3. New Sensing Technologies

Photonics & Optical Communications

The Photonics and Optical Communications Group (POCG) started research on optical wave propagation in optical fibres in 1974, under the headship of the world-renowned Prof. A.E Karbowiak, then Prof. P. L Chu.

Since then, the Group grew steadily both in number of research students and full time research staff, and also in financial support from the Government and private industries. Consequently, the research activities of the Group also widened. By early 1980's, the Group established the first optical fibre manufacturing facility in the country dedicated for research purposes. In 2010s we have established the new photonic fibre fabrication facilities.

The Group also developed the world's first non-destructive measurement method of stress distribution in optical fibre and preform. This method leads to the manufacture of stronger fibres. The Group also developed a far field method for measuring the spot size of a single mode fibre which is now being used world-wide. In the mid-1980's, the Group discovered the mutual interaction effect between neighbouring solitons which leads to an upper limit of the achievable fibre bandwidth. It was only in 1995 that other research groups in the world have verified experimentally the important significance of these methods.

The Group also developed many theoretical methods of analysing the performance of various kinds of fibres such as the stress birefringence in polarisation-maintaining optical fibre, and the cut-off calculation of noncircular fibres using effective index method.

Currently under the leadership of Prof. Gang-Ding Peng, the ongoing research work in the group includes fiber laser, optical fiber sensing, special silica and polymer optical fibers and devices, planar photonic and waveguide devices, photonic signal processing techniques etc..

For more details, please visit our website:

http://www2.eet.unsw.edu.au/photonics/index.html

The interdisciplinary photonics laboratories (iPL)

The interdisciplinary photonics laboratories are a key focal point for cross disciplinary activity between scientists and researchers of all persuasions utilising photonics and nanotechnology in new ways for new applications. From ultra high temperature waveguide gratings to self-assembled photonics in organic, oxide and other media, understanding materials, their transformations and interactions in the bulk, the nano domain and at interfaces at a fundamental level and their utilisation in new and novel ways is of particular importance. Through national and international collaborations many of the technologies are being evaluated in advanced applications including train and furnace diagnostics, single photon sources and more. iPL welcomes further collaborations and undertakings to enhance scientific research in Australia and across the world.

Next to our logo find an excellent video from the European Photonics Industry Consortium (EPIC) on the ubiquity of photonics prepared before the International Year of Light in 2015 http://www.light2015.org/Home.html (A bit tacky having these so-called international years of something or other but hey it hopefully educates a broader audience to optics and phonics and the importance of materials).

International research at iPL spans most continents and projects have involved groups from the United States, China, Canada, Brazil, Europe, India, UK and more. Activities span optical fibre and grating research, self assembled photonics and materials. iPL also provides consultation services, advice and some infrastructure resources, as well as independent advice on government policies, intellectual property and legislation.

iPL, through the School of Chemistry, Faculty of Science, offers the highest quality PhD research degrees in photonics and related activities. Further, the cross disciplinary activities means students from Physics and Electrical Engineering and other departments work at iPL and can be co-hosted jointly. For more information contact the iPL director. For general student information, both local and international, please see the links on the right to the relevant University sites.

A joint network of collaborating institutions, with support from Australian Research Council funding, to the commissioning of a custom-designed national fibre facility for the advanced fabrication of silica optical fibres at the University of New South Wales More. Prof. Canning has been appointed Conjoint professor in recognition of his contributions to this facility and to strengthen ties between the University of Sydney and UNSW. Recent innovations include ultra broadband luminescent Bi/Er co-doped optical fibres and other Er fibres used in record breaking demonstrations of few mode communications.

For more details, please visit our website:

http://www.iplaustralia.com/

Vibration and Acoustics

In Vibration and Acoustics, we use analytical and numerical modelling tools to study the physical mechanisms in multi-disciplinary problems that include acoustics, vibration, fluid dynamics and fluid-structure interaction.

Numerical modelling of acoustic-structure interaction: We use 3D fully coupled finite element and boundary element models to predict the radiated sound from structures submerged in or filled with fluids. Several techniques have been developed to improve the understanding of the physics surrounding the interaction of heavy acoustic fluids and thin-walled structures, such as modal decomposition of fluid-loaded structures and surface contribution techniques.

Flow induced noise: We use hybrid computational fluid dynamics and boundary element models to investigate flow induced noise generated by a marine vessel and its propeller. Our models aim to identify the hydrodynamic mechanisms responsible for this flow induced noise, the propagation of the acoustic waves produced by these flow noise sources and the radiated sound fields due to scattering of the acoustic waves by a body immersed in the flow.

Vorticity induced vibrations: We use fully coupled finite element and computational fluid dynamics models to predict vibrations induced by vortex shedding behind hydrofoils. The models are used to investigate the lock-on effect of structural vibration and vortex shedding, as well as radiated sound due to vorticity induced vibrations.

Stochastic models on uncertainties: Uncertainties are integrated into dynamic models of complex vibrating structures to represent randomness in geometric or material properties, or uncertainties arising from the manufacturing and assembly process. Uncertainties also arise in bio-mechanics, for example, in the healing process of a bone implant. Using polynomial chaos expansion, we are developing new stochastic mechano-biological models to predict the distribution of new-formed tissue around a bone implant.

3D sound barrier models: We use a novel quasi-periodic boundary element method to predict the acoustic performance of noise barriers in three dimensions. This method is being used to investigate sound barriers with Helmholtz resonators and acoustic diffusers with the aim to reduce low frequency road traffic noise.

Vibration and Acoustics Laboratories:

- Acoustics and Vibrations Lab

For more details, please visit our website:

http://www.engineering.unsw.edu.au/mechanical-engineering/vibration-and-acoustics