2022 NDIA MICHIGAN CHAPTER
GROUND VEHICLE SYSTEMS ENGINEERING
AND TECHNOLOGY SYMPOSIUM
AUTONOMY, ARTIFICIAL INTELLIGENCE & ROBOTICS TECHNICAL SESSION
AUGUST 16-18, 2022 - NOVI, MICHIGAN

THE 'GUILLOTINE' AN ADAPTIVE, ROBOTIC, ANTI-TANK PRECISION ATTACK SYSTEM

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ABSTRACT

Main Battle Tanks (MBTs) remain a key component of most modern militaries. While the best way to 'kill a tank' is via the employment of another tank, matching enemy armor formations one-for one is not always possible. Light infantry lack organic armor and their shoulder launched anti-tank capabilities do not defeat the latest generation of MBTs. To compensate for this capability gap, the U.S. Army has employed precision guided anti-tank munitions, such as the "Javelin." However, these are expensive to produce in quantity and require risking the forward presence of dismounted Soldiers to employ. Mine fields offer another option but are immobile once employed. The 'Guillotine' Attack System proposes to change the equation by pairing an AI enabled, adaptive unmanned delivery system with a shaped charge payload. Guillotine can loiter for hours, reposition itself to hunt for targets, and- when ready- deliver a precision shaped charge strike from the air.

Citation: "The 'Guillotine'; An Adaptive, Robotic, Anti-Tank Precision Attack System," In *Proceedings of the Ground Vehicle Systems Engineering and Technology Symposium* (GVSETS), NDIA, Novi, MI, Aug. 16-18, 2022.

1. INTRODUCTION

Russian made Main Battle Tanks are among the most prolific complex weapons platforms on today's modern battlefields. As of 24 February 2022, there were over 582 T-90 tanks, 3,550 T-80 tanks, and 10,000 T-72 platforms (in all variants) in service to Russian armored forces alone. This does not take into account the tens of thousands of additional nearly identical MBTs exported to other client states, or license built by those countries for their own use. Standardized upgrades to the armor protection systems of these tanks, over the last 20+ years, have also endeavored to keep pace with a variety of anti-tank systems designed to defeat them. Cheap, shoulder launched anti-tank weapons are prolific (such as AT-4 rockets, M3 Carl Gustav munitions, or RPGs). However, to have a reasonable chance at success, they must be fired close to the MBT target, at vulnerable sides and rear areas, and in volleys to be effective. Such a reality places

dismounted Soldiers at increasingly higher risks, maneuvering on foot across a battlefield to get within 300 meters or less to even have chance to get a kill shot.

2. CONVENTIONAL SOLUTIONS

Reliable ground-employed precision guided anti-tank missiles (ATGMs) have existed for some 40 years, and their steady improvement provides some tank killing anti-armor capability. The most advanced top attack anti-tank guided missiles, such as the Javelin, are very effective in their ability to defeat the latest generation of MBTs. Fire-and-forget targeting and tracking capability adds a layer of protection for infantry teams employing these systems. However, such a premium capability does not come cheap. The average Javelin costs roughly $246k per missile shot.

Anti-tank minefields also provide options. The family of scatterable mines (FASCAM) is an evolution in the standard, land mine. Modern fusing, sensing, and anti-disturbance devices allow these scatterable mines to defeat enemy attempts to reduce and/or clear the minefield. FASCAM mines can be delivered through artillery, rocket launchers, indirect crew served weapons, special mine sowing vehicles, helicopters and aircraft. FASCAM mines can defeat both armor and personnel. They can also utilize a random or pre-programmed self-destruct period, countermeasure hardening and anti-disturbance features. All FASCAM mines have an active life cycle and self-destruct (SD) time after their active life has expired. The duration of the active life varies from 4 hours to 15 days depending on the system. Such a minefield can provide an effective stopgap against enemy armor, however, once emplace it remains a fixed solution. If the enemy armored threat moves around the mine field, light infantry formations are once again dependent upon expensive ATGMs or cheaper, but significantly less effective shoulder launched options.

3. TYPICAL MODIFIED DRONE SOLUTIONS WILL NOT WORK

There are a handful of innovative protype solutions proposed by a variety of vendors that seek to pair UAVs with munition payloads. Some propose to attach explosives to conventional quadcopters. Others propose to completely redesign conventional ATGMs with quadcopter hover capability. (Figure1). In each case, the key challenge lies in the short duration of these UAV solutions. Once deployed, a loitering UAV is burdened by the limitations of composite batteries. The heavier the explosive payload, the shorter the duration of the loitering munition. Additionally, loitering munitions hovering in the air can be detected and jammed or shot down prior to their maneuvering into optimal strike position. There must be a better way to blend both UAV loitering munition capability, coupled with a method to extend mission duration and assured precision control.

Figure 1

4. THE IDEAL SOLUTION

Robotic Research proposes blending the lethal destructive power of an armor-defeating shaped charge payload found in the most destructive ATGMs, with the target recognition and precision guidance available in the most sophisticated AiTR tracker heads, with the flexibility of an adaptive, long duration UAV/UGV delivery system. It is called the "***'Guillotine' Strike System."*** (Figure 2)

Figure 2

Figure 3

Our solution consists of an explosive shaped charged payload, of varying weight and configuration, carried on a Pegasus adaptive UAS/UGV platform. Details of the variable payloads envisioned for Pegasus depend on the type of target and strike location intended. The platform can be programmed to loiter on the ground and wait for a tank target for hours. Upon detection of a tank, Pegasus lifts off and targets one of two AiTR programmed options: The tank's gun tube or the commander's hatch on the top of the turret.

In the case of a ***gun tube strike*** option select, the performance objective result is the crippling of the tank's gun tube. A shaped charge induced hole or crosscut in the gun barrel would result in destruction due to the forces from gasses escaping around the first projectile the tank attempts to fire. (Figure 3) A 'firepower kill' on a tank renders it operationally useless as a direct fire platform and deliberately increases the logistical burden of evacuating the vehicle to higher maintenance facilities not commonly found at the forward edge of the battlefield. Robotic Research considered an option for the AiTR to also target the engine of the MBT, but considered it not as effective at meeting the requirement to defeat the primary capability of a tank; to whit, defeating its ability to bring its firepower to bear. An immobilized tank merely becomes a stationary anti-tank gun emplacement that can still shoot and threaten all within range of its cannon.

Defeating the ability of an MBT to shoot also increase the enemy's logistics burden to remedy. In practice, replacement engines/power packs and roadwheels are common in maintenance detachment repair stocks, whereas stacks of replacement tank

gun barrels are not. Additionally, the subsequent replacement of a tank gun requires specialized equipment and hours to complete, followed by testing requirements to ensure the gun fires safely "in battery," before allowing the tank to return to combat.

The Guillotine strike system, in ***turret attack mode*** configuration, would use a Pegasus system, equipped with a targeting AI, to attack the top hatches of a tank. This would provide a cost-effective solution to disabling a tank with a targeted "command and control kill" on the vehicle commander, at a minimum. Not only are the hatches not protected by reactive armor, they are of thinner armor than the rest of the turret, making the commander and gunner very vulnerable from top attack munitions. More importantly, the explosively formed penetrator from Guillotine would likely detonate the exposed ammunition carousel normally located directly beneath Russian designed MBTs. This carousel routinely detonates upon penetration of the tank turret, resulting in a catastrophic detonation of ammunition and propellant. (Figure 4)

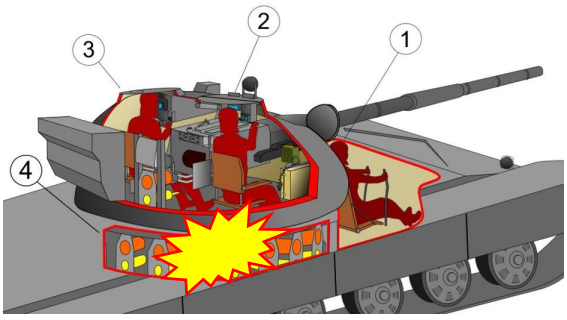

Figure 4. 1-Driver, 2-commander, 3-gunner, 4- ammo carousel

The AI targeting system for Guillotine would be trained to easily recognize the hatches of shape and design common to every Russian AFV built since 1950. (Figure 5)

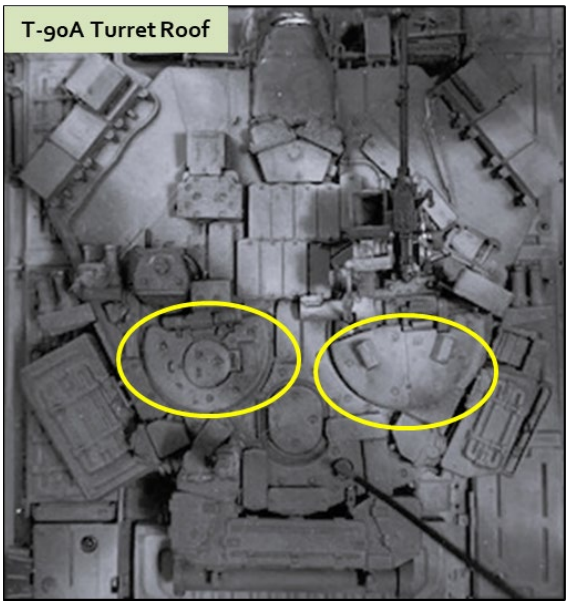

Figure 5

4.1. OVERVIEW OF THE PLATFORM: PEGASUS

Pegasus™ is a family of tactically deployable, transformable, autonomous robotic systems that provides all the air capability of a VTOL UAS in conjunction with the capabilities of a tracked UGV. The Pegasus family consists of the mid-size Pegasus II with mapping and situational awareness capabilities, the larger heavy-lift Pegasus III, and the small back-packable Pegasus Mini that fits in confined spaces. Each Pegasus platform provides the flying and driving capability in a single device. Our Pocket Universal Controller Kit (PUCK) is a single controller for any model in the Pegasus family and can send autonomous missions to multiple Pegasus systems at once. The PUCK is a game style controller that uses government owned ATAK software and COTS hardware for its user interface. A single Pegasus platform can perform air and ground missions serially, allowing Pegasus to perform operations in areas unreachable by other robots. Pegasus could fly to a location, land on top of a building or vehicle, and drive to a precise target location to emplace an effect before flying home.

We propose Pegasus II for this effort due to its size, weight, and payload capability. We have worked with integrating a variety of energetic effects onto Pegasus II. The standard battery on Pegasus II allows up to 8 hours standby time, 6 hours driving operation, and 20 minutes flight time. We have integrated an EO/IR gimbal with laser pointer on some of the fielded platforms. The standard configuration of Pegasus includes an MPU5 Wave Relay meshing network radio for communications to the GCS as well as peer-to-peer for coordinated operations.

Since 2018, Pegasus II has been operated in a wide variety of environmental conditions and fielded by the Army's Special Forces through the Rapid Equipping Force (REF). Pegasus II has demonstrated reliable operation in extremely hot dusty environments like summer in White Sands, NM (ATEC Testing) and Yuma, AZ (Project Convergence) where it has performed flawlessly on 116°F days. The REF has been granted a safety release and confirmation for Pegasus from the Army's Test and Evaluation Center (ATEC). Pegasus II's environmentally resilient design has proven successful during rain testing and training operations. In testing for DTRA, Pegasus II was hard-mounted on the back of a Polaris MRZR-D and driven off-road on bumpy terrain for over four hours, then was immediately test flown without any intervention. In similar testing, Pegasus II was flown through moderate rainfall (0.12 inches per hour) for the duration of a full battery.

4.2. OVERVIEW OF THE SHAPE CHARGE PAYLOAD

Following the design and capability of our UAS/UGV delivery platform, the explosive payload is the most critical element. Ensign-Bickford Aerospace & Defense (EBAD) is combining its decades of experience manufacturing warheads, fuses, and Electronic Safe and Arm Devices (ESADs) for products ranging from hypersonic missiles to nuclear-capable Inter Continental Ballistic Missiles (ICBMs), as well as serving as the premier supplier of energetic breaching capabilities to U.S. Special Operations Command, to develop a weaponization kit for a small UAS.

EBAD is developing a weaponization kit that can be attached via a universal mechanism to any UAV. An independent weaponization kit, with operator handheld control mechanism, will eliminate the need for the sUAV recertified by a Safety Board each time a modification to either the UAV or kit is made, speeding its deployment to warfighters. EBAD is currently trading designs with Robotic Research using primarily off the shelf ESADs, electro-mechanical render-safe architectures, and wireless receivers to determine the optimal balance between reusability (to drive down operating price), weight, and complexity, while ensuring redundant active safety measures. **The team has also designed and demonstrated a variety of energetic effects that would fit the payload bay of a Robotic Research platform; a conical shape charge for precision munition effects, a linear shape charge for destruction and severance of a vehicle or other hard target.** EBAD has also designed an anti-personnel fragmentary charge similar in effect to a 40mm fragmentation HE grenade.

4.3. CONCLUSION: SOLVE BATTLEFIELD NECESSITY WITH THE INNOVATIVE APPLICATION OF UGV/UAS DELIVERED MUNITIONS

The character of the modern battlefield is changing at an accelerated rate. Soon autonomous robotic combat vehicles will join their MBT and AFV stablemates as mass returns to the maneuver fight. Land mines,

not matter how easily delivered, as a fixed obstacle, will not be able to keep up with the dispersed and fluid pace of modern battle. Shoulder launched munitions must possess ever more expensive boutique capabilities to remain effective against the latest evolutions in armored fighting vehicle protection systems. It is an expensive proposition, and one few armies can afford to match.

Only The Pegasus Guillotine capability provides a "ready now" affordable solution that combines the best of breed in all the afore mentioned systems. The 'Guillotine' Attack System proposes to change the equation of modern MBT dominance by pairing an AI enabled, semi-autonomous adaptive unmanned delivery system with an affordable shaped charge payload. Pegasus Guillotine acts as essentially a smart minefield. Capable of smart movement and able to loiter for hours, Pegasus can reposition itself to intelligently hunt for targets, and- when ready- conduct a precision shaped charge strike, from the air, against either a tank commanders hatch or the tank's gun tube.

5. REFERENCES

[1] All materials in this document are proprietary to Robotic Research, with the exception of Figure 1, with is taken from an open-source video at: https://youtu.be/XQWPRaZPKpA, and Figure 3, which is taken from Wiki Commons stock imagery.