Detecting The Ever-Elusive UAV

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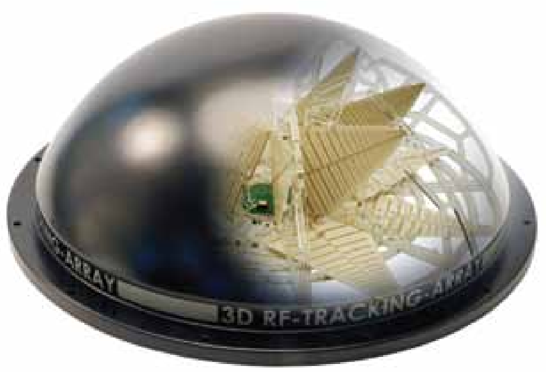


This artwork shows the internal layout of an IsoLOG direction-finding antenna

History sometimes repeats itself. On 28 July 1945, a B-25 Mitchell twin-engined bomber crashed into the 79th and 80th floors of the Empire State Building in New York. On 4 February 2016, the same skyscraper received a second aircraft hit when a unmanned aerial vehicle (UAV) crashed into the building's 40th floor.

In the first case, a US Army Air Corps pilot had become lost while flying in thick fog. In the second incident, a private citizen lost control of the UAV he was flying, and later went to the Empire State Building in the hope of reclaiming it. No one was hurt, but the UAV operator later pleaded guilty to a charge of disorderly conduct.

It was one of around 600 drone incidents that have been recorded by the US Federal Aviation Administration (FAA) over the previous six months. Civilian-operated UAVs are a problem that is getting worse—on 17 April this year, a British Airway's Airbus A320 making its final approach to London's Heathrow airport was reported to have struck a UAV. Two months earlier, an A320 that had just departed from Heathrow Airport had a near collision with a UAV. An official report later stated: "The entire event lasted no more than three or four seconds, making any evasive action virtually impossible."

That statement summarises a major problem—how do you swiftly and reliably detect a flying object so small that it has minimal radar signature? A solution is urgently needed.

The UAVs that landed in front of German Chancellor Angela Merkel in September 2013, and on the roof of Japanese Prime Minister Shinzo Abe's office in April 2015, were flown by protestors trying to win publicity for their views, but in future such UAVs could carry a warhead and be flown with lethal intent.

Sophisticated receiver capabilities

The German company, Aaronia, recognised the need for a reliable method to detect tiny airborne intruders. Following a four-year development programme, it launched the Drone Detector, a product that exploits the radio-frequency (RF) radiation emitted by the UAV's onboard systems and by the operator's control unit. Real-time RF signal detection, combined with what the company terms "pattern triggering,"

The most basic Drone Detector configuration is best suited to mobile operation. It teams a single antenna with an XFR V5 PRO portable unit.

provides rapid warning of any UAV or UAV control unit that is operating within the area being monitored.

Military communications links often exploit techniques such as frequency agility in order to reduce the probability of interception, but the designers of UAVs are trying to field an inexpensive commercial product. As a result, UAV communications links are low-cost, unsophisticated sub-systems that have no clandestine qualities. Since Aaronia's Drone Detector has more sophisticated receiver facilities than those of the UAV and its control unit, it will have a longer range than is available to the UAV operator.

Two types of 3D direction-finding antenna are offered by the Drone Detector—the IsoLOG 3D 80-UWB and IsoLOG 3D 160-UWB. These have eight sectors with 24 antennas, and 16 sectors with 48 antennas respectively. Both cover from 9 kHz to 6 GHz, and extenders are available should VLF (below 9 kHz) and 6-20 GHz coverage be required.

These antennas must be teamed with either an XFR V5 PRO (used for portable installations) or an RF Command Centre (for stationary use). Both cover frequencies from 9 kHz to 20 GHz, so include the frequencies commonly used for UAV control and video links—typically 433 MHz, 900-915 MHz, 1.3 GHz, 2.4 GHz, and 5.8 GHz.

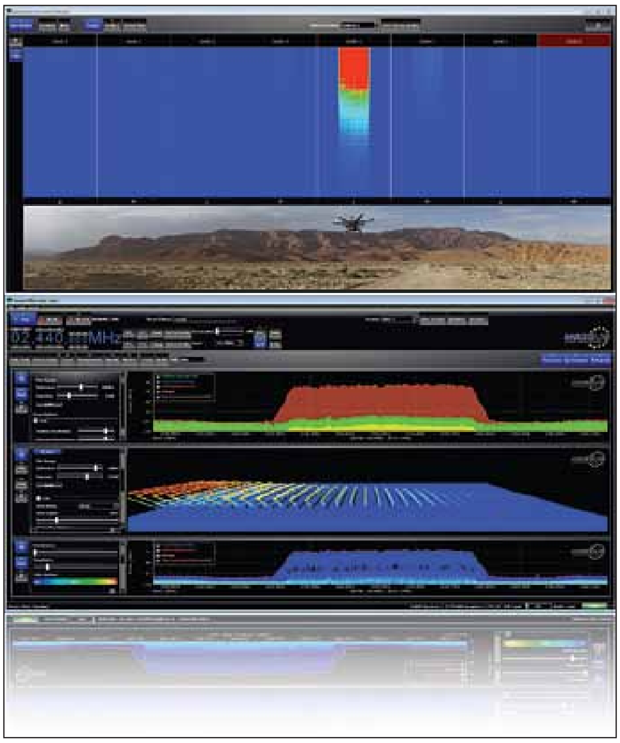
Locating the UAV and its operator

In its standard form, the Drone Detector has a real-time bandwidth of 80 MHz. Optionally, this can be extended to 175 MHz. The standard system can be shipped without the need for an export license, but this is not the case if the customer requires a 175 MHz bandwidth.

Using these basic components, the user can opt for systems of varying complexity. The simplest consists of a single IsoLOG 3D antenna and a stationary or mobile spectrum analyser. This is sufficient for surveillance of a small area. If a fully mobile solution is required, the system can be installed on a vehicle and operated from battery power. Its antennas are resistant to the effects of salt water splashes or spray, allowing deployment on a boat.

Once a signal has been detected, its approximate bearing will be shown to an accuracy that depends on which model of antenna is being used. With the standard IsoLOG 3D 80-UWB, the bearing accuracy will be at least within the 45-degree

A fixed installation can use the Command Centre



Aaronia's custom-written software shows the presence of an UAV directly to the south of a detector installation. If the drone changes position, the red indication on the display will move to the right or left.

coverage of a single antenna sector, says Aaronia, but is often much higher.

When larger areas must be covered, several antennas and spectrum analysers can be connected to a single centralised PC, which manages these simultaneously. The larger the area to be covered, the greater the number of antennas and analysers that must be deployed. Any threat signal is likely to be received by several antennas, so the results can be triangulated to provide detailed information on the location of the UAV and/or its operator.

Since the system is designed to recognise the RF signals specifically associated with UAVs by observing their frequency and other characteristics, it will not provide false alarms when faced with other types of RF signal. When faced with several UAVs, the system can detect these, even if the intruders are of the same type or of a different type.

The average time needed for detection of a UAV is between 10 microseconds and 500 milliseconds. It depends on factors such as the complexity of the deployed system and the number of antenna arrays being used. While a clear line of sight between the antennas and the UAV or its operator gives the best results, the system can detect RF signals whose source is obscured by trees, bushes or a crowd of people.

The system is passive, emitting no signals of its own that could interfere with the normal operation of nearby assets such as airports, or give the UAV operator warning of its presence. System performance is unaffected by darkness or poor weather—if meteorological conditions allow UAVs to fly, they can be detected.