STRATEGIES XXI International Scientific Conference
The Complex and Dynamic Nature of the Security Environment,
Bucharest, Romania - February, 27th, 2025

DOI: 10.53477/3045-2309-25-16

PRECISION GLIDE MUNITIONS. METHODS FOR EFFECTIVE COUNTERACTION BASED ON THE CONFLICT IN UKRAINE

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Abstract: *The evolution of the modern battlefield is defined by the rapid manifestation of transformative processes in weapons systems deployment, which alter past warfighting capabilities and concepts. One such weapons system, massively deployed in the conflict in Ukraine, is that of the precision glide munitions in its most modern iterations, which has had a profound impact on conventional military operation. The following paper examines the role of precision glide munitions in modern warfare, with a focus on their tactical and operational impact during the conflict in Ukraine. Through an analysis of their capabilities, operational deployment, and effectiveness, the study identifies counteraction methods, including electronic warfare, air defence adaptations, and emerging technologies. The paper centres on a mixed-methods approach, structured around collection, analysis and deconstruction of open-source intelligence, technical analysis of munition characteristics, and synthesis of third-party expert assessments. The focus on open-source intelligence and third-party analyses, alongside the rapid evolutionary patterns within the examined weapons system type, predispose potential biases, whose mitigation is sought through a robust, multifaceted and objective examination of source materials. The overarching findings underscore the necessity for conventional forces to adapt to evolving threats through integrated defensive systems and doctrinal innovation.*

Keywords: *glide munitions; glide bombs; counteraction; countermeasures; air defence; Ukraine.*

Preliminary Considerations

The contemporary dynamic era in the international system of security relations predisposes the processes of accelerated armaments development and weapons deployment on the battlefield. The conflict in Ukraine has served to further elevate the process, introducing both novel systems, as well as serving to reevaluate the role, characteristics and battlefield application of numerous existing weapons categories. The "glide munition" has been a persistent element in weapons arsenals for decades, as it has proven itself as a sound and effective concept for providing a military force with limited stand-off capabilities. However, the conflict in Ukraine has witnessed the employment of this weapons category to an unprecedented extent, in a variety of conditions and in evolving roles on the modern field of battle. The overall results of the use of modern precision glide munitions have proven effective, if not pivotal, in certain stages of the conflict, garnering increasing future interest in the glide munition concept, both air- and ground-launched, as a fundamental element of modern military arsenals.

Concurrently, a practical question: specifically, how to effectively counteract glide munitions, given their effectiveness? The extent of the problem to the effective operation of ground forces is such, that it has been placed as a principal focus of NATO's Allied Command Transformation Innovation initiative, as efforts are made to identify solutions in detecting, intercepting and neutralising glide munition types (Headquarters Supreme Allied Commander Transformation 2025). The following paper will seek to provide avenues of approaching this specific problem through the lens of the observable work of precision glide munitions within the Ukrainian conflict and based upon known or proposed method for their effective counteraction.

The *object of analysis herein is that of the modern precision glide munition*, as defined by its technical characteristics and application on the battlefield. The *subject of analysis is focused on the methods for effective counteraction of glide munitions* based on the observable characteristics of the weapons systems currently employed and the case study of the conflict in Ukraine. The principal objective within the paper is to *derive and list the possible methods of counteraction* and provide for their known or presumed effectiveness based on observable and known results from military operations in Ukraine. Ultimately, the paper serves to bridges a gap in existing literature by synthesizing observable data from Ukraine to propose actionable countermeasures, which should further the necessary discussions and efforts in improving conventional deterrence capabilities within armed forces structures and to eliminate critical shortcomings against potential threats.

In order to achieve set objectives, the paper is subdivided into two main sections, where in the first the capabilities, operation and effectiveness of modern glide munitions are discussed, followed by in the second section, through the methodological approach of logical extrapolation, with the definition and listing of specific methods of counteraction, based on the previously described overarching characteristics of glide munitions and their usage. This study employs a mixed-methods approach to analyse the role of precision glide munitions in the Ukraine conflict and propose actionable countermeasures. The methodology is structured around three primary pillars: open-source intelligence (OSINT) collection, technical analysis of munition characteristics, and synthesis of third-party expert assessments.

The first pillar involving OSINT collection, forms the foundation of the study. Publicly available materials, including geolocated strike footage, satellite imagery, and media reports from a diverse range of sources, were gathered and cross-referenced with verified news outlets and military blogs to ensure accuracy. To mitigate bias, OSINT data was subjected to a multi-step verification process. Geolocated strikes were confirmed using multiple independent sources, while strike patterns were analysed against frontline movements and operational timelines. However, the reliance on OSINT introduces potential gaps due to incomplete datasets, disinformation, and the fog of war. These limitations were acknowledged and addressed by triangulating data with technical analyses and expert opinions.

The second pillar, technical analysis, focuses on the characteristics and operational performance of glide munitions. Key technical parameters, such as range, guidance systems, and warhead types, were analysed using manufacturer specifications and defence industry publications. Comparative tables were developed to highlight differences between systems. The effectiveness of glide munitions was further assessed through case studies within the conflict in Ukraine, which examined strike density, target types, and tactical outcomes. This analysis was supplemented by video evidence and after-action reports. Additionally, the study explored emerging trends, including the integration of glide munitions with unmanned aerial vehicles and the use of boost-glide techniques to enhance range and survivability.

The third pillar, synthesis of expert assessments, contextualises the findings within the broader discourse. Insights from defence analysts, think tanks, and military journals were integrated to provide a nuanced understanding of glide munition deployment and counteraction efforts. The study also extrapolated future trends based on current trajectories.

Despite its comprehensive approach, the study has limitations. The reliance on OSINT and third-party analyses introduces potential biases, particularly in a conflict marked by information warfare. The rapid evolution of glide munition technology and countermeasures necessitate that some findings may become outdated as new systems are deployed. By combining OSINT, technical analysis, and expert synthesis, this study provides a robust framework for understanding the role of precision glide munitions in modern warfare. The methodology ensures a balanced, evidence-based approach, while acknowledging the inherent limitations of open-source research in a dynamic conflict environment.

1. Precision Glide Munitions. Capabilities, Operational Deployment and Effectiveness

In order to ascertain the possible methods of effective counteraction, first some general characteristics of modern precision glide munitions must be discussed and taken into account. Based upon known technical characteristics and observable performance in Ukraine, the capabilities, operations and effectiveness of precision glide munitions can be summarised, which would provide the basis for the further discussion on the topic of their effective counteraction.

1.1. Capabilities

Contemporary precision glide munitions follow the general historical role of this type of weapons system, albeit with modern technological developments, which have exponentially increased overall performance. The principal goal of glide munition development has been to provide for a cost-effective stand-off munition with some degree of precision targeting. Whilst during the Cold War, glide munitions, such as the US GBU-8 and AGM-62, as well as Soviet KAB series, were operationally employed, the proverbial revolution in glide munitions development and capabilities came only with the mass integration into weapons systems of satellite guidance technologies. Satellite guidance provides for increased mission flexibility and autonomy of munitions, whilst simultaneously increasing targeting precision in a cost-effective manner compared to more sophisticated yet expensive methods. In modern designs, satellite guidance is usually the primary guidance method, coupled with said other guidance methods for increased effectiveness, such as electro-optical (television guidance - TGM) or laser guidance (semi-active laser homing - SALH), with inertial navigation systems (INS) serving as a secondary guidance method (Table no. 1).

Modern glide munitions similarly follow the historical process of exploiting existing stockpiles of gravity munitions, with the process of transforming a “dumb” projectile (either an aerial gravity bomb or standard artillery shell) into the broader weapons system category of a precision guided munition – defined separately as either an aerial “glide bomb” or other type of guided glide munition, depending on the launch platform and final characteristics of the system. The process encompasses the retrofitting of a guidance, glide and control components in a unified module/kit to the existing munition through rudimentary procedures. Thus, the production of glide munitions is expedited by using existing stockpiles and constrained only by the ability to manufacture the guidance/glide kits. When cheap solutions are utilised, such as the case of the Russian Unified Gliding and Correction Module (Унифицированный модуль планирования и коррекции - UMPK), which can cost as low as 20,000 USD, the end result can be a weapons system capable of mass employment (Watling and Reynolds 2025, 7) – this is a principal vector of understanding modern glide munitions and specifically in the case of the conflict in Ukraine, where glide bombs in particular have had an extensive role, in addition to other glide munitions types.

The range of such munitions can vary, but is usually between 40-150+km (Table no. 1), thus placing the launch platform (if airborne) outside the range of short and medium range air defence assets. Moreover, the capabilities and role of glide munitions has been further expanded through the use of a boost-glide approach in delivery, as in the French AASM Hammer and Russian D-30SN, where an initial booster stage is utilised to either increase range, or more importantly to allow the launch platform to deploy the munition at lower flight altitudes, avoiding detection and potential engagement (Figure no. 1) (SAFRAN n.d., Commission des affaires étrangères, de la défense et des forces armées 2012). Furthermore, precision glide munitions have been integrated into ground-launch platforms, wherein the glide munition is retrofitted to existing booster-stage bodies for large-calibre multiple launch rocket systems (such as the US HIMARS (Raytheon 2010) or Russian Tornado-S (Redacción Aviacionline 2024)), with such munitions including the US GLSDB and Russian UMPK

D-30SN, and possessing superior ranges of over 100km, 150km in the case of the GLSDB (US Air Force n.d., Raytheon 2010).

Table no. 1: Modern Guided Glide Munitions (Marinov 2024)

System	Range	Warhead Weight	Guidance	Cost
JDAM/ Mark 82	24km	89kg	GPS, INS, SALH	21,000 USD (Air and Space Forces Magazine n.d.)
JDAM ER/ Mark 82	72km	89kg	GPS, INS	36,000 USD (Air Force Technology 2023)
AGM-154 JSOW	110km	225kg	GPS, INS, IR	540,000 USD (US Navy 2019, US Navy 2021)
GBU-53/B	110km	48kg	ARH, SALH, IR, GPS, INS	220,000 USD (Raytheon 2010, Roblin 2023)
GBU-39/B SDB GLSDB	110km (air-launched) 150km (ground-launched/ GLSDB)	62kg	GPS, INS, SALH	40,000 USD (US Air Force n.d.)
AASM Hammer	70+km	89kg	GPS, INS, IR, SALH	163-320,000 USD (Commission des affaires étrangères, de la défense et des forces armées 2012, SAFRAN n.d.)
UMPK/ FAB500	≈70km *depending on source and observations	200kg	GLONASS, GPS, INS	≈20,000 USD (Reisner 2025)
UMPK D-30SN	90-165km *depending on source and observations	100kg	GLONASS, GPS, INS	Unknown (Redacción Aviacionline 2024, Reisner 2025)

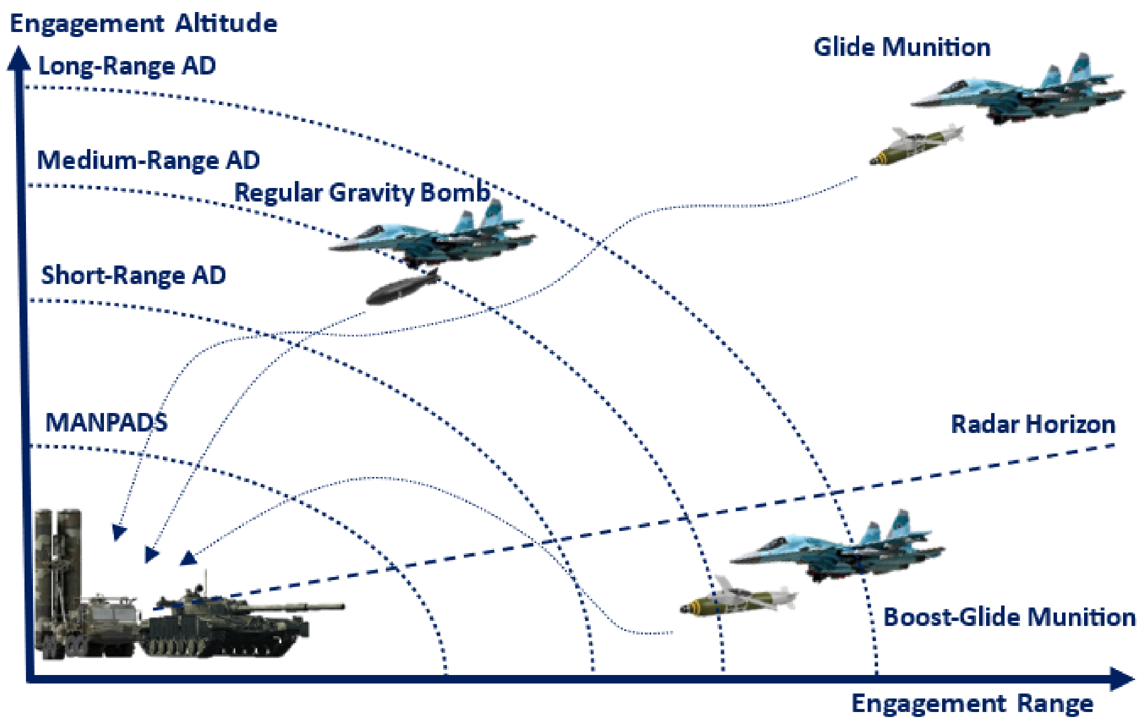

Figure no. 1: Engagement profile comparison of gravity, glide, and boost-glide munitions (Marinov 2024)

The capabilities of glide munitions on the modern battlefield are further enhanced by their ability to utilise multiple compatible warhead types, which greatly expands effectiveness against engaged targets. In the context of the characteristics of the modern battlefield, which favour defensive operations and a static-centric type of warfare, glide munitions can prove particularly effective in engaging an entrenched adversary in both open and urban positions (Kharchenko and Inwood 2024). In consideration of the firepower requirements to inflict the required effect on target in such conditions, precision glide munitions offer a tenable alternative to other methods, such as tube and rocket artillery, which has become both increasingly vulnerable to counter-battery fire and unable to concentrate and maintain fire for the necessary periods of time. Glide munitions offer the ability to deliver multiple times more firepower compared to artillery munitions and in a precise manner, whilst also affording the ability to feature specialised warhead types, such as cluster, thermobaric, concrete-penetrating or high-explosive fragmentation, thus increasing effectiveness against targets from singular strikes (Marinov 2024).

1.2. Operational Deployment

Since early 2024 precision glide munitions, of both air- and ground-launched variants have extensively proliferated in deployment by both sides of the conflict in Ukraine. Ukraine received examples of Western air-launched munitions such as the JDAM-ER (72km range, 89kg warhead) (Air Force Technology 2023) and AASM Hammer (70+km range, 89kg warhead), as well as the ground-launched GLSDB (150km range, 62kg warhead) (Air Force Technology 2023). Russia has made extensive use of the UMPK glide module (45-70km range) (Reisner 2025), which has been demonstrated in use on the FAB-250, FAB-500 FAB-1500 and FAB-3000 general-purpose high explosive bombs, the ODAB-500 and ODAB-1500 thermobaric bomb and the RBK-500 cluster submunition bomb, with also the more recent introduction of the D-30SN (up to 165km range, 100kg warhead) in both air and ground-launched versions (Nikolov 2024, Reisner 2025).

Russian operations are of particular importance in understanding the modern role of precision glide munitions due to their intensity of use and overall effect on the battlefield. In terms of intensity, bombardments by glide munition types have reached upwards of one hundred strikes per day along the entirety of the frontline, whilst during specific set-piece engagements, such as the case of the Battle of Avdeevka, witnessed up to one hundred strikes in a 24-hour timespan against a singular section of the frontline (Figure no. 2) (Marinov 2024). The main method of operational deployment in Ukraine has been based on aerial delivery platforms, such the Russian Su-34 fighter-bomber and includes the salvo-launch of two to four munitions based on the FAB-250 or FAB-500. Larger munitions, FAB-1500 and FAB-3000 have also been demonstrated in more singular episodes of usage.

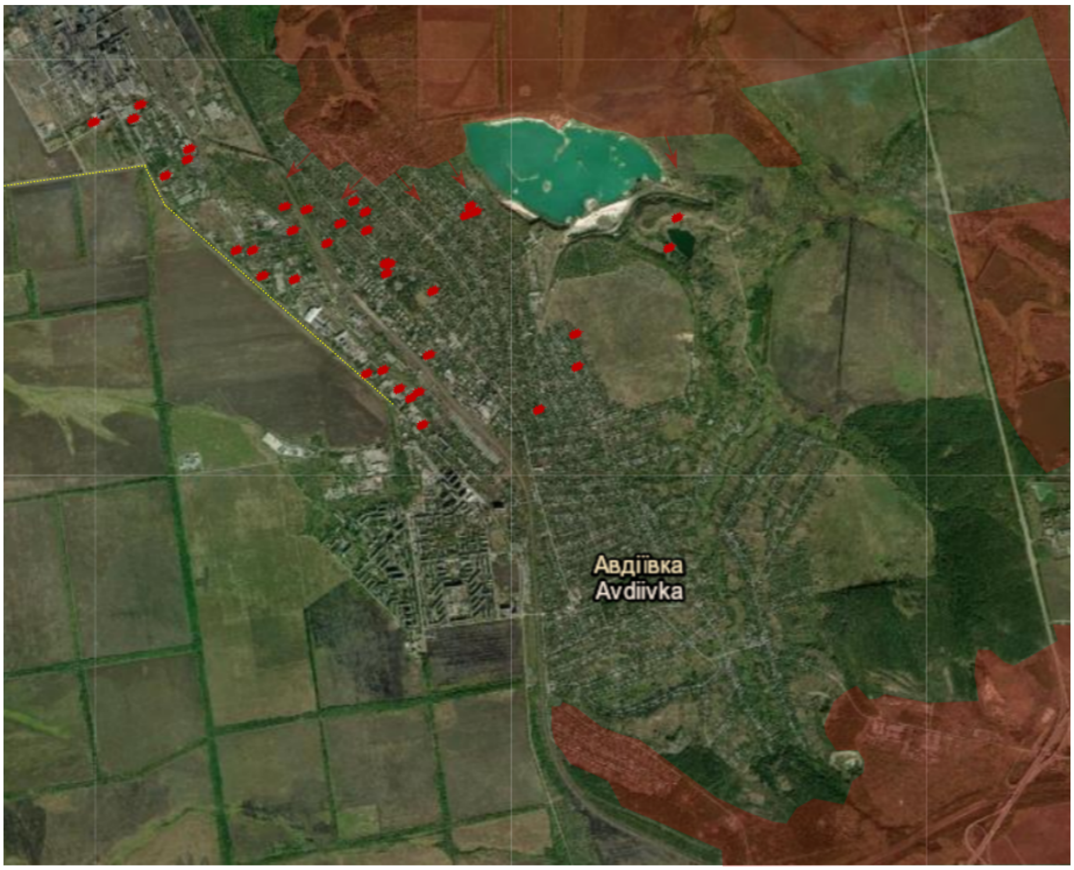

Figure no. 2: FAB strikes on Avdeevka around February 2nd, 2024.
Legend: FAB strikes geolocated as per red icons. Russian control and movement in red.
Ukrainian forces main supply route (MSR) in yellow (Marinov 2024).

On the other hand, Ukraine has made particular use of the AASM Hammer, which has allowed a substantial boost to the operational effectiveness of the Ukrainian Air Force in utilising the munition’s boost-glide functionality to conduct airstrikes from low altitudes in conditions of contested air space (Army Recognition 2025).

The use of precision glide munitions in Ukraine, due to their increased availability, has been noted in several operational roles. In the role of a breakthrough weapon against specific frontline positions, different munitions with the UMPK module have been used to bombard positions at a given section of the frontline, as a substitute or complementary to artillery fire. Against hardened positions, such as trench bastions or build-up residential areas, the high explosive mass of even singular munitions has been noted to deliver effective destruction. In the interdiction role, UMPK equipped munitions have been recorded used in the operational depth in undermining bridge infrastructure, temporary points of unit concentration, munitions storage facilities and against positions of fire assets, such as artillery and air-defence systems. In particular, by the latter half of 2024, the use of the FAB-3000 with the UMPK module has been noted against troop concentration areas close to the frontline.

1.3. Effectiveness

In the conditions of the Ukrainian conflict, precision glide munitions have demonstrated their effectiveness in complex battlefield conditions, where counter-battery fire has become increasingly effective and where neither side enjoys aerial superiority. Glide munitions have thus allowed both sides to utilise aerial platforms at stand-off ranges to support frontline operations. Similarly, the ground-launched variants have allowed MLRS systems, such as the HIMARS to inflict fire damage from extended ranges and with greater precision.

The ease of manufacture of glide modules further reinforces an effectiveness of employment through quantity. In 2024, estimations of Russian production of UMPK kits places output at 40,000, whilst for 2025, production is set to reach 70,000 (Watling and Reynolds 2025, 7). Thus, effectiveness on the battlefield becomes limited by the number of launch systems available to the user. If the consideration is made for the proliferation of use with unmanned aerial vehicles, then the volume of precision glide munitions will further increase and become less dependent on traditional aerial platforms. An October 2024 incident followed by the examination of the wreckage of a fallen Russian S-70 “Okhotnik” stealth unmanned aerial vehicle, demonstrated that the particular platform was armed and possibly being tested with the D-30SN glide munition (Newdick 2024).

In the aforementioned Battle of Avdeevka, precision glide munitions, employed *en masse* were critical in facilitating a final breakthrough of Ukrainian defences in the north of the city (Peck 2024). Russian forces bombarded both frontline positions, facilitating the advance by its own units, as well as the Ukrainian main supply route into the city, thus starving the principal defence areas of supplies and making the concentration of forces for potential counterattacks impossible, leading to the main defensive nodes in the city centre and coking plant being gradually separated and cut off, precipitating the eventual fall of the city (Figure 2) (Marinov 2024).

The analysis of precision glide munitions in the context of the Ukraine conflict reveals their profound impact on modern warfare. Examined systems, leveraging advancements in satellite guidance, modular design, and cost-effective production, have emerged as a cornerstone of precision glide munition effectiveness on the modern battlefield. Their ability to deliver precision strikes at stand-off ranges, coupled with diverse warhead types, has rendered them indispensable in both offensive and defensive operations. The conflict in Ukraine has demonstrated their versatility, from breaking through entrenched defences to interdicting supply lines and neutralizing high-value targets. However, their effectiveness is not without limitations. The reliance on GPS and other guidance systems makes them vulnerable to electronic warfare, while their low heat signature complicates interception efforts. The mass production of glide kits, exemplified by Russia’s UMPK modules, underscores the challenge of countering saturation tactics. As the battlefield evolves, so too must the strategies to mitigate these threats. The lessons from Ukraine highlight the need for integrated defensive systems, doctrinal innovation, and investment in emerging technologies. Precision glide munitions are not merely a tactical tool, but a strategic enabler, reshaping the dynamics of modern conflict and demanding a proactive response.

2. Methods for Effective Counteraction

Having examined the core characteristics of precision glide munitions expressed in their capabilities, methods of deployment and effectiveness on the modern battlefield, the argument has been placed forward that this specific weapons class has an expanding and vital role on the battlefield, thus precipitating further deliberation as to the methods of its effective counteraction. Throughout the conflict in Ukraine and since the beginning of mass deployment of precision glide munitions, no effective universal method of counteraction has been demonstrated, but vital observable lessons and more importantly, vectors of future development can be derived, allowing to draw conclusions and discuss a range of methods from the operationally proven to the hypothetical. The methods examined can be based on the approach towards engaging (neutralising) specific elements within the overall weapons complex. The complex incudes both the launch platform (air- or ground-based), the glide munition itself, as well as the corresponding characteristics, such as the range to the target it is engaging. The overall engagement zone for glide munitions can thus be stated to range from the basing site of carrier platform itself (several hundred kilometres) to the active phase of deploying the glide munition (up to 150-165 kilometres) against a specific target. Based on the specific target itself, whether it is on the line of contact or within the operational depth, methods of counteraction with varying engagement ranges can be utilised.

Based upon the conflict in Ukraine, the first and most effective method of counteraction has been demonstrated to be the engagement of either the launch platform or storage sites for the glide munitions themselves (Hoehn and Courtney 2024). Long range fire assets have been operationally utilised to engage the launch platforms either in the process of firing or when parked at either permanent or temporary deployment positions. Launch platforms have further proven to be vulnerable when in the process of deploying glide munitions. Aerial platforms, in particular due to the range of glide munitions and the required flight altitude for munitions release, can fall victim to long-range air defence assets. Similarly, ground-launch platforms can fall victim to detection and neutralisation when *enroute* or immediately after conducting fire missions close to the frontline. However, in all cases, bringing assets within sufficient range to engage launch platforms can have effect of exposing them to detection and neutralisation by the adversary – the example of neutralised long-range air defence assets from both sides (Patriot and S-300V batteries) close to the line of combat contact (Military Watch Magazine 2024).

After munitions release from the carrier platform, interception becomes a much more difficult, but not impossible task. Throughout the conflict, the most efficient method of degrading the performance of glide munitions has been demonstrated to be through the employment of electronic warfare (EW) methods, which can degrade the precision of the weapon (Hoehn and Courtney 2024) – specifically jamming and spoofing of the satellite navigation signals. Russian EW systems have been noted to be particularly effective against numerous types of GPS-reliant munitions, including the discussed JDAM and GLSDB (Gall and Golovin 2024), with known performance decreases in other munitions such as the 155mm “Excalibur” guided-shell facing a degradation in accuracy from 70% to 6% (Patt 2024, 3). EW means offer advantages compared to other methods of counteraction to be discussed in their ability to offer spherical coverage of a large area and effectiveness against numerous munitions types. However, certain disadvantages also manifest – such system offer degradation in performance, either through decreased accuracy (jamming) or through a redirection of the projectile from its original coordinates (spoofing), yet the projectile remains live and will inevitably produce an impact. Moreover, such systems are expensive and can be lost when providing coverage close to the frontline, especially in modern battlefield conditions and the existence of radiation homing missiles, including specialised jamming homing kits for glide munitions (such as for the JDAM-ER) (Trevithick 2024, Defence Express 2024).

Alternatively, neutralisation of glide munitions must rely on direct interception through air-defence assets. In order to ensure interception, such assets must necessarily provide adequate coverage of protected areas, which as the conflict in Ukraine has demonstrated, includes coverage of frontline positions. The requirement for such an air-defence umbrella, raises the question as to which specific sets of systems can be utilised in such a role and which can effectively engage glide munitions in a cost-effective manner. The lack of a significant infra-red (IR) heat signature predisposes problems of employing systems relying on IR tracking (such as MANPADS and certain short-range air defence assets) (Hambling 2025), and no discernible episode of the use of such systems has been recorded in Ukraine. Instead tracking and engagement must rely on either radar-guidance, or other forms of direct line-of-sight tracking. The scale of deployment of glide munitions in Ukraine has demonstrated the requirement for mass interception in order to provide effective coverage of areas. In terms of sophisticated radar-guided long-range air defence assets, such a prospect is unfeasible due to both cost of individual missile interceptors and inherent vulnerability of the missile defence complex close to the line of combat contact. Thus, the role of interception must be relegated to other air-defence means.

With the increased requirements for saturating frontline areas with effective means to counter aerial threats, such as small aerial attack munitions (FPV drones and loitering munitions), a potential solution for countering glide munitions can also be sought after in short-range air defence platforms (SHORAD). One solution to future SHORAD capabilities, which are severely lacking within NATO, is through the introduction of mobile barrel-type systems, such as the Rheinmetall Oerlikon “Skynex”, which utilises a 35 mm radar-guided revolver-type cannon with air-burst munitions to inflict a kinetic kill on targets (Rheinmetall 2024). Such systems, are sought in mobile configurations, such as the Rheinmetall Boxer Skyranger 30, which can be brought close to the combat line and be equally capable to exfiltrate to avoid detection and destruction by enemy fire assets. Another solution in SHORAD capabilities presented to Ukraine relies on the use of smaller guided interceptor missiles. The “Vampire” system, which utilises the Advanced Precision Kill Weapon System II (APKWS) rockets through optical tracking is modular enough to be fitted on a variety of platforms, including light vehicles. The specific system has been operationally deployed against both aerial drones and loitering munitions. However, the cost of interceptor missiles, at 27,000 USD still favours glide bombs in the cost-benefit ratio (Smith 2024, Helfrich and Rogoway 2022). Regardless, none of the above systems have been demonstrated in Ukraine to effectively provide coverage against glide munitions. If the consideration is made that radar or optical tracking of mentioned and other such SHORAD systems, as well as the method of the effector being viable against glide munitions, the efficient saturation of the operational space with enough assets and the economy of interception in the face of massive use of glide munitions could make even such methods ineffective, thus requiring a shift in discussion to other methods (Hambling 2025).

Aside from existing air defence systems, perspective methods have also been put forward as a solution. One possibility is to utilise cheap interceptors in the forms of unmanned aerial platforms of the quad-copter type, which have demonstrated a sufficient economy of scale in Ukraine. The concept relies on methods utilised to engage aerial drones and loitering munitions, in a similar role, but against glide munitions (Hambling 2025). Small drones deployed in the tactical and operational spaces, could engage incoming glide munitions through direct interception. This method of counteraction would require sufficient detection, tracking and guidance of drone effectors, as well as sufficient technical capabilities in terms of speed and tracking of the drone platforms itself, which considering the size limitations and requirements for a cost-effective platform, can be considered to constitute a challenge. The overarching conceptualisation, as defined in research and development tenders (Headquarters Supreme Allied Commander Transformation 2025), would place a future emphasis on resource efficiency, portability, scalability and greater integration of advanced solutions, such as artificial intelligence (AI), machine learning (ML), internet of things (IoT) or other unconventional techniques that enhance performance. A greater reliance on solutions, which incorporate artificial intelligence (such as in the role of target recognition, identification and direction) in a decentralised networked and autonomous weapons system, which utilises mass drone effectors, provides an avenue towards effective counteraction of glide munitions in the wider combat space and beyond the capabilities of other discussed systems.

A more passive approach in the absence of near-term effective solutions could rely on doctrinal changes, which should strive to lessen the effectiveness of glide munition bombardment. As the conflict in Ukraine has demonstrated, glide bomb effectiveness particularly excels in cases where the engaged targets include fortifications, urban areas and large concentrations of forces. As such, an effort to decrease vulnerability of targets through a change in the deployment of conventional forces on or near the combat line would decrease the impact of glide munitions on the warfighting potential.

Regardless of the individual solutions proposed, a compressive answer to precision glide munitions must utilise a systemic approach where multiple components form the proposed solutions are networked together into a system of response with a multilayered approach to negating the threat posed. A resilient system of counteraction is required, which includes multiple networked systems, which include countermeasures against both glide munitions and other types of projectiles can be seen as the most cohesive approach towards future enhancement of military capabilities.

The counteraction of precision glide munitions demands a multifaceted strategy that addresses vulnerabilities across their operational lifecycle. Neutralising launch platforms and degrading guidance systems through electronic warfare remain the most proven methods, yet limitations—such as interceptor cost and incomplete interception — highlight the need for complementary solutions. Short-range air defence systems, like mobile gun-based or missile-based platforms and networked drone interceptors, show promise, but require further development to achieve cost parity with mass-produced glide bombs. Passive measures, including force dispersion and hardened logistics, can reduce targeting efficacy, while emerging technologies like AI-augmented detection systems offer transformative potential. However, no single solution suffices; success hinges on integrating these methods into a cohesive, adaptive framework. The Ukrainian experience demonstrates that resilience lies not in isolated systems, but in systemic redundancy – layering interception, deception, and doctrinal agility to counter saturation tactics. As military personnel worldwide confront this escalating threat, investment in interoperable defences and international collaboration will be pivotal to maintaining strategic parity.

Conclusions

The proliferation of precision glide munitions in the conflict in Ukraine underscores their transformative role in modern warfare. These systems, combining cost-effectiveness, stand-off capabilities, and modular adaptability, have redefined the dynamics of firepower delivery in high-intensity conflicts. Their ability to degrade entrenched positions, disrupt supply lines, and overwhelm traditional air defences highlights a critical vulnerability in conventional military doctrines and force capability. While electronic warfare and interception efforts offer partial mitigation, the absence of a universal countermeasure necessitates a paradigm shift in defensive strategies. A holistic approach - integrating layered air defence networks, decentralized force deployments, and emerging technologies like AI-driven interception systems - is essential to neutralize the threat. Furthermore, the lessons from Ukraine emphasise the urgency for NATO and allied forces to prioritize innovation in both materiel and doctrine, ensuring resilience against adversaries leveraging mass-produced precision munitions. Future research must focus on scalable, cost-effective solutions, such as drone swarms and efficient SHORAD, to bridge the gap between evolving threats and defensive capabilities. Ultimately, the glide munition's ascendancy is not merely a tactical challenge, but a strategic imperative, demanding collaboration across industry, academia, and defence institutions to safeguard the integrity of modern battlefields.

Acknowledgement and financing: This work was supported by the NSP SD program, which has received funding from the Ministry of Education and Science of the Republic of Bulgaria under the grant agreement no. Д01-74/19.05.2022

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