Radar Activities Within The Sensors, Systems and Circuits Group

Academic Staff: Prof. Paul Brennan, Prof. Hugh Griffiths, Dr. Kenneth Tong, Dr. Karl Woodbridge

Research Staff: Dr. Matt Ash, Dr. Lai Bun Lok, Matt Ritchie, Dr. Bo Tan

UCL

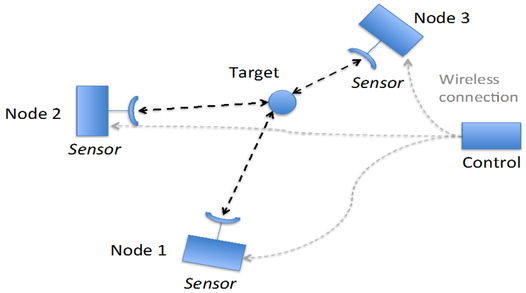
Bi-static/Multi-static Radar

H. Griffiths, M. Ritchie, K. Woodbridge

The group is a pioneering research team in the area of bistatic and multi-static radar systems. This has been demonstrated by the awarding of the IET A.F. Harvey award to Hugh Griffiths for his work in this field.

We have developed our own multi-static radar system, NetRAD, which has been used during numerous trials. Experiments have ranged from novel work on monostatic and bistatic sea clutter analysis to passive WiFi detection.

Potential advantages for bistatic/multistatic systems are: counter-stealth abilities, more immune to EW techniques, reduced size and weight of passive nodes, extra degrees of freedom which provide more information on target and background.

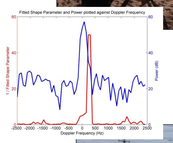


Sea-clutter/Martine Target Analysis

M. Ritchie, H. Griffiths, K. Woodbridge

Through the improved understanding of the behaviour of sea clutter returns significant improvements can be made in the detection of targets in the maritime environment. Experimental campaigns in the UK and South Africa have given new insight into the behaviour of sea clutter.

The focus of this research has been on the characterisation of the changes in sea clutter statistics as a function of Doppler. The conclusions from this work directly effect the way detection algorithms should be applied in the Doppler domain.



Collision Avoidance Maritime Radar

S. Halai, P. V. Brennan

Researchers in the group have developed an omni-directional collision avoidance radar system for port manoeuvring of large vessels in collaboration with Guidance Microwave.
The novel aspect of the radar is that it has no electrical or mechanical steering but range and bearing to a target can still be determined.

Figure: UCL developed maritime Radar system

Passive WiFi Radar

B. Tan, K. Chetty, K. Woodbridge

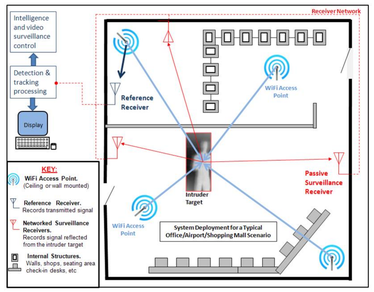


Figure: Passive WiFi radar system deployed as an indoor security sensor.

The group, in collaboration with the Dept. of Security and Crime Science, is pioneering the use of WiFi access points as transmitters of opportunity in passive radar systems. The technology has been demonstrated as a means of detecting the movement of humans through walls. Its applications could be numerous, including security systems for intruder detections in scenarios where CCTV does not provide adequate coverage.

Microwave-Optical Tissue Oxygenation Monitor

A. Al-Armaghany, T. Leung, K. Tong

A newly developed sensor exploits a innovative type of bio-compatible antenna to induce a local temperature rise in muscle tissue while maintaining low temperature in the superficial layers. The elevated tissue temperature produces alteration in human thermoregulation, which is measured by the integrated optical sensors using near infrared Spectroscopy. Physiological response in the deep tissue can provide valuable information toward the study of various vascular diseases.

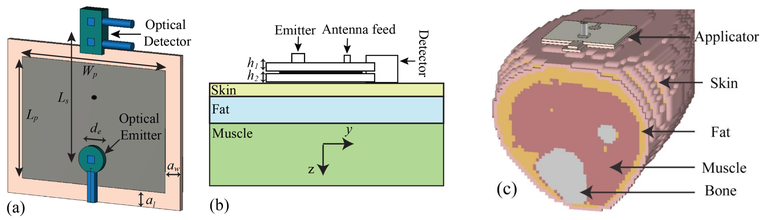


Figure: Tissue oxygenation monitor design and simulation.

Modelling the Topside EM Environment of Ships

A. Gharib, D. Andrews, H. Griffiths

A naval ship contains a large number of electrical and electronic systems within a confined space. Electromagnetic Interference (EMI) between these systems can cause performance degradation of the on-board systems.
Computational Electromagnetic (CEM) tools can be used to predict the topside EMI levels early on in the design phase. Research in the UCL radar group is working to exploit these tools and validate their predications against measurements of scale models.

Figure: Scale model of type 22 batch 2 frigate including on-board antennas.

Radar Imaging of Avalanches

M. Ash, M. Ardeshir-Tanha, P. V. Brennan

Avalanches pose a significant threat to human life and settlements.

Researchers in the group have developed a high-resolution radar that has been recording avalanches for three winter seasons. It operates in a bunker facing a slope of an avalanche-prone mountain. The radar data that it has produced to date has been of unparalleled quality and is helping geophysicists to improve their understanding of avalanche dynamics.

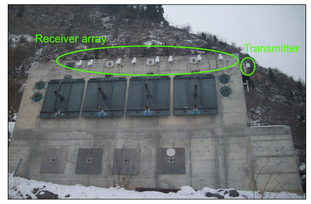


Figure: Avalanche bunker where current radar system is deployed.

The group has recently received funding from NERC to develop a new radar system for improved cross-range resolution.

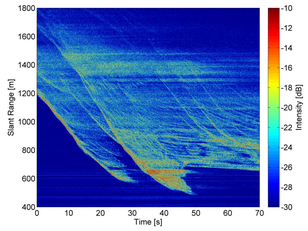


Figure: Radar measurement of large wet snow avalanche.

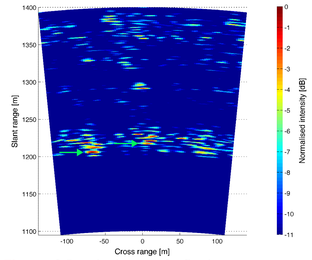


Figure: 2-D radar image of a flowing avalanche (arrows indicate avalanche fronts).

Antarctic Ice Shelf Monitoring

L. Lok, A. Narayanan, S. Rahman, P. V. Brennan

Measuring and understanding the melt rate of ice shelves is paramount in developing predictions of future sea level rises in a warming climate.

Researchers in the group participated in an early demonstration of the use of the MIMO radar technique to generate radar images of ice-shelves. Images were produced using data collected by a system based on a network analyser configured as a stepped frequency radar (see figure below).

Figure: Ice-shelf radar deployed at the Larsen-C ice shelf, Antarctica.

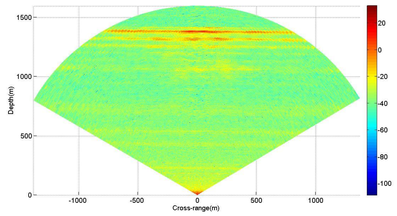


Figure: Radar image of Filchner-Ronne ice shelf generated from data measured using an early proof-of-concept stepped frequency radar with antennas arranged in a MIMO fashion.

Since then, they have gone on to develop a phase sensitive FMCW MIMO radar in collaboration with British Antarctic Survey. The more compact, low-power system is helping scientists to image ice shelves over long periods of time. From the high-quality data they can calculate melt rates with mm accuracy.

SELEX · THALES · GUIDANCE MICROWAVE · EPSRC Engineering and Physical Sciences Research Council · BMT Group · British Antarctic Survey NATURAL ENVIRONMENT RESEARCH COUNCIL · NATURAL ENVIRONMENT RESEARCH COUNCIL · IET The Knowledge Network