Final year projects offered by Professor Jie Pan
(2012-2013)

Project 1: Design and analysis of sound absorber at a pipe bent
Project 2: Correlation of pump vibration with unsteady flow inside of the pump
   The main objective of the pump project is to establish the link between the hydrodynamic force of the fluid inside of the pump and the pump vibration. The vibration can be measured by attaching accelerometers to the pump. The internal hydrodynamic force is hard to access. I am thinking to insert a pressure transducer into the fluid chamber for this measurement. Although, we can have the access at one point of the flow field, we can use this measurement to compare with CFD results, which allows the pressure and velocity inside of the pump.

Project 3: Vibration analysis of a disc type winding
Project 4: Vibration analysis of a centrifugal pump
Project 5: Vibration analysis of oil-filled transformer tank
Project 6: Development of a virtual Swan Bell museum
   Perth Swan Bell museum has collected a range of western bells, tubular bells and carillons and several precious eastern bells. Sometimes, the sounds of those bells can be heard by the visitors when the bell ringers are around. To overcome this difficulty, a virtual Swan Bell museum will be developed so that both visitors and people from all over the world can view the bells and listen to the bell sound online. The project involves
   (1) Development of virtual tour in the museum;
   (2) Record bell sound at higher quality and link the sound files with each bells in the museum;
   (3) Provide some analysis tools so that the listeners can compare and analysis the quality of the bell sound;
   (4) For the three bell groups (18 western bells in the main hall, tubular bells at the entrance, and carillons at the top floor, visitors of the virtual museum should be able to design the play sequences and listen the result of the on-line bell music composition.

Project 7: Analysis and control of a magnetic thrust actuator
Project 8: Vibration induced damage in transformer winding insulation
Project 9: Effect of sound and structural coupling on cello's sound at body resonance
   Cello players and makers have found that the cello note near the cello’s body resonance vary from cello to cello. However this note is important in characterize the quality of a cello. It has been recognized that the coupling between the cello’s acoustical resonance and the modes in the top and bottom plates of the cello controls the sound quality at the note (fundamentals and harmonics and their decays). An investigation of this coupling, by using laser scanning vibrometer and vibration modeling, may provide the cello makers a guideline for design a high quality cello sound near its body resonance.
**Project 10: Aerodynamics and aero-acoustics of Entecho’s vehicles (team project)**  
**Project 11: Environmental noise measurement, modeling and control (team project)**  
**Project 11.1: Noise from evaporative air conditioning**

*Supervisor: Winthrop Prof. Jie Pan/DEC Contact: Peter Popoff-Asotoff*

Roof mounted evaporative air-conditioning units are widely used in Western Australia. Compared with other air-conditioning systems, the evaporative units are generally cheap to install and operate. However, the current economic boom in WA has resulted in more crowded living environment in Perth. One of its consequences is that more and more residential lots have been subdivided, and neighbours are living closer and closer. As a result, complaints about noise from the neighbour’s evaporative air-conditioning units in Perth have been gradually increasing. Further, installers continue to install evaporative units that do not comply with the noise regulations.

This project will be conducted in two aspects: (1) a study of noise issues associated with evaporative air-conditioning systems in the Perth metropolitan area and (2) an investigation into quieter evaporative air-conditioning systems, such as using quieter fans, and the application of noise control technologies such as acoustic ductwork and enclosures that reduce the noise transmission from the air-conditioning systems.

**Objectives**

The objectives of the proposed study are to provide the community and local governments with information about the noise problem associated with roof-mounted evaporative air-conditioning units in Perth, and guidance in reducing this noise problem.

**Project 11.2: ACTIVE NOISE CONTROL OF TRAFFIC NOISE IN BEDROOMS – PILOT PROJECT**

*Supervisor: Winthrop Prof. Jie Pan/DEC contact: Dr. Jingnan Guo*

Transport noise has long been an environmental pollutant affecting the health and quality of life of residents living along roads, railways and under aircraft flight paths. The current economic boom in Western Australia has lead to more traffic in all transport systems and an increase in the density of living environments, hence increasing the traffic noise problem. Up to now, a lot of effort has been put into the acoustic treatment of the dwellings in the vicinity of noisy traffic routes, which includes the double glazing of windows, acoustical insulation within ceilings and selection of optimal double walls, etc. All these traditional noise control technologies have a common feature: effective in the attenuation of the high-frequency components of the noise, but less effective for low-frequency noise. As a result, traffic noise transmitted into dwellings is dominated by low-frequency energy. This low-frequency noise can be very annoying and deteriorates the indoor living quality, especially with regards to sleep.
A new noise control technology - active noise control - has been developed recently. This state-of-the-art technology involves using noise to cancel existing noise, and is becoming another practical noise control option. A very important advantage of this new technology is that it is particularly effective for use with low-frequency noise. The proposed study is to investigate the feasibility of using active noise control technology to reduce low-frequency traffic noise transmitted inside the dwellings, and improve the acoustical quality of the bedrooms.

Objectives

The objectives of the proposed study are to investigate the feasibility of using active noise control technology to reduce the low-frequency traffic noise transmitted into the bedrooms, and hence improve sleep quality.

Project 11.3: Fast vs Slow noise assessment

Supervisor: Winthrop Prof. Jie Pan/DEC Contact: Peter Popoff-Asotoff

Sound level measurements using almost any grade of sound level meter can be Fast or Slow time weighted. These weightings date back to the time when sound level meters had analogue meter displays and defined the speed at which the needle moved. Under Fast the needle would move quickly to show quickly varying noise and under Slow the needle would be damped to smooth the noise out to be easier to read. Fast corresponds to a 125 ms time constant, while Slow corresponds to a 1 second time constant. For easier reading, the prescribed noise standards (assigned noise levels) specified by Western Australia’s Environmental Protection (Noise) Regulations 1997 are given in terms of Slow time-weighted noise levels ($L_{A_{\text{Slow}}}$). As the consequence, environmental noise measurements and compliance assessments are all conducted in terms of $L_{A_{\text{Slow}}}$ in WA.

The advantage of ‘easier reading’ under a Slow response has disappeared with the introduction of digital sound level meters. As a result, most jurisdictions worldwide have switched their environmental noise criteria and measurements to Fast response. It can be expected however that Fast and Slow responses may result in different measured environmental noise levels. This means that the assigned noise levels may also need to be modified if the time weighting under the regulations were to be changed from Slow to Fast response. It is important to understand this potential difference before a change from Slow to Fast response can be considered.

This project is to investigate the differences of $L_{A_{1}}$, $L_{A_{10}}$ and $L_{A_{\text{max}}}$ statistical noise levels (on which the assigned levels are based) when measured with Slow and Fast responses. The investigation will be conducted on various environmental noise sources and under various conditions.

Objectives
The objectives of the proposed study are to provide the Department of Environment and Conservation with information on the differences of measured noise levels when using Slow or Fast time-weighted response, the results of which will form the basis for the possible change from Slow to Fast response in WA’s noise regulations.

**Title: Wind farm noise and its impacts**

**Supervisor: Winthrop Prof. Jie Pan/DEC Contact: Peter Popoff-Asotoff**

As a clean and renewable energy source, wind farms have been widely and increasingly installed worldwide. Currently there are 12 wind farms operating in WA with a total of 198 megawatts of installed generation capacity, which accounts for 63% of WA's electricity produced from renewable energy sources. The Department of Environment and Conservation (DEC) continues to receive new proposals for wind farm developments. It can be expected that WA will have more wind farms in the near future.

It has been reported that wind farms can be a source of annoyance for some people, which is found to be dependant on a person’s sensitivity to noise. This potential noise impact needs to be assessed to ensure sufficient buffers are maintained. DEC is currently starting work to develop guidelines for wind farm noise impact assessment.

This project is to investigate the noise emissions of the current wind farms in WA and the community’s responses to wind farm noise. Noise measurements will be conducted at a couple of selected wind farms, in order to collect data and information regarding the wind farm noise emissions at different buffer distances and under different weather conditions. The possible intrusive characteristics of the wind farm noise, such as tonality, impulsiveness and low-frequency noise will also be studied.

**Objectives**

The objectives of the proposed study are to provide wind farm operators and proponents with information on wind farm noise and its impacts. This information will also be used by the Department of Environment and Conservation for developing guidance material for wind farm noise impact assessment and management.

**Project 12: Sound propagation in 3 dimensional enclosed space**

The property of sound wave propagation in a 3D space is related to the acoustical quality of the space. This project involves the modeling of time domain sound field in a 3D space and use the modeled impulse response functions at two ears of a listener (with respect to a loudspeaker) to generate a virtual sound test software. Head related transfer functions are included in the sound generation to the two ears for realistic spatial hearing. The software will allow the listener to compare the acoustical quality of the space. The first model of the sound field is from the modal solution of sound in a rectangular room.

**Project 13: Transient vibration in pump-pipeline system**

**Project 14: Sound radiation and scattering of underwater structures**
This project involves numerical modeling of scattering of underwater sound by a large plate with a surface discontinuity (such as a finite sized patch). The project will study the significant of the scattering of the patch in terms of the size of the patch (with respect to the wavelength), material properties (stiffness and mass) and angle of incidence of the incoming wave.

**Project 15: Test and modeling of flow induced vibration/motion of a marine riser**

**New topics:**

Project 16: Analysis and control of flow induced vibration in Water Corp’s chemical dose spears

Project 17: Optimal chemical mixing in Water Corp’s water treatment pipe

Project 18: Analysis and control of the reverberation in the stairway of the Engineering Faculty building