CSIR and ATNS expand passive radar testing

ATNS and the CSIR are installing passive radar technology at KMIA.

The Council for Scientific and Industrial Research (CSIR) and South Africa's Air Traffic and Navigation Services (ATNS) company will trial innovative passive radar technology at Kruger Mpumalanga International Airport as passive radar systems continue to gain traction in South Africa.

ATNS and the CSIR signed a Memorandum of Understanding (MoU) in May 2017 on the deployment of passive radar system technology for civil aviation operations, and renewed this in April 2023.

ATNS said both entities are making significant progress in meeting the MoU's requirements and improving civil aviation safety in South Africa and beyond. ATNS is the sole provider of air traffic management, communication, surveillance, navigation, and training and associated service within South Africa. ATNS manages 10% of the world's airspace.

The CSIR has collaborated with local companies on passive radar including Peralex and Lochtron, as well as academic institutions (the University of Pretoria and University of Cape Town). Armscor has also provided funding support for passive radar research and development.

Passive radar is much cheaper than active radar, as it has no moving parts and only requires receiving antennas, receiver hardware and a computer – a single node could cost around a few hundred thousand Rand, versus millions of Rand for a traditional radar system.

With the CSIR leading technology development, ATNS has provided technical know-how on system configuration to meet Air Traffic Management (ATM) technical standards requirements, in line with the International Civil Aviation Organization Standards and Recommended Practices (ICAO SARPs).

Over the last eight years the CSIR's passive radar system has been rolled out to multiple sites in the North-Eastern part of South Africa, including one site on the roof of the CSIR's buildings in Pretoria, another at the University of the North West (Potchefstroom campus), a third at Emalahleni (Tshwane University of Technology campus), one at Hartebeeshoek and another at OR Tambo International Airport.

Now, ATNS and CSIR engineering teams are currently at Kruger Mpumalanga International Airport (KMIA) to measure and survey passive radar site coverage. The aim is to determine the coverage that the system will provide in the area once deployed. This exercise will also determine the sites and the number of radar antennas to be installed, ATNS said this month.

"Deploying a passive radar at KMIA is an ideal opportunity to test the system, refine the current software and hardware solutions, and monitor continued passive radar performance characterisation testing over a predetermined period. This will include a robust systems engineering approach followed by customisation updating, verification and validation of the Air Traffic Control Passive Radar technology," ATNS said.

Transmitters of opportunity

Unlike traditional radar, passive radar only needs a receiver to detect reflections of targets of interest from signals emitted by other sources, such as FM radio broadcast towers, TV transmitters, WiFi and weather radar. This makes passive radar (also known as passive coherent location, passive bistatic radar, piggyback radar and covert radar) cost effective, safe (no emissions) and highly mobile. No spectrum licensing is required either. By using several receiver sites one can use multilateration to identify the location of an aircraft, or by using a single receiver one can measure the angle of arrival of the reflected signal to determine a target's location.

One of the benefits of passive radar is that it is covert, as it does not have a transmitter subsystem onsite that can be detected and destroyed. Transmitters more often than not, consist of public broadcast infrastructure and are therefore clandestine as radar transmitters. Furthermore, it is possible to detect stealth aircraft using passive radar due to the bistatic nature of the radar (transmit and receive functionality are geographically separated), as well as the lower operating frequencies of passive radar illuminators – which renders the radio absorbent material of stealth aircraft ineffective.

Passive radar is a rapidly progressing technology as the number of useable emissions increase and the cost of computer processing power decreases. Some European countries are even looking at replacing their active air traffic radars with passive radar systems.

The CSIR is looking at multiple applications for passive radar, including air traffic control (pending certification), border security and unmanned aerial vehicle (UAV) detection around airports. It has even tested passive radar at the coast and discovered that it can detect surface vessels like harbour patrol boats – small boats were detected at ranges of 4-5 kilometres during tests carried out in 2014 in the Western Cape. Tests at the CSIR have also seen the system detecting road traffic.

Passive radar prototypes have been built and tested in South Africa since 2013. In the Western Cape, passive radar receivers were able to detect large airliners at ranges of 250 km and also detect and track a C-47TP Turbo Dakota transport aircraft. A test in Gauteng in 2013 was able to detect a Cessna 172 aircraft flying at 2 000 feet above ground level at a range of 80 km and accurately predict the rotation speed of the aircraft's propeller. These tests were done by using FM radio transmissions as the illuminator of opportunity.

ATNS pointed out that passive radar can be used for air surveillance or to fill gaps in active radar networks, and in the long term, may replace primary surveillance radars.

Passive radar for the Square Kilometre Array

Peralex has successfully used passive radar stations in the Northern Cape to monitor air traffic for the Square Kilometre Array (SKA) radio telescope in what is one of the first commercial applications anywhere in the world for the technology.

Peralex was contracted to supply a commercial passive radar system as the South African Radio Astronomy Observatory (SARAO) has a requirement to monitor their airspace. Requiring minimal electromagnetic interference is a co-requisite for this, making passive radar an ideal solution.

The SARAO therefore needed a way of monitoring air traffic without radar signals affecting its radio receivers at its Carnarvon site in the Northern Cape. Peralex used several FM radio broadcast transmitters in the area as transmitters of opportunity. Peralex subsequently established three receiver nodes around the SKA core, which pick up the FM transmitters in Prieska, Calvinia, Carnarvon and Upington. The Visserskloof node was commissioned and accepted in October 2018 and the De Hoek node was commissioned and accepted in February 2019. A third site is near Alkantpan. The monitoring of the sites takes place from the SARAO Control Room and the Radio Frequency Interference office in Cape Town.

Before full deployment, Peralex ran several trials with aircraft including Albatros, King Air, Bosbok, Bushbaby, Cessna 172, Cessna 206, RV7, Ravin, Whisper and Jabiru light aircraft as well as microlights and gyrocopters. Chartered PC-12 aircraft can be detected at 160 km

from the core site, although when the aircraft flies at low altitude (50 metres above ground), detection range is about 20 km.

Source: https://www.defenceweb.co.za/aerospace/aerospace-aerospace/csir-and-atns-expand-passive-radar-testing/