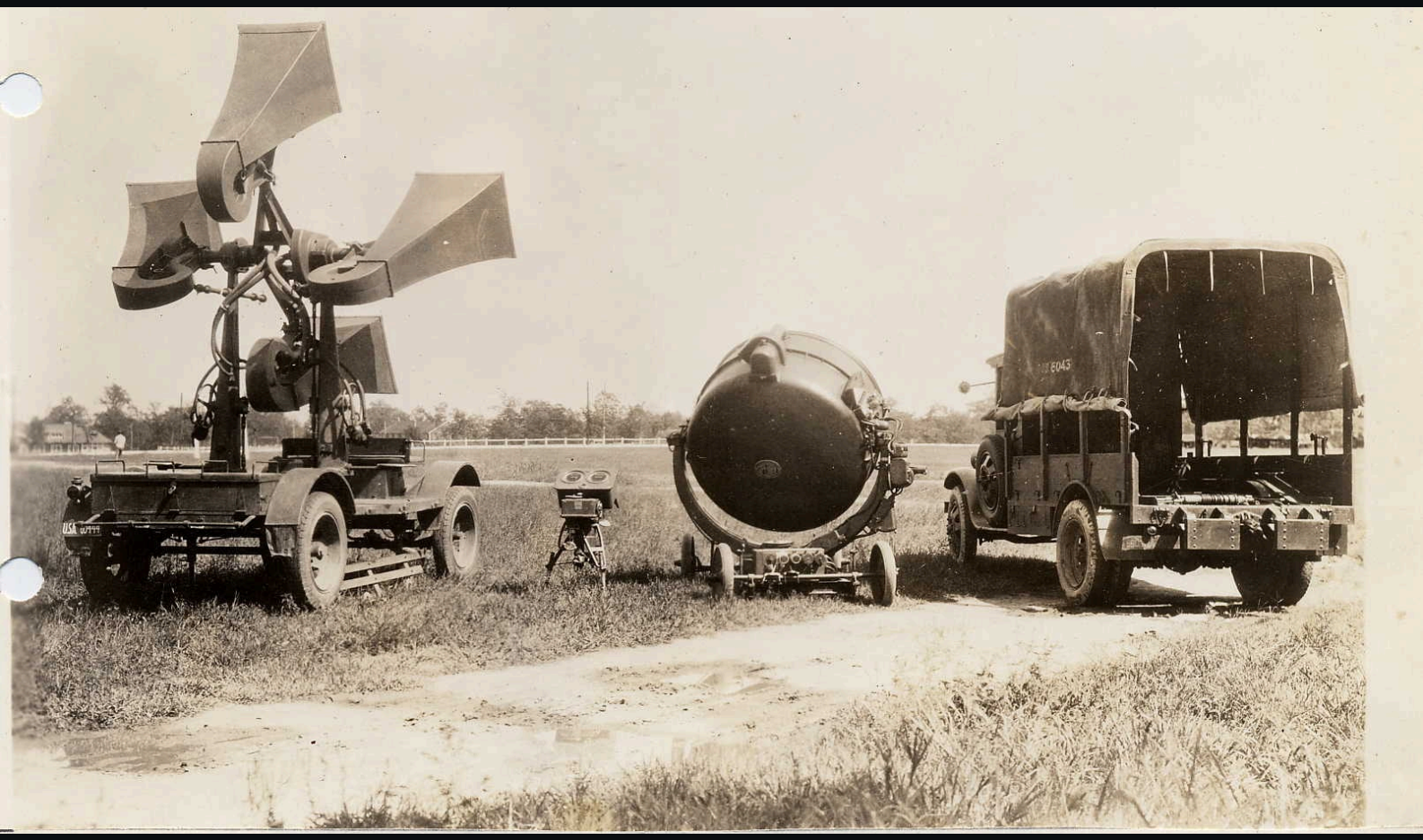


Photo: U.S. Army Coast Artillery Corps sound locator, 1932 · Public domain · Wikimedia Commons

OSINT · TECHNOLOGY ASSESSMENT

WHAT A MICROPHONE CAN HEAR

Acoustic drone detection went from a Ukrainian improvisation to a national air-defence layer in under three years. It is also widely misunderstood, oversold by some and dismissed by others. This report sets out plainly what passive acoustic detection does, the physics that limits it, and where it fits alongside radar, RF and optical sensors.

REPORT DETAILS

PUBLISHED	SUBJECT	SOURCE BASE
October 2026	Passive acoustic detection of drones	Acoustics research, Ukrainian systems reporting, U.S. federal guidance, manufacturer claims (flagged)
METHOD	**VERDICT**	**CONFIDENCE**
Explain the physics; compare claims with independent figures	Strong against small, low, radio-silent drones close in; weak at range and in noise	Moderate
AUTHOR		
Ghulam Mujtaba, Ph.D.		

BOTTOM LINE

Acoustic detection finds drones by the one signature they cannot switch off: the sound of their propellers and engines. A passive microphone emits nothing, can hear around obstacles and works the same whether a drone is controlled by radio, by fibre-optic cable or by its own autopilot. That makes it well suited to the drones radar and RF detection handle worst, which are small, low, slow and radio-silent. Its limits are physical too. Sound fades over hundreds of metres rather than kilometres, wind and city noise mask it, and most published range claims come from manufacturers. Acoustic sensing works alongside radar as a dense, cheap, passive layer that fills radar's blind spots, as Ukraine has shown at national scale.

0

SIGNALS AN ACOUSTIC SENSOR EMITS

◆ NOTHING TO JAM, LOCATE OR LICENSE

150–450 m

CLAIMED RANGE AGAINST FPV DRONES

◆ ZVOOK NW0, MANUFACTURER FIGURE

≈ 5 dB/km

AIR ABSORPTION AT 1 KHZ

◆ RISING TO ≈ 77 DB/KM AT 8 KHZ

$400–1,000

COST OF A UKRAINIAN ACOUSTIC NODE

◆ AS REPORTED

KEY QUESTIONS

How does acoustic drone detection work?

Microphones listen for the tones a drone's propellers and engine make. Software on each sensor recognises the drone's sound pattern, and several networked sensors compare arrival times to work out where it is. The sensors emit nothing.

How far away can an acoustic sensor hear a drone?

It depends on the drone and the environment: claims for small FPV drones are a few hundred metres (Zvook's NW0: 150–450 m), while loud piston-engined drones are reported at up to about 5 km. Wind and background noise shorten every figure.

Can acoustic sensors detect fibre-optic drones?

Yes. A fibre-optic drone sends no radio signal, so RF detectors miss it, but its propellers still make sound. Ukraine's newest acoustic sensors are marketed specifically for fibre-optic FPVs.

THE RULER — THE WHOLE ARGUMENT

Where acoustic detection fits

SENSOR	HOW IT FINDS A DRONE	WHERE ACOUSTICS ADDS WHAT IT LACKS
RADAR REFLECTION	Echo of its own transmission	Low, small or hovering drones in clutter (see our radar series)
RF DETECTION EMISSIONS	Control and video radio links	Fibre-optic, autonomous or radio-silent drones [new]
OPTICAL / INFRARED SIGHT	Camera image	Night, cloud, smoke and narrow fields of view

SENSOR	HOW IT FINDS A DRONE	WHERE ACOUSTICS ADDS WHAT IT LACKS
ACOUSTIC SOUND	Propeller, motor and engine noise	Range: acoustics is the shortest-reaching of the four
DROSONIC NETWORKED PASSIVE ACOUSTIC	Propeller sound, classified by neural networks on each low-cost node; position from arrival times across nodes	Built for the fibre-optic and radio-silent drones RF detection misses

● THE GAP ACOUSTIC SENSING FILLS MOST CLEARLY · OUR ASSESSMENT

FIELD 01 — THE SIGNAL

What a drone sounds like

Every propeller produces a tone at its **blade-pass frequency** (the number of blades multiplied by the rotation rate) plus a series of harmonics. In drone recordings these tonal peaks stand roughly 10–20 dB above the surrounding broadband noise. USPTO↗ Research on drone acoustics finds the strongest peaks between about 100 Hz and 10 kHz, and judges acoustic detection best suited to small, low-flying drones at short to medium range. Acta Acustica↗

Those tones form a **signature**. A quadcopter's whine, a hexacopter bomber's deeper hum and a Shahed's two-stroke rattle are different enough to classify, as our report Every Drone Has a Voice sets out family by family. A drone can go radio-silent, fly at night or hide in clutter, but it cannot fly without moving air.



VIDEO: PLAY IT IN THE ONLINE REPORT

LISTEN — WHAT A MICROPHONE HEARS

A field recording of a small quadcopter hovering on a windy day, with birdsong behind it. The steady buzz is the blade-pass tone and its harmonics; the gusts show why wind is the microphone's main enemy. About a minute; turn the sound on.

RECORDING: MIKAEL MAFFEI, SOUNDS OF CHANGES / TYÖVÄENMUSEO WERSTAS · CC BY 3.0 · WIKIMEDIA COMMONS

FIELD 02 — THE SENSOR

From microphone to alert

A modern acoustic node does three things in a few hundred milliseconds:

1. **Captures** sound with one or more microphones. A parabolic dish gives passive gain in one direction; a small array of microphones can estimate direction electronically.
2. **Classifies** it on the spot. Software running on the node, increasingly a compact machine-learning model, decides whether the pattern is a drone, a car, a generator or a bird, and of what type. Only a short detection report leaves the node, not raw audio.
3. **Locates** it with neighbours. Sound reaches nearby nodes at slightly different moments. With shared GPS timing, the differences in arrival time (TDOA) fix the drone's position, the same principle Britain's sound-ranging and mirror stations used a century ago (Listening to the Sky tells that history).



THREE MICROPHONES, ONE POSITION — TIME DIFFERENCE OF ARRIVAL

Each pair of nodes puts the drone on one curve; where the curves cross is the drone. Sound covers about 34 m in a tenth of a second.

DIAGRAM: DROSONIC OSINT · ORIGINAL

Because the node emits nothing, there is nothing for an adversary to detect, jam or home in on. In the United States it also sits on firmer legal ground than some alternatives. A 2020 advisory from the Justice Department, FAA, Homeland Security and FCC says detection systems such as radar, EO/IR and acoustic sensors "are less likely to pose concerns under federal criminal surveillance statutes", because they do not "capture, record, decode, or intercept electronic communications."[U.S. DOJ, FAA, DHS & FCC↗] Radar, unlike acoustics, also needs an FCC radiolocation licence.



A PARABOLIC COLLECTOR — PASSIVE GAIN IN ONE DIRECTION

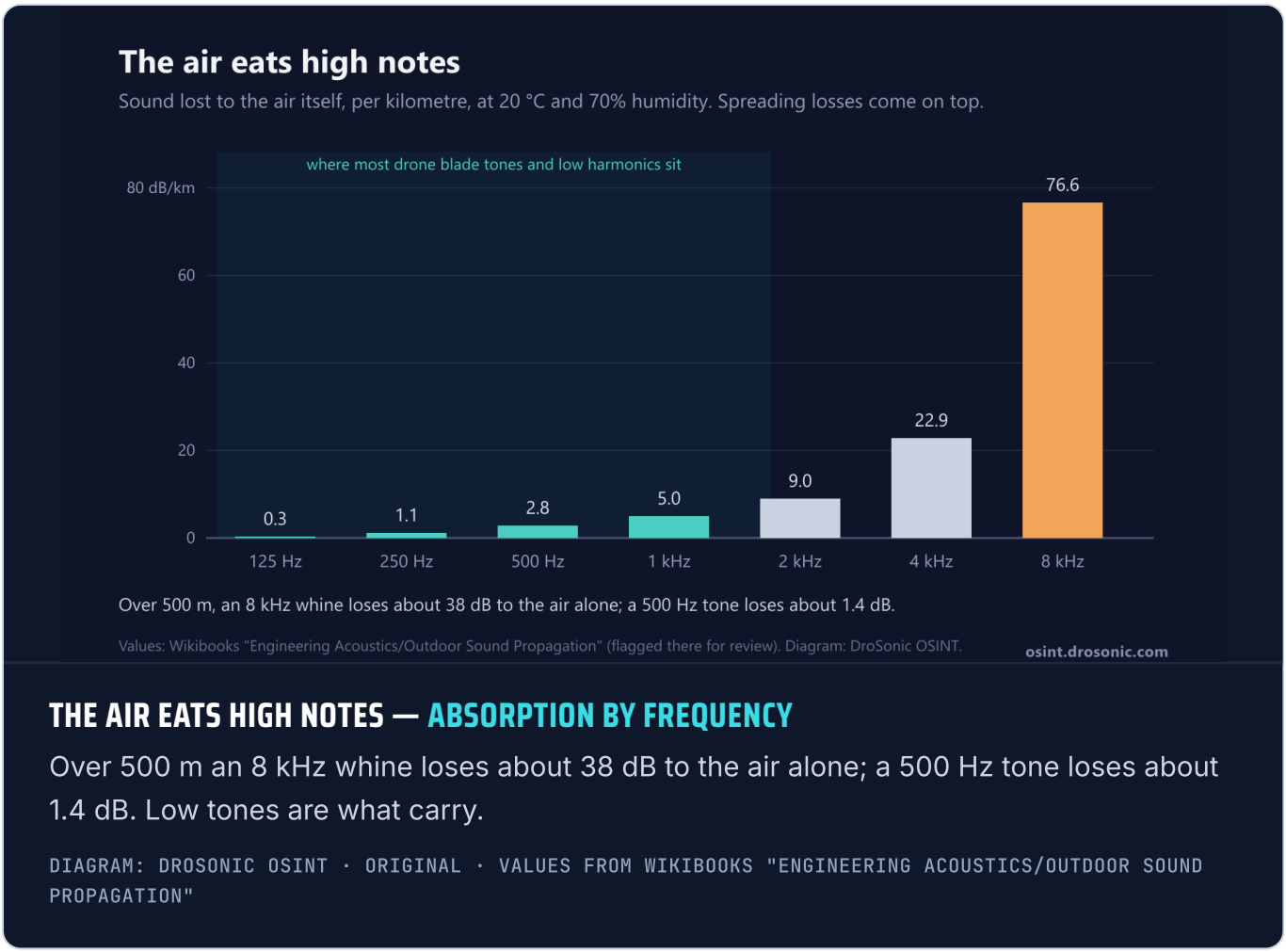
The same idea as the 1930s sound locators and the concrete mirrors before them: focus faint sound onto a microphone.

PHOTO: VICTORGRIGAS · CC0 · WIKIMEDIA COMMONS

FIELD 03 — THE PHYSICS

Why range is short

Sound weakens with distance in two ways. It **spreads out**, losing about 6 dB every time the distance doubles, and the **air absorbs** it, much more strongly at high frequencies. At 20 °C and 70% humidity, absorption is roughly 5 dB per km at 1 kHz, 23 dB at 4 kHz and 77 dB at 8 kHz. Wikibooks↗ That is why a small quadcopter's high whine fades within hundreds of metres, while a piston engine's low rattle carries much further.



THE AIR EATS HIGH NOTES — ABSORPTION BY FREQUENCY

Over 500 m an 8 kHz whine loses about 38 dB to the air alone; a 500 Hz tone loses about 1.4 dB. Low tones are what carry.

DIAGRAM: DROSONIC OSINT · ORIGINAL · VALUES FROM WIKIBOOKS "ENGINEERING ACOUSTICS/OUTDOOR SOUND PROPAGATION"

The atmosphere also bends sound. Wind and temperature gradients change the speed of sound with height. Upward refraction lowers sound levels near the ground, while a warm layer above cooler surface air bends sound back down and helps it travel. Wikibooks↗ The same drone can be audible at a kilometre on a still evening and lost at a few hundred metres on a windy afternoon.

Then there is noise. Traffic, generators, industry, rain and wind rushing over the microphone itself all compete with the drone. Wind on the microphone is one of the biggest practical limits, and windscreens make a large difference: one outdoor study of microphones for drone-detection arrays found that a windscreen extended detection range in strong wind by roughly 31–131%, depending on direction. PubMed Central↗

> **Sound reaches round corners and through darkness, but not far. Acoustic detection is a short-range sensor by nature, and that is what lets it be cheap.**

FIELD 04 — THE RECORD

What fielded systems claim

Most published acoustic ranges come from manufacturers or the governments using them, and should be read that way:

- **Small FPV drones:** Zvook's NW0 tactical sensor claims 150–450 m with 360-degree coverage, including fibre-optic FPVs, and recommends spacing sensors 400–600 m apart. Militarnyi↗
- **Larger drones:** Zvook's fixed stations are reported to detect a drone at up to 5 km. Militarnyi↗ FENEK claims a single unit can measure a target's bearing to within 2 degrees, with three or more units needed to fix a position. Militarnyi↗
- **At national scale:** Ukraine's Sky Fortress network was described by a U.S. Air Force commander as about 9,500 sensors at $400–500 each, credited with helping down 80 of 84 drones in one attack. Defense One↗

The independent picture is consistent. For fibre-optic FPVs, Reporters Without Borders' 2026 frontline safety guide says such drones can be detected only by sight or by sound. Our report When the Detector Stays Silent covers that guide. RSF guide↗

FIELD 05 — THE HONEST LIMITS

What acoustics cannot do

- **Long range.** It will not replace radar for early warning tens of kilometres out.
- **Very noisy places.** City centres, airports during heavy traffic, and gun lines all raise the noise floor sharply.
- **High-altitude glide attacks.** A Lancet-type munition diving from altitude is quiet until the end. RSF's guide calls it "practically inaudible" until the dive.
- **Friend or foe.** A microphone can identify the type of drone but not whose it is, so it needs fusing with friendly flight data and with other sensors

such as cameras (The Ear Points the Eye).

— **Density.** Short range means many nodes. The economics work only because each node is cheap.

CONFIDENCE

How sure we are, and what would change it

High confidence in the physics: blade-pass tones, spreading and absorption, refraction, and the advantage of passive sensing are standard acoustics.

Moderate confidence in system ranges, which are mostly manufacturer or government claims without independent test data. The windscreen figure comes from a single study.

What would change it: published independent trials of acoustic systems against standard drone sets, which do not yet exist in the open literature.

DROSONIC — OUR APPROACH

Why we chose the cheapest ears

DroSonic started from the gap in the table above: the drones that radio detectors cannot hear because they send nothing. In September 2026 its founder, Dr. Ghulam Mujtaba, presented "Passive Acoustic Detection and Cueing of Fiber-Optic and Radio-Silent UAS on Low-Cost Edge AI Hardware" at NDIA's Emerging Technologies for Defense conference in Washington. DroSonic↗ The same month it filed a U.S. provisional patent application covering passive acoustic detection, classification, localisation and tiered defeat cueing. DroSonic↗

The design follows the physics in this report. Each node is cheap and short-ranged, so the answer is to network many of them. Each runs the whole capture, classify and locate chain on board, on low-cost edge hardware, so the network carries alerts rather than raw sound and a lost link does not blind a node. DroSonic↗ In October 2026 DroSonic joined the SOF RACER consortium, which connects U.S. Special Operations Command with commercial technology companies. DroSonic↗

CLOSE — WHAT IT MEANS

The cheapest ears in the air-defence stack

Acoustic detection's strengths and weaknesses come from the same physics. It is short-range, so it must be dense, and it can be dense because each node is cheap, passive and self-contained. It is weakest where radar is strong (long range, open sky) and strongest where radar and RF struggle: low, small, slow, hovering and radio-silent drones close to what they are attacking.

At DroSonic this is what we build. Our distributed nodes classify propeller sound with neural networks running on each node and locate drones by comparing arrival times across the network, with no radio or radar emissions. A prototype was tested against live drones at the DIRT Days 26.04 field exercise in September 2026, supported by CMI2 with U.S. Central Command and U.S. Army DEVCOM. DroSonic↗ More on how DroSonic detection works.



DIRT DAYS 26.04 — A PROTOTYPE MEETS LIVE DRONES

DroSonic's test position at the field exercise, eight months after the project began. Like every system in Field 04, its performance is the developer's own account until independent trial data is published.

PHOTO: DROSONIC · FIELD-TEST WRITE-UP

ABOUT DROSONIC

DroSonic builds passive acoustic drone detection: networked sensors that listen for drones instead of their radio signals, using acoustic AI and edge computing. DroSonic OSINT is our open-source research into the threat that technology is built to meet.

THE RECORD SO FAR

OCT 2026	Joined the SOF RACER consortium, which connects USSOCOM with commercial technology companies
SEPT 2026	Prototype tested against live drones at DIRT Days 26.04, a field exercise supported by CMI2 with U.S. Central Command and U.S. Army DEVCOM
SEPT 2026	Technical presentation at NDIA's Emerging Technologies for Defense conference on detecting fibre-optic and radio-silent drones
SEPT 2026	Filed U.S. provisional patent 64/148,522 on passive acoustic detection, classification, localisation and defeat cueing
JUL 2026	Pitched to the U.S. Space Force at Space Systems Command's Reverse Industry Engagement Day, Colorado Springs

How DroSonic detection works → · Where it is used → · Talk to the team →

THIS REPORT ONLINE

https://osint.drosonic.com/assessments/acoustic-drone-detection-explained.html

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DroSonic OSINT: open-source assessments on drones and counter-UAS from DroSonic, passive acoustic drone detection. drosonic.com · sudo@drosonic.com



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Ghulam Mujtaba, Ph.D., is the founder and CEO of DroSonic and leads its work on passive acoustic drone detection. A computer engineer with 13 years of experience building machine-learning systems for edge hardware, he holds a Ph.D. in computer engineering from Gachon University in South Korea, was an NSF postdoctoral fellow at West Virginia University in the United States, and is an Assistant Professor of AI and Data Science at Regis University in Denver, Colorado. An IEEE Senior Member, he has published more than 20 papers on deep learning, computer vision and multimedia for edge devices.

PROFILE ↗ LINKEDIN ↗ ORCID ↗

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