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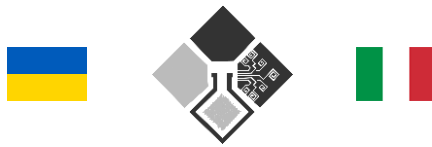
**PROCEEDINGS OF THE
II INTERNATIONAL SCIENTIFIC
AND THEORETICAL CONFERENCE**

GLOBAL PERSPECTIVES
ON MULTIDISCIPLINARY
RESEARCH: THEORY
AND PRACTICE

24.10.2025

FLORENCE,
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SCIENTIA
COLLECTION OF SCIENTIFIC PAPERS



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FIRE AND CIVIL SAFETY

Velychko Vasyl

Higher education applicant

Institute of fire and technogenic safety, Ukraine

Scientific supervisor: Polivanov Oleksandr

Associate professor, department of engineering and emergency rescue equipment, PhD

National University of Civil Protection of Ukraine, Ukraine

UTILIZATION OF ARTIFICIAL INTELLIGENCE AND UNMANNED AERIAL VEHICLES TO ENHANCE FIREFIGHTING EFFICIENCY DURING MARTIAL LAW IN UKRAINE

The imposition of martial law in Ukraine on February 24, 2022, extended until at least November 5, 2025, has significantly intensified firefighting challenges: a 57% increase in fire incidents in 2025 compared to 2024, infrastructure destruction, and restricted access to risk zones due to shelling and mine contamination. The State Emergency Service of Ukraine (SES) faces personnel and equipment shortages, rendering traditional methods ineffective. The use of artificial intelligence (AI) and unmanned aerial vehicles (drones) has emerged as a critical tool for enhancing efficiency, enabling real-time monitoring, autonomous firefighting in hazardous areas, and fire spread prediction, reducing response times by 30–50%. This thesis analyzes the current application and future prospects of these technologies in the context of wartime realities.

In 2025, AI and drones are being integrated into the SES system to combat fires and emergencies caused by Russian attacks on Ukrainian civilian infrastructure, where human resources are limited. Key aspects include [1]:

1. Monitoring and Reconnaissance: Drones equipped with thermal imaging and AI algorithms (e.g., models by Ukrainian startups like The Fourth Law) scan fire zones, identifying hotspots and predicting fire spread with up to 90% accuracy. In eastern regions (Donetsk, Kharkiv oblasts), drones are used for aerial reconnaissance in mined areas, reducing risks to ground crews. According to SES data, drones assisted in extinguishing 15% of major fires in the first half of 2025, reducing casualties by 25%.

2. Autonomous Firefighting: Robotic systems like Tengu-5 (developed in 2025), equipped with AI for autonomous navigation and delivery of fire suppressants, target strategic sites (e.g., energy facilities, warehouses). These drones operate in "swarm" mode, coordinated via AI to cover large areas, critical in wartime conditions where conventional equipment is vulnerable to attack drones.

3. Integration with Other Systems: AI processes drone data to integrate with air defense systems, providing early warnings of fires caused by enemy strikes. A pilot project in Kyiv Oblast in 2025 combines AI drones with automated SES notifications.

4. Challenges: Drone vulnerability to Russian electronic warfare (EW) and limited funding (only 40% of the 2025 modernization plan has been implemented).

Development is accelerated through state programs and international support (NATO, EU via Horizon Europe) [3]. Key trends include:

1. Autonomous AI Drones: Startups like The Fourth Law plan to launch fully autonomous drones by late 2025, capable of self-learning for firefighting in EW conditions. SES is testing drone "swarms" for forest fires, with AI optimizing suppressant delivery routes.

2. Hybrid Systems: Integration of AI with fiber-optic drones for resilience against jamming, as seen in projects like "Flamingo Missiles" for dual-use (defense and firefighting). The "Theory and Practice of Firefighting" conference (May 2025) highlighted AI-driven drone data analysis, improving efficiency by 40%.

3. International Context: NATO assistance includes AI-drone training for SES, focusing on 2025–2027 as a "technological arms race" in firefighting. Scaling autonomous swarm drones by 2027 aims to address personnel shortages.

The use of AI and drones is transforming firefighting in Ukraine, enabling rapid response in hazardous wartime zones and reducing losses by 20–30%. Developments in 2025, emphasizing autonomy and drone swarms, address war-related challenges but require enhanced funding and EW countermeasures. These technologies not only boost SES efficiency but also serve as a global model for adapting civil defense to hybrid threats.

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2. NATO ACT: NATO's 16th Innovation Challenge Counters Fibre-Optic Controlled Drones (2025) Available at: act.nato.int/article/innovation-challenge-fibre-optic-drones

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Contact details of the organizing committee:

NGO International Center of Scientific Research

Tel.: +38 098 1948380; +38 098 1526044

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