

# Newsletter

## Second Issue 2014

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### President Message

*Tommy Chan*

*Professor in Civil Engineering, Queensland University of Technology*

First of all, I would like to congratulate Hong Hao, Hong Guan, Yew-Chaye Loo, David Thambiratnam and Jianchun Li for winning ARC Discovery grants in the recently announced round! Only 20 Civil Engineering Projects were successful in this round, and the overall success rate was just 18%, with a much lower success rate for Civil Engineering projects. Therefore, it is not easy to get a Discovery project. Well done!

Hong Hao stated that the existing ARC Discovery system is a very fair system, and I totally agree. My understanding is that a significant number of quality project proposals were submitted to the ARC, and the Council faced the issue of only being able to select a few among all of them.

Besides educating the community about the importance of SHM, ANSHM could help its members secure Discovery projects by providing a suitable platform, in which they can:

- share their views and get insights for preparing significant projects with innovative and feasible ideas
- identify research partners to establish collaborative projects with experts in different research areas of SHM
- strengthen their track records
- help the assessors better appreciate and give higher scores for projects in the areas of SHM

Jianchun correctly stated that we should establish an environment to help our SHM projects, in order to be more competitive. Furthermore, we should compete with non-SHM related projects, rather than competing with one another within ANSHM. I will work with the ECM and ABM to



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achieve this objective.

To me, I will be very pleased as long as we could obtain more and more ARC SHM related projects. ANSHM has a considerable number of experts working in the field of SHM. It is not difficult for us to conduct research individually or within an institution in the field of SHM. However, I believe we can have a better impact, if we establish a project under ANSHM. We have been working hard for the past few years to achieve this. At the moment we are still awaiting the decision of AustRoads to fund the project that we submitted early the year.

Recently I met Ari at the CIES Symposium 2014 (UNSW). He made a very good suggestion that on one hand we should continue to wait for the reply from AustRoads, as an ANSHM project funded by AustRoads will give a very positive impact to the community about the technology of SHM. However, at the same time, we could still start the project by inviting some road authorities to contribute cash and in-kind support. He conveyed that RMS could be happy to provide such support. It is a really good suggestion because as long as we can have three to four government organisations supporting this idea, we could use part of it for the first year funding to support the first year work stated in the AustRoads proposal with the scale adjusted to the funding available. Then we could use the other contributions to be used for an ARC Linkage project preparing a proposal based on that. We will discuss this in the coming Advisory Broad Meeting and it will be one of the tasks for the coming year of ANSHM. We could use the principles we formulated in 2011, as a guideline to prepare for this ARC Linkage project for ANSHM.

Meanwhile we will still wait for the reply from AustRoads. On the other hand, we have not forgotten ITRP and we are always prepared to submit our application whenever our research areas fall within the priorities of future rounds for Industrial Transformation Research Hubs.

In my opinion, ANSHM will provide a platform for us to establish more fundable projects and development in the area of SHM, for the advancement of technology, and for the benefits of the country. Of course, my dream is that one day we could have an ANSHM-based project and all of us working collectively, as ANSHM members.

Below are some updates for the month.

## Call for Nominations for Election of Executive Committee Members

The call for Nominations for Election of Executive Committee Members for the two year term 2015 – 2016 have been sent on 20 November 2014. According to the Rules of ANSHM, the Nominations shall be called at least 14 days prior to the election during the forthcoming Annual General Meeting on 9 December 2014. As mentioned in the Call for Nominations message, the two year term of office of six of the existing EC members, including myself, will be completed this year. I am very pleased to see all of the current EC members happy to continue their service in the EC. I am blessed to be working with this group of people, including all of the EC members. Previously, we were concerned about having too many members in the EC, as it would be difficult to find a common



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time for our EC meetings. However, it seems that although we currently have 9 members, we have yet to come across such a problem. This is due to our devotion to ANSHM and setting EC meetings to a very high priority. We are always trying our best to serve ANSHM. As mentioned in the message, the six of us who will all be on the list for re-election are:

- Tommy Chan (President)
- Jianchun Li (Deputy President)
- Hong Guan
- Saeed Mahini
- Xinqun Zhu
- Ying Wang

As the Association is growing and we also welcome new blood to serve in the EC, so we still can nominate other potential candidates for the election, including the roles of President and Deputy President. The election will be conducted at the forthcoming AGM on 9 December 2014. The nomination (for others not on the above list) can be made by sending an email to me ([tommy.chan@qut.edu.au](mailto:tommy.chan@qut.edu.au)) by 5 December 2014, if you have not done so already. In the upcoming Advisory Board Meeting, we will also discuss the number of members required for the EC.

## 6<sup>th</sup> Annual Workshop of ANSHM

We all notice that the 6<sup>th</sup> ANSHM Workshop at Holiday Inn Parramatta on 8-9 December 2014, hosted by the University of Western Sydney, has been well prepared by Bijan and Xinqun. We thank both of them for their hard work. I know that many of you have already planned to attend the workshop. For those who have not received the workshop flyer, please visit our web site for the final workshop programme and other details <http://www.anshm.org.au/Poster/workshop6.pdf>.

I am pleased to inform you that the general manager of Engineers Australia (John Anderson) accepted that this workshop to be considered as a CPD. Engineers Australia has already uploaded the conference details onto their events calendar (<https://www.engineersaustralia.org.au/portal/event/6th-annual-workshop-australian-network-structural-health-monitoring>). Many thanks for Saeed's efforts.

To follow the success of the last ANSHM Workshop, we will continue to have an industrial forum on the second date of the Workshop. In the presentations, the researchers will showcase their developments in SHM and how the technologies could be applied to monitor and manage the civil structures. The workshop will then provide a great opportunity for the industry to share their views on how SHM could help to meet their needs. Additionally, researchers in academic institutions can use this opportunity to help the industry understand how SHM could work for them in different aspects and different scales.

I am very excited to meet all of you in less than 10 days.



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## **Advisory Board Meeting and Annual General Meeting**

It has been our tradition since the establishment of ANSHM, for our Advisory Board Meeting and Annual General Meeting to be conducted during our annual Workshop. Therefore please try your best to attend the forthcoming 6th Annual Workshop. These two meetings are important as we need to re-evaluate the directions of ANSHM. ANSHM has grown significantly since its establishment. In the last issue of our Newsletter, I also summarised our achievements that we have made so far. However, as mentioned in the last issue that “we will continue to work on organising workshops, special sessions and special papers in journals, these are all important and we have been successful in organising these. However in order to have new achievements, we should think of some new things...” The two meetings can provide us a great opportunity for us to think of new things we can do to achieve our objectives.

Moreover, it was suggested in the last EC meeting that we need to change Cl 10.1 of the Rules. You should have received the corresponding notice for this change of Rules. For your convenience, I re-state the suggested amendments for the clause:

### **Original:**

10.1 These rules may be amended, repealed or added to by a resolution passed by at least three quarters of all Members.

### **Revised:**

10.1 These rules may be amended, repealed or added to by a resolution passed by at least three quarters of all Members Representatives present at the AGM meeting under rule 6.3.

The above amendment will be voted on at the coming AGM, on 9 December 2014.

## **Annual Membership Renewal**

According to our Rules, we need to have one half of the number of Core Members plus one to satisfy the quorum requirement for the AGM. Therefore, it is important for us to have sufficient number of Core Members attending our AGM. Our Rules Cl 5.5 also states that “A Core Member is a Member, of which there is at least one individual who is prepared to attend most of the meetings of the Association, e.g. Annual General Meetings, Advisory Board Meetings, Executive Committee Meetings.” In the last EC meeting, we decided that in order to simplify our annual membership renewal, Ying will prepare a form for the existing members to sign for their membership renewal during the 6th ANSHM Workshop. If an existing member is present at the workshop and s/he is interested to be a Core Member, s/he could be automatically admitted as a Core Member. Ying will also send an email to all the members who were not able to attend the workshop. Similarly, the



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members will be asked for whether they would like to be a Core Member or not. The EC will then approve the membership based on their participations in ANSHM meetings for the last two years.

## **SHMII 2017**

Saeed and I are closely working with QUT Conferences to update the budget for the conference. In a recent communication, Dr. Wolfgang Habel, President of ISHMII raised his concern about the venue for our SHMII-8 in 2017. He recommended for us to utilise the university's rooms and facilities, in order to reduce our expenses. We noticed that we could in fact save a significantly large portion of the venue cost, if we set the conference at QUT, rather than Brisbane Convention and Exhibition Centre (BCEC). Conversely, the success of recent G20 at BCEC was noted, and this could help promote our conference, attracting more delegates, however, at a price of increased costs. After discussions in the most recent EC meeting, we are inclined to use the Science and Engineering Centre of QUT, as the venue. We will discuss it again during the forthcoming Advisory Board meeting.

## **Special Issue in Electronic Journal of Structural Engineering (EJSE)**

For the papers under my attention, I have received reviewer reports from all the reviewers, except one. For Tuan's set of papers, he expects to receive all of his reviewer reports by the end of this week. Tuan and I would like to express our gratitude to those who helped in the review process for this special issue. For those who have not finished the review, please complete it as soon as possible. We plan to send the reviewer reports to the authors for them to revise their papers accordingly. Although EJSE will help us edit the papers accordingly to their format standard, we expect the authors will use the EJSE standard template to revise their papers according to the required format. In our last EC meeting, we aim to have this special issue published in December 2014.

## **Special Issue in Structural Monitoring and Maintenance (SMM)**

This special issue is entitled "Special Issue of Structural Health Monitoring from Data to Decision Making". The preparation for the publication of this special issue is progressing well. For those who have submitted an abstract to this special issue should have received a call for paper message from Ying. The deadline for the full paper submission is 5 Jan 2015. We aim to have this special issue published in mid-2015.



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## NICTA Structural Health Monitoring Update

*Peter Runcie*

*Business Leader, NICTA*

ANSHM members would be aware of the SHM system that NICTA is developing and deploying on the Sydney Harbour Bridge. In this update we discuss SHM system design and introduce the “Labwiki” user interface designed for researchers and educators.

### **System Design**

#### ***Requirements***

The SHM system has been designed to be used for a variety of structures and a variety of purposes. Each structure is different (design, materials etc) and the information required will vary with business requirements for example condition assessment, damage detection, characterising load etc.

Considering this variety it is clear that for a SHM system to be widely applicable it must support a range of sensors. A wide range of analytical techniques will also be needed to extract the information required by engineers and asset owners.

With respect to analytical techniques in many cases these techniques are either in development or are the subject of current or planned research activities in universities and industry.

While NICTA has strong research skills in computer science disciplines (particularly in signal processing, machine learning and computer vision), there are many more researchers in Australia and New Zealand including ANSHM members working on a wide variety of new techniques.

Given diverse range of structures, business needs, techniques and contributors we have designed the system to be an SHM “platform”. It can accommodate a range of sensors, data sources, signal processing techniques, analytical techniques and user interfaces as they are developed.

### ***Hardware***

Our approach to hardware has been to directly support commonly used sensors (accelerometers, strain gauges, displacement sensors etc). In addition other sensors that may be available such as fibre optic sensors, weather stations and ultrasonics can be integrated into the system with software.

The heart of the onsite system is the “smart node”. This is a small computer that is remotely programmable and can pre-process sensor data to reduce the volume of data transmitted to the central site. It also has sensor and network connectors. Several of these would be installed on a typical structure.



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The smart node communicates with a server located offsite (at NICTA's data centre) which performs data storage, analysis and presentation of SHM applications to users.

When there are only limited data communications capabilities such as in rural locations the system data can operate in a store and forward mode.

## ***Software***

A modular software design allows researchers to develop new signal processing or analytical techniques. The techniques are then coded as software and can be "plugged in" to the system as modules that can analyse data continuously if required.

A schedule is maintained for each node that controls data acquisition, processing and communications.

To date we have developed and are using several analytical modules including a vibration comparison module for detecting joint damage, a vehicle event detection module and a machine learning classifier (support vector machine) module.

Analytical modules can execute either onsite in smart nodes and/or on the server according to where analysis is needed and whether there are data communications constraints.

When a new technique is available it can be distributed across the network to the smart nodes without requiring a site visit.

## **"Labwiki" tool**

Labwiki is a web based user interface for the SHM system specifically designed for researchers and students.

With Labwiki the user can design experiments, collect data from a structure, perform analysis and document the results.

## ***Usage***

Labwiki has three screen panels: "Plan", "Prepare" and "Execute".



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**ODEL Tutorial 1**

**Walk-through the ODEL experiment description**

- First, a reminder that all details on ODEL are available in the [ODEL reference page](#).
- loadOBDI** (line 12). This command is used to include in your ODELs experiment other external ODEL scripts. In this example, we are loading the definition of a ping application, which has been instrumented with OML.
- defProperty** (line 14-18). This command is used to define experiment properties (aka variables), you can set the values of these properties as parameters for each experiment file, and will then have them across the entire experiment run. In this example, we are defining 6 properties, to hold the names of each of the resources that we will use and the target for the ping application.
- some internal variables** (line 21-26). There are these simple Ruby commands that allow us put all our resource in a single list, then split that list into one holding the **initial** resources, and one holding the **backup** resources. As opposed to the above **defProperty** variables, these internal variables cannot be set at the start of every experiment run (without having to change the content of the ODELs script itself).
- defGroup** (line 32-41). This command is used to define a group of resources which will use in this experiment. A group may contain many resources or any other group, and a resource may be included in many groups. This command may also be used to associate a set of configurations and applications to all resources in a group. In this example, we first define 4 groups (e.g. "Worker\_X1", each with only one resource, then we are associating an instrumented ping to the unique resource in each group. This association is made using the **addApplication**. Furthermore, we also define a final group ("Initial\_Worker"), which will contain the "Worker" groups with the initial resources.
- allowEvent** (line 43-63). This command defines the name of a user's custom event and the block of conditions which will be used to check if this event should be triggered.
  - Within the condition block we have access to the **value** variable, which hold a array. Each element of that array represents a resource and it is hash of key/value pairs corresponding to each properties of that resource.
  - In this example, In our condition block we check for each resource if it failed before. If not we check if it is an application and if it is currently stopped. If so then we add it to the list of failed resources, and we trigger the event.
- onEvent** (line 65-81). This command defines the set of actions to perform when a specific event is triggered. In this example, the event is our previously defined "APP\_FAILED". The action to perform in this case is to select a backup resource and start its ping application. There is another onEvent declaration further (line 66-74), for the event "APP\_UP\_AND\_INSTALLED", i.e. when all resources are ready to receive commands and all applications associated to them are installed. When this event triggers, we start the ping application on the resources within the "Initial\_Worker" group, then after 60 seconds we stop all applications and terminate the experiment.

The “plan” panel is used to document the experiment. This panel is essentially a textual write up of the experiment objectives, design and methods. It is edited like a “wiki” page.

The “prepare” panel is where data collection and some analysis can be specified. The smart nodes to be used for the experiment are identified together with sensor selection, data sample rates and sampling intervals. Data processing and analysis can be included here also. The experiment plan is scripted using a *domain-specific language* based on the Ruby language and can be edited and saved by the user.

After the experiment is prepared it can be executed. Experiment status and results are then shown in the “execute” panel.

Results are stored in a database on the server and can be downloaded in CSV or SQL format for further analysis.

## Behind the scenes

There is a lot happening behind the scenes to make this process simple to use.

The experiment description and script are stored on the server and are associated with the user’s



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login ID.

The SHM system is aware of the smart nodes installed at each location.

When the user executes the experiment the SHM system interprets the corresponding script and sends commands to the relevant smart nodes (subject to security permissions).

The nodes will execute these commands and reports their results and any collected measurements to the server.

## ***For Educators***

We are developing additional features into Labwiki to allow use of the system in group settings – for example with in undergraduate engineering students.

In this case the lecturer can configure a new experiment space on the server and provided user IDs to students. They can then collaborate on experiments and share result files. The execution of student experiments can be batched and scheduled to optimise the use of smart node resources. The outcome of these experiments can be automatically validated to provide feedback to the lecturer (e.g. how many student succeeded in running the experiment, what type of problem did they have, etc...). When no longer needed the user IDs and associated data can easily be removed.

## **Summary**

In addition to the data collection and analysis there is a significant IT systems aspect to Structural Health Monitoring.

We also recognise that each type of user has distinct needs and have designed the system and user interfaces to cater for those needs.



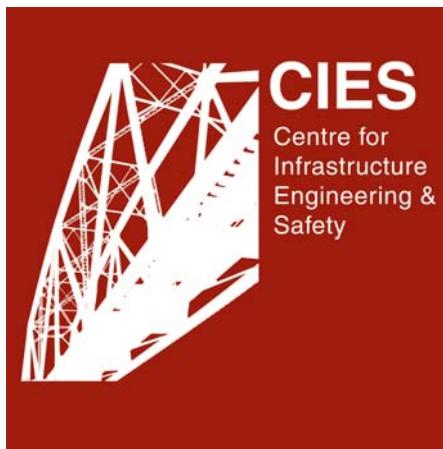
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## Centre for Infrastructure Engineering and Safety at UNSW

*Brian Uy*

*Professor of Structural Engineering and Director*

*CIES, University of New South Wales*



CIES (Centre for Infrastructure Engineering & Safety) was established in 2007 at UNSW Sydney.

CIES was established as a University of New South Wales Research Centre in 2007 to facilitate advanced research in all aspects of civil engineering infrastructure, embodying building structures, bridges, tunnels, roads, railways, pavements and the like.

It was also made possible by UNSW's unrivalled resources of academic and research staff, research students and state of the art laboratory facilities.

The Centre for Infrastructure Engineering and Safety is focused on high-level research in structural engineering, geotechnical engineering, engineering materials and computational mechanics. Specifically, we apply our skills to engineering and safety assessments and with the risk management of buildings, bridges, dams, roads and other infrastructure when subjected to both in-service conditions and overload (or limit) conditions, such as may occur in fire, earthquake, cyclone or blast situations, or when structures are exposed to hostile environments. The centre aims to promote multi-disciplinary collaboration across the Faculties of Engineering, Science and the Built Environment at UNSW and to foster international and interdisciplinary research partnerships.

CIES:

- Is an established world-class interdisciplinary research team, supported by advanced analytical, computational and experimental techniques and facilities, and underpinned by structural and geotechnical engineering expertise, in the field of infrastructure engineering and mechanics.



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- Provides a forum for research engineers and scientists from various disciplines to exchange ideas and to develop and lead collaborative research programs.
- Provides a platform for the submission of highly- competitive nationally peer-assessed research grant funding applications, specifically through the Australian Research Council's Discovery and Linkage Project schemes and for the development of proposals for research funding from industry.
- Promotes the application of research outcomes and deliverables to industry.
- Contributes to the education and training of high-quality postgraduate students in a wide range of relevant disciplines in engineering and applied science, and provides an outstanding research and learning environment.

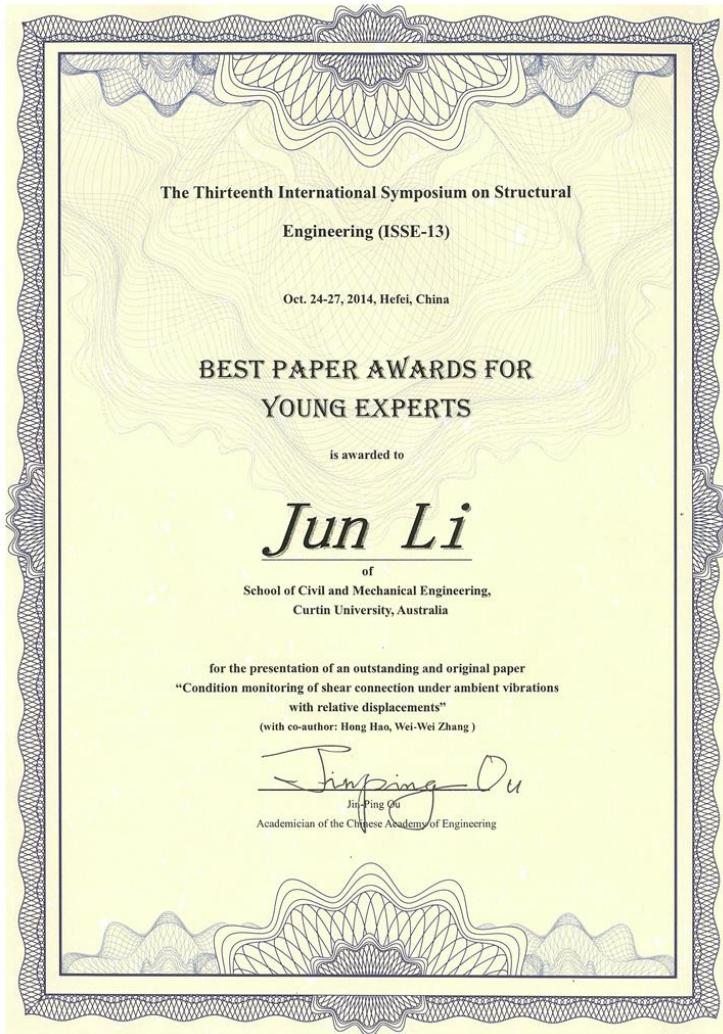
The CIES Executive team consists of Centre Director: Professor Brian Uy, Research Director: Laureate Fellow and Scientia Professor Mark Bradford; Deputy Directors: Emeritus Professor Ian Gilbert and Professor Chongmin Song.

For more information on CIES, visit: [www.cies.unsw.edu.au](http://www.cies.unsw.edu.au)



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## Conference and Award Information



Congratulations to Dr Jun Li, Prof. Hong Hao and Dr Weiwei Zhang to receive the following best paper award

**Name of award:** Best Paper Awards for Young Experts

**Awarding body:** The Thirteenth International Symposium on Structure Engineering, Hefei, China, 2014.

**Award sponsor:** National Natural Science Foundation of China

**Paper title:** Condition Monitoring of Shear Connection under Ambient Vibrations with Relative Displacements

**Presenter:** Jun Li

## Conference Information

- **The 6<sup>th</sup> ANSHM annual workshop**, Holiday Inn Parramatta, Sydney, 8-9 Dec 2014. Organized by Dr Xinqun Zhu and Prof. Bijan Samali at University of Western Sydney.
- Special Session "**Research Advances in Structural Health Monitoring – Australian Experiences**" with the **7<sup>th</sup> International Conference on Structural Health Monitoring of Intelligent Infrastructure (SHMII 7)**, 1-3 July 2015, Torino Italy. Organized by Prof. Hong Hao, Prof. Tommy Chan and Dr Jun Li.
- **The 6<sup>th</sup> International Symposium on Innovation & Sustainability of Structures in Civil Engineering**, 26-27 July 2015, Beijing, China. Organized by Tsinghua University.



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## Social Media

Follow us at the next social media and webpages

- ANSHM Facebook webpage: [www.facebook.com/ANSHMAU](https://www.facebook.com/ANSHMAU)
- ANSHM Facebook group: [www.facebook.com/groups/ANSHM](https://www.facebook.com/groups/ANSHM)
- ANSHM LinkedIn group:  
[www.linkedin.com/groups/ANSHM-Australian-Network-Structural-Health-4965305](https://www.linkedin.com/groups/ANSHM-Australian-Network-Structural-Health-4965305)

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Welcome your any comments and suggestions, please contact

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