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Title: Acoustic Sensor Systems for Artillery and Drone Threat Detection in Ukraine

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Observation

Ukraine has developed and deployed advanced acoustic sensor networks, such as “Sky Fortress” and “Zvook,” to counter artillery and unmanned aerial system (UAS) threats from Russian forces. Introduced by Vidar Systems at the Brave1 Defense Tech Innovations Forum 2025, these systems use sound triangulation combined with artificial intelligence (AI) to detect and locate enemy artillery fire up to 25 kilometers away and track low-altitude drones like the Shahed-136 kamikaze UAVs. The Sky Fortress system comprises approximately 14,000 sensors, while Zvook covers 5% of Ukraine’s territory, each sensor costing between \$400 and \$1,000, significantly more affordable than traditional radar systems. Lightweight and portable, a five-sensor complex weighs around 25 kilograms and can be deployed by one or two personnel. Field tests have proven effective, with reports of successful interception of 80 out of 84 Russian drones in a single instance. These systems integrate with mobile fire teams equipped with tablets and anti-aircraft guns, enabling rapid response with minimal training. Fundraising initiatives like “Safe Skies” have supported deployment expansion, while NATO and the U.S. have expressed interest in adopting similar low-cost, scalable acoustic detection systems.

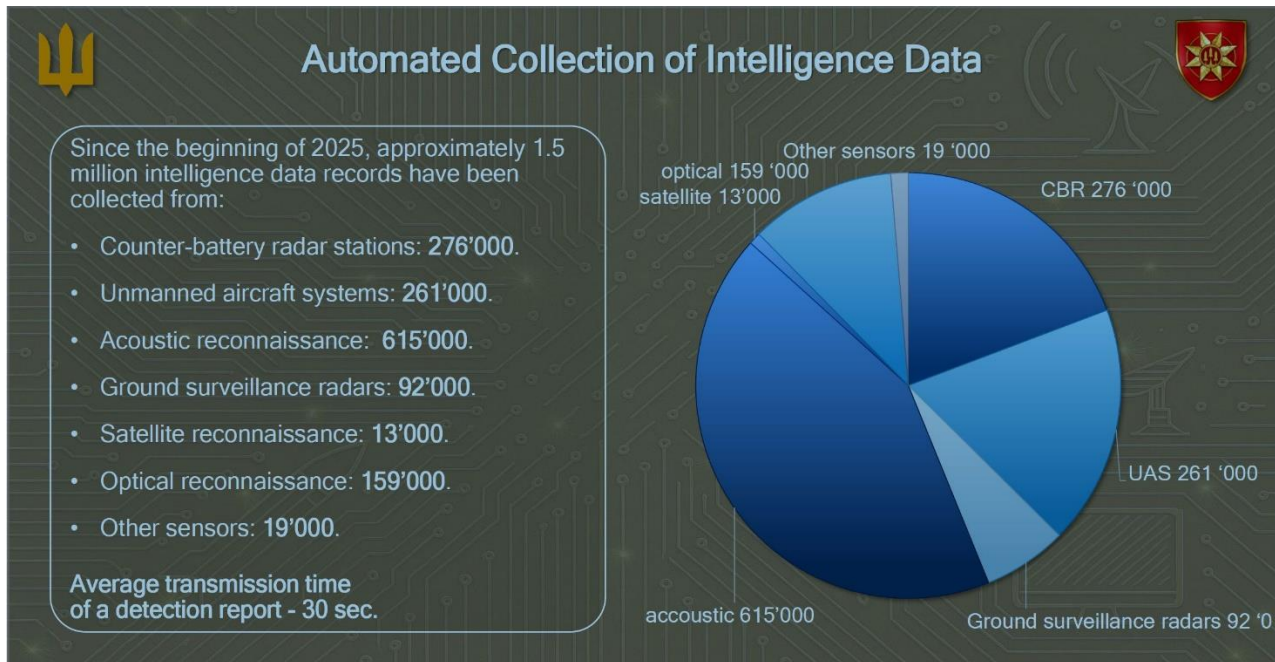


Image: NSATU Fires Conference

Discussion

The rising prominence of acoustic sensor networks in Ukraine addresses critical gaps in traditional radar-based air defense, particularly against stealthy, low-flying threats such as FPV drones and cruise missiles that often evade radar detection. Unlike active radar systems, acoustic sensors operate passively, detecting sound waves generated by artillery fire or drone engines and using AI to differentiate them from ambient noise. This passive operation makes the systems resilient to electronic warfare and difficult for adversaries to detect or jam. Their distributed deployment ensures that damage to individual sensors degrades overall system performance only partially, allowing for rapid replacement due to low sensor cost. Ukraine's innovation extends to leveraging commercial technologies, such as using cell phones as initial processors in the Sky Fortress system and integrating acoustic data with volunteer networks via platforms like Telegram for timely alerts. The affordability estimated at under \$5 million for a network of 9,500 sensors, contrasts sharply with high-cost missile systems like the Patriot, which can cost between \$4 and \$10 million per unit, making acoustic sensors a sustainable solution against the low-cost threat posed by drones. However, challenges remain, including the need to expand coverage to around 12,500 sensors for full national protection and the vulnerability of acoustic networks to physical decoys and cyberattacks. Integration with existing radar and air defense systems is necessary to create a comprehensive, layered defense. The Ukrainian approach exemplifies a hybrid "flat war" strategy that combines grassroots innovation, AI, and distributed sensing to maximize effectiveness in a technologically contested environment.

Conclusion

Ukraine's development and deployment of acoustic sensor systems represent a significant advancement in modern, cost-effective air defense against artillery and drone threats. By harnessing AI and passive acoustic detection, these systems overcome many limitations of conventional radar, particularly in detecting low-altitude, low-signature threats. Their affordability, ease of deployment, and resilience to electronic warfare make them a vital component of Ukraine's defense architecture and a model for other nations facing similar asymmetric threats. Yet, ensuring broader coverage, defending against deception and cyber risks, and integrating these systems into a multi-layered defense network remain essential for maximizing long-term effectiveness.

Recommendations

1. **Expand Deployment:** Accelerate the deployment of additional acoustic sensors to achieve comprehensive coverage and enhance early warning capabilities.
2. **Enhance Integration:** Develop seamless interoperability between acoustic sensor networks, radar systems, and electronic warfare assets for a layered, multi-domain defense approach.
3. **Invest in Cybersecurity:** Strengthen protections against cyberattacks and physical decoys to safeguard sensor integrity and reliability.
4. **Leverage AI Advances:** Continue advancing AI algorithms for improved noise filtering, target classification, and predictive threat analysis.
5. **Promote International Collaboration:** Share lessons learned and technology with NATO and allied nations, encouraging adoption of cost-effective acoustic detection systems.
6. **Conduct Regular Testing:** Implement frequent live-fire and simulated exercises to validate sensor performance, integration, and operator proficiency under realistic conditions.

Sources:

- [TechUkraine, February 24, 2025](#)
- [United24 Media, 2025](#)
- [Defense One, July 2024](#)
- [The Warzone, 2024](#)
- [Eurasian Times, 2025](#)