim of material attached to the target structure close to a critical joint. Under the action of cyclic stress in the structure, a fatigue pre crack at the centre of the shim, introduced during manufacture, extends by fatigue crack growth. The sensor design is such that the extent of crack growth in the shim is proportional to the cumulative fatigue damage for a welded joint subjected to the same loading. In other words, the condition of the sensor indicates how much of the design life of the adjacent weld has expired and how much remains.

7. Vibration Monitoring at Cranfield / BINDT Condition Monitoring Activities

Len Gelman
Cranfield University / BINDT

Professor Gelman provided an overview of research activities in his group at Cranfield University, concerned with monitoring turbine blades and gearboxes. The vibration monitoring of turbines (Rolls-Royce) using accelerometers, can detect small cracks in blade roots from changes of non-linear parameters in the vibration signal. The detection of gear tooth damage, e.g., small levels of pitting, often due to misalignment in gearboxes, was undertaken using adaptive filter and wavelet technology for gear vibration. He also highlighted some work on early detection of impact damage in composites from changes in resonance frequency with the number of cycles.
Professor Gelman also outlined the activities of the BINDT Committee COMADIT (Condition Monitoring & Diagnostic Technology) of which he is currently the chairman. The Committee is involved in conferences, publications, standards and other activities, several of which have close links to Simonet interests.

8. Discussion Session.

A questionnaire was distributed to members on arrival and 20 completed questionnaires were available for analysis and presentation in this session. The three questions were:

1) Current Technologies – what are the main areas where improvements would be most beneficial?
2) What are the main fields that would benefit from new or improved technology?
3) Which degradation mechanisms are the most important for which structural monitoring would be most useful?

The results led to an interesting discussion session, led by Prof. John Sharp. The results from analysis of the questionnaires will be made available on the Simonet web site.

Conclusion

Professor Sharp closed the seminar, thanking those who had presented and those attending and reminded attendees of the next Simonet seminar in the spring.