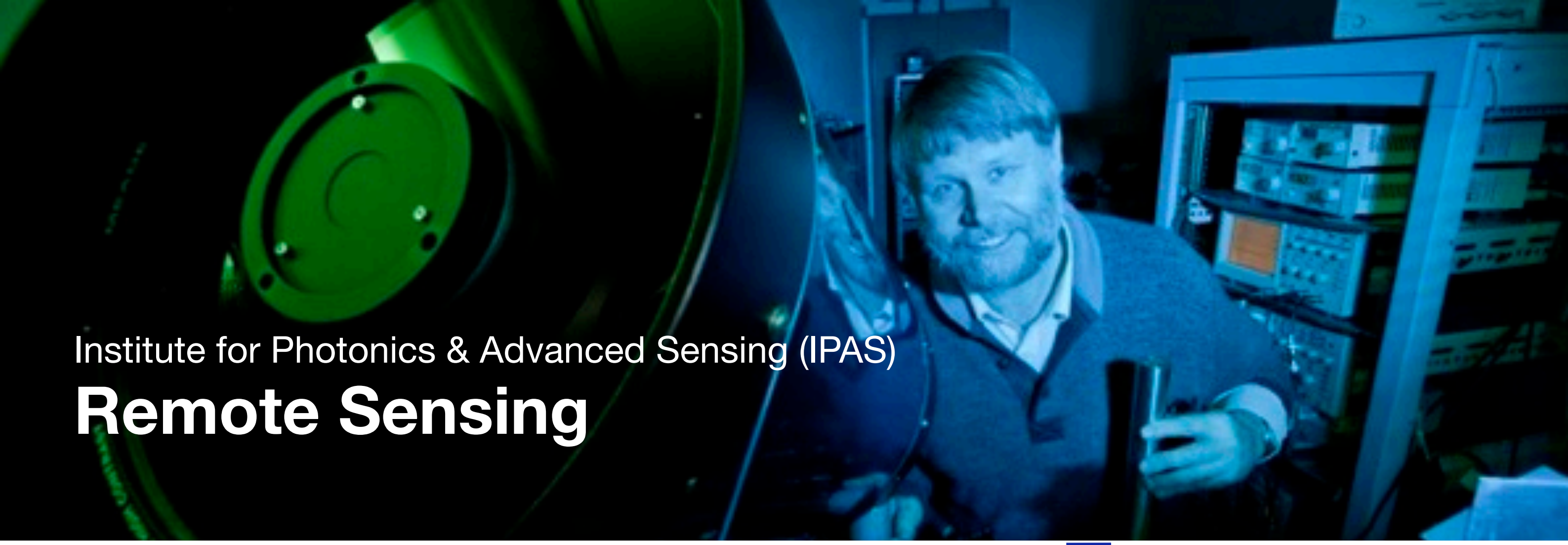

Institute for Photonics & Advanced Sensing (IPAS)

Remote Sensing

Theme Leaders

Dr David Ottaway

Dr Gavin Rowell

Remote Sensing research at IPAS includes the search for gravitational waves using ultra-precise lasers (LIGO), the development of LIDAR systems for measuring wind fields for wind farms, pollutant monitoring (SO_x, NO_x, dust) at industrial sites and high energy astrophysics research on the detection of cosmic and gamma rays.

The team has a wealth of experience in developing technologies that underpin remote sensing devices and specialises in refining and deploying high precision photonic technologies for sensing at a distance.

IPAS contributes to and actively engages with several international research projects in this theme, including the Laser Interferometer Gravitational Wave Observatory (LIGO) and the High Energy Stereoscopic System (HESS).

Our extensive facilities, including laser & detector development laboratories and optical detection systems are situated on The University of Adelaide campus or at our Buckland Park Field Station & Observatory.

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Light Detection and Ranging (LIDAR)

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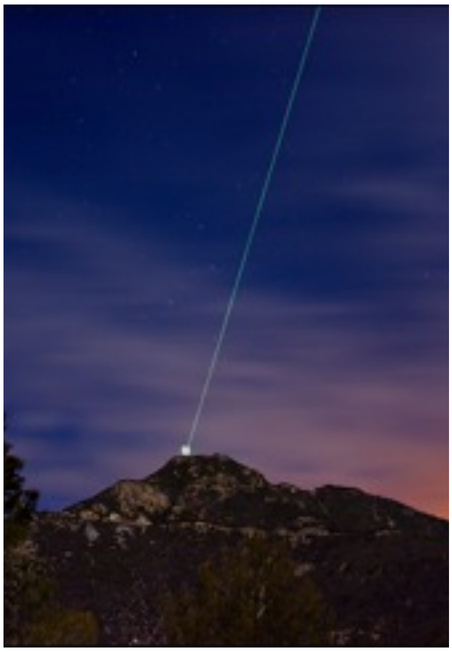

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Light Detection & Ranging (LIDAR)

The Light Detection & Ranging (LIDAR) researchers are developing coherent laser radar (CLR) system for a range of eyesafe LIDAR applications. Current interests include monitoring dust and pollution surrounding mining and industrial sites, mapping wind speeds for wind farm site assessment and turbine protection, and turbulence detection for aerospace applications.

We are also developing differential absorption LIDAR (DIAL) to remotely sense specific compounds in the atmosphere. Water vapour sensing has been demonstrated, and NO_x, SO_x and CH_4 detection is also an active research interest.

Gravitational Wave Detection (LIGO)

IPAS has strong links to the global LIGO project. IPAS researchers have worked in senior positions in the LIGO project, including Head of the LIGO advanced system test-bed interferometer (LASTI).

We have designed and developed a range of laser systems, architectures, and components for the LIGO project. We are currently developing ultra-sensitive optical wave-front sensors for installation on the advanced LIGO detector.

Buckland Park Field Station & Observatory

High Energy Astrophysics

Using high energy cosmic messengers such as gamma and cosmic rays to study the universe is a particular focus of the High Energy Astrophysics activity. This work is motivated by the search for the origin of high energy particles in the universe and how they can be accelerated by extreme astrophysical systems.

Advanced visible to UV detectors are used to detect the passage of high energy particles travelling through the Earth's atmosphere. These detectors use advanced techniques to filter the particles' light from the atmospheric background and require a detailed knowledge of atmospheric transmission conditions. Current projects include the design of multi-Tera-electronvolt gamma ray telescopes and ultra high energy cosmic ray detectors.

Buckland Park Field Station & Observatory

The Buckland Park Field Station & Observatory facility occupies an 80ha coastal site approximately 40km north of Adelaide. The site boasts an array of equipment dedicated to studying the atmosphere, including radars (MF, VHF & VHF BL), a radio acoustic sounding system (RASS) and a 3-field photometer.

Recently this facility has been extended to include LIDAR capability, which permits measurements of atmospheric temperature, wind velocity and dynamical other processes with high spatial and temporal resolution at altitudes between 10km and 105km. Combined with the co-located radar and passive optical systems, the Buckland Park Field facility delivers a unique atmospheric measurement capability extending from the troposphere up to the lower thermosphere.

Case Study: LIDAR Detection

In collaboration with DSTO, we are developing light detection and ranging LIDAR systems to measure water vapour up to about 12km height. The aims of this work is to gain an understanding of the variability of water vapour, and of the extinction of transmitted radiation due to liquid water, ice and aerosols.

Our previous work in this area includes the demonstration of a system capable of measuring water mixing ratios that correlate very accurately to the Bureau of Meteorology radiosondes up to a height of 700m. We are now extending the range of our system, as well as developing a Rayleigh LIDAR, adding two Raman channels, in which light that is wavelength shifted through Raman scattering by water and by nitrogen molecules is detected.