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## Versatility, originality and leadership in acoustics



Minister for Defence Senator Marise Payne presents Brian Ferguson with the 2016 Minister's Award for Achievement in Defence Science, at Russell Offices, Canberra on 10 November, 2016.

### ***Brian Ferguson (MD) wins the 2016 Ministers Award for Achievement in Defence Science.***

Brian Ferguson, who has spent a career exploiting the science of sound to pinpoint military threats underwater and over land, has won the 2016 Minister's Award for Achievement in Defence Science.

He received his award from the Minister of Defence, Senator Marise Payne, in Canberra last month at a ceremony attended by the Chief of the Defence Force, the Secretary for Defence and the three Service Chiefs.

Brian has led the world in the development of novel signal processing algorithms, demonstrating exceptional versatility, originality and leadership in the fields of underwater and atmospheric acoustics and sonar signal processing and analysis. His extensive sensor data collection field experiments established a direct connection between acoustic signals and the course, speed and identity of ships, submarines, aircraft and even speeding bullets.

The transition of his science into useful real-world applications and operational systems has improved Australian and US defence force detection, classification, localisation and tracking and imaging of acoustic sources. For example, an acoustic system based on Brian's studies accurately geolocated mortar fire from insurgents during Operation Iraqi Freedom and saved the lives of coalition forces and innocent civilians. He was also the first researcher to develop land-based acoustic systems with low false alarm rates for remote unattended surveillance, resulting in these systems being developed for use in conflict zones by the Australian and US armies. During his acceptance speech, Brian said he was grateful for the opportunities, encouragement, support, resources and leadership that the Department of Defence has always made available to him, and that has enabled this series of achievements.

## Genuine interest in others, and a good science communicator

Brian became an Australian Government scientist in 1974, and in 1984 joined the Royal Australian Navy Research Laboratory (RANRL, later part of DST). Through initial work with Australia's fledgling submarine force he developed new data processing techniques. These enabled Navy's sonar operators to identify targets at significantly greater distances than before, allowed submerged submarines to track aircraft flying overhead and improved safety in Navy's mine hunting operations by delivering acoustic imagery for examining mine-like objects from safe, stand-off distances. His work has resulted in enhancements to sonar technologies that are now incorporated in Australian and US submarines.

"The period 1984-1994 were the halcyon days of submarine sonar research and development in Australia," Brian says. "We knew that our team was having operational impact, that the science was compelling, because after at-sea test and evaluation, all the experimental sonars that we built stayed on board and became operational."

Retired RAN Commodore Kim Pitt strongly endorsed Brian's award, stating that "Dr Ferguson's work in support of the operational submarine force was exceptional for its scientific rigour and the improved tactical capability it delivered." He added that Brian's selfless nature and genuine interest in the officers and sailors of the submarines he served "endured him to us all", adding "[Brian's] skills as a science communicator were very good indeed and especially important to building the set of results that improved overall fighting efficiency of the squadron."



Pictured (L-R): SECDEF Dennis Richardson, CAF Leo Davies, CN Tim Barrett, Minister for Defence Marise Payne, Brian Ferguson, CDF Mark Binskin, CDS and CA Angus Campbell at the 2016 Minister's Award for Achievement in Defence Science ceremony.

## Sounds like a winning combination

Brian's research has covered both passive (listening for sounds) and active (listening for echoes of transmitted sounds) sonar. His algorithms for processing passive sonar data have improved the localisation of sounds in the ocean. This improved undersea situational awareness, and systems based on this have been fitted to the USN Sea Wolf and Virginia class submarines as well as the RAN Oberon and Collins submarines. Brian also applied this "adaptive beamforming" to towed array data, creating a powerful diagnostic tool that was used, for example, to analyse slim line buoyant fibre towed arrays manufactured in Australia.

"All the clever ideas, concepts and signal processing algorithms were proven at sea using real data during multi-million dollar scientifically-controlled experiments involving the Australian Defence Forces' submarines, ships and aircraft, which attracted the attention of the US Navy's submarine community," Brian recalls. "The fact that these Australian sonar innovations are implemented on modern US submarines are examples of transitioning scientific excellence into leading edge operational capability."

Brian's significant advances in active sonar include the production of landmark high resolution acoustic imagery of undersea objects (sea mines) at safe distances. The tomographic sonar images generated were unsurpassed in image quality at that time.

Later success included applying time delay estimation methods to the detection and localisation of jet aircraft transits over ground-based microphone arrays. Brian was the first person to exploit acoustical Doppler effects to estimate the speed, altitude and blade rate of transiting turbo prop aircraft and helicopters using a single microphone.

While these are key areas, Brian has also made notable contributions to physical acoustics, ionospheric physics, solar astronomy (measurement of the lifetime of coronal holes), low frequency ambient sea noise (research on wind induced noise in the deep ocean).

## International recognition

In 2015, [Connections announced](#) Brian's Acoustical Society of America's Silver Medal in Signal Processing in Acoustics 'for contributions to in-air and in-water acoustic classification, localisation and tracking. This was only the third time this award has been presented, and Brian was the first non-American to receive the award.

In an encomium supporting that award, international peers Ed Sullivan and James Candy describe the three characteristics associated with Brian Ferguson's work. "It always embodies a novel approach, it is always experimentally verified, and it usually finds its way into real systems. There are few researchers who can make this claim. In Brian's case it has resulted in his recognition by the Australian Government as well as internationally."

Brian says he has benefited throughout his career from the guidance of colleagues, collaborators and the US "titans" of acoustics, and he believes it is his responsibility to give back. He has the chance to do that at DST through his role as Principal Scientist, and more widely through active collegial participation as a Senior Member of the Institution of Radio and Electronics Engineers (Australia), a Fellow of the Institution of Engineers Australia, and a Fellow of the Acoustical Society of America. He also gives generously of his time as a mentor to protégés within DST and around the world.

The annual Minister's Award for Achievement in Defence Science recognises original and outstanding contributions capable of enhancing Australia's defence effectiveness and efficiency. It's clear Brian is a worthy recipient.

*Congratulations Brian!*



In 1996 Brian Ferguson began work with LTCOL Rik Modderman (at right) to reintroduce acoustic sensors to the battlefield.