

## **DIRECTORY**

**Tactics of use by the enemy  
FPV drones (in diagrams)  
and ways to counteract it**



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## I. Introduction

An analysis of the large-scale use of FPV drones by the Ukrainian Armed Forces indicates a significant increase in their role in combat operations, as **effective means fire damage**. Having a low mass, they are capable of lifting a load several times greater than their own weight and carrying it to a target at a speed of 100 km/h and a range of up to 10 km.

In percentage terms, kamikaze drones have gradually taken the leading place (**up to 70%**) in causing losses to manpower and equipment in tactical depth. At the same time, these indicators are characteristic **for all sides of the armed conflict**.

Technological development of FPV drones and related components for their combat use (increasing range and flight time, portable payload, increasing resistance to electronic warfare, the ability to use in conditions of limited visibility, expanding the range and types of ammunition, introducing intelligent target acquisition and tracking systems, creating specialized UAV testing centers and operator training) have led to **expansion of tactical techniques and the range of tasks they solve**.

The presented material briefly and clearly reveals general information about FPV drones, considers the main tactical methods of their use in countering Russian troops. At the same time, similar methods of combat use are actively implemented by our "drone breeders" on the battlefield. A separate block presents brief recommendations and advice on methods of combating "kamikaze" drones on the line of combat contact.



## II. General information about FPV drones

**FPV (English First Person View) drones**- these are UAVs equipped with a video camera and transmitting the image in real time to the pilot's glasses or helmet (controlled from the first person).

**Advantages** before quadcopters:

- first-person drone control;
- instant response and maximum control over the drone;
- high maneuverability and flight speed (up to 120 km/h);
- resistance to the impact of electronic warfare (due to the modularity of the device) (a system that allows you to quickly change the configuration and settings);
- the ability to change the drone design to suit the task;
- cheapness of the product (on average 40-50 thousand rubles).

**Disadvantages** include:

- average flight duration 7-10 min;
- flight range (without repeater) – up to 10 km;
- the need for selection and high-quality training of the pilot (operational training) Torah – not less than a month).

### 1. Equipment



FPV drone



Video glasses

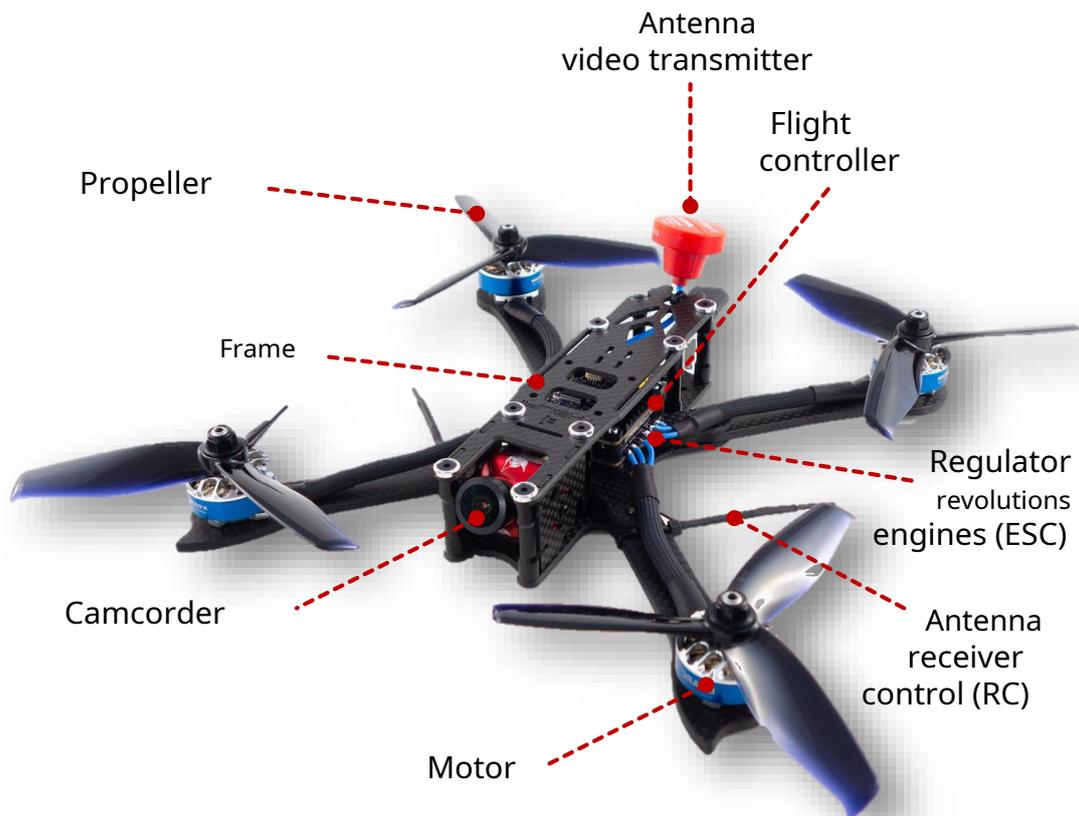


Battery



Remote control

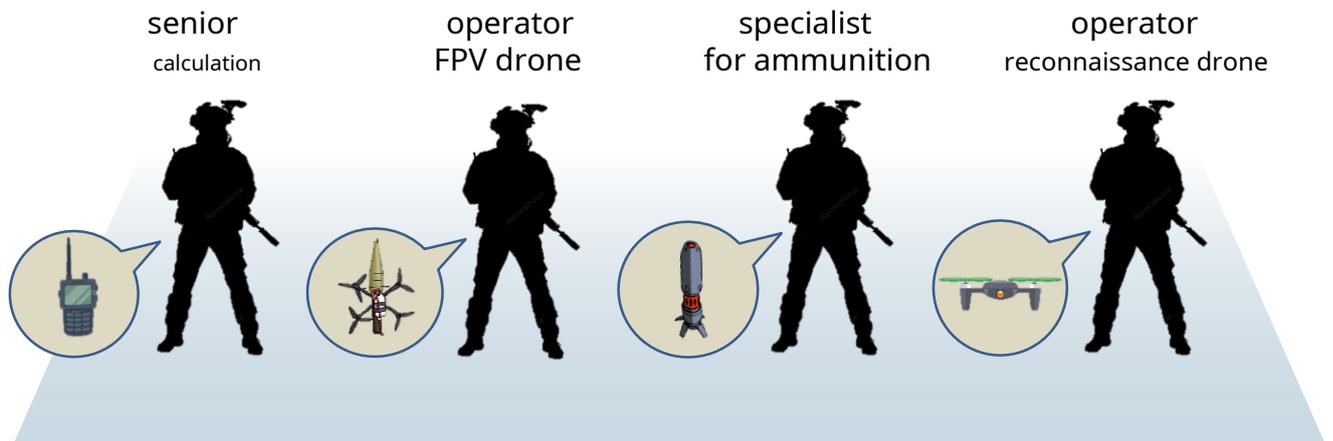
## 2. General structure of FPV drone



### 3. General performance characteristics of a typical FPV drone

- drone size – 7 inches;
- load capacity – up to 2.5 kg;
- maximum speed (with load) – up to 120 km/h;
- flight time with load – up to 10 min;
- flight range with payload (without repeater) – 10-12 km;
- time to prepare for launch – 2 min.

### Calculation of UAVs (option)

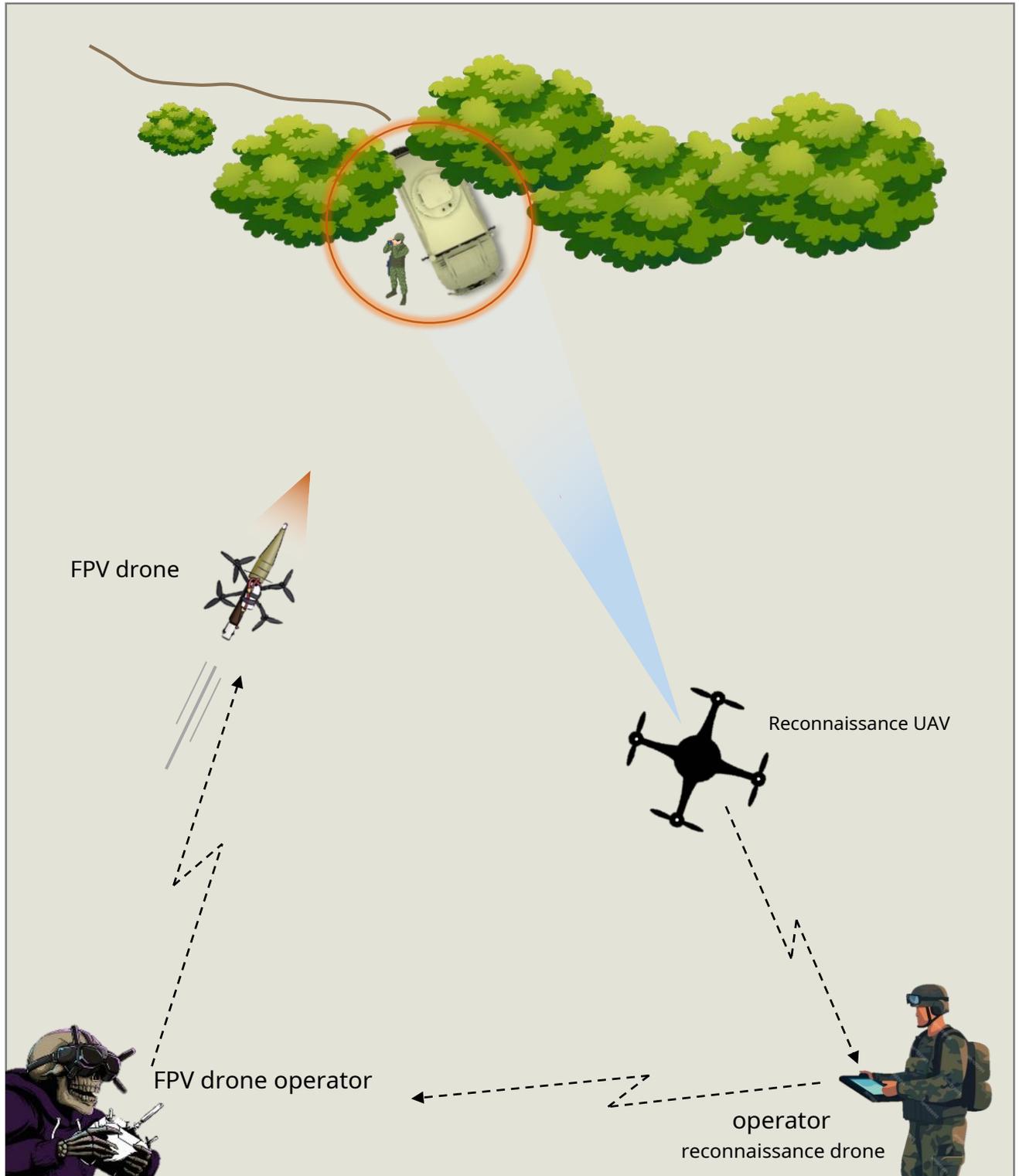


### III. Tactical techniques for using FPV drones

#### 1. "Classic"

(identification of the target by a reconnaissance UAV – launching a drone and destroying it)

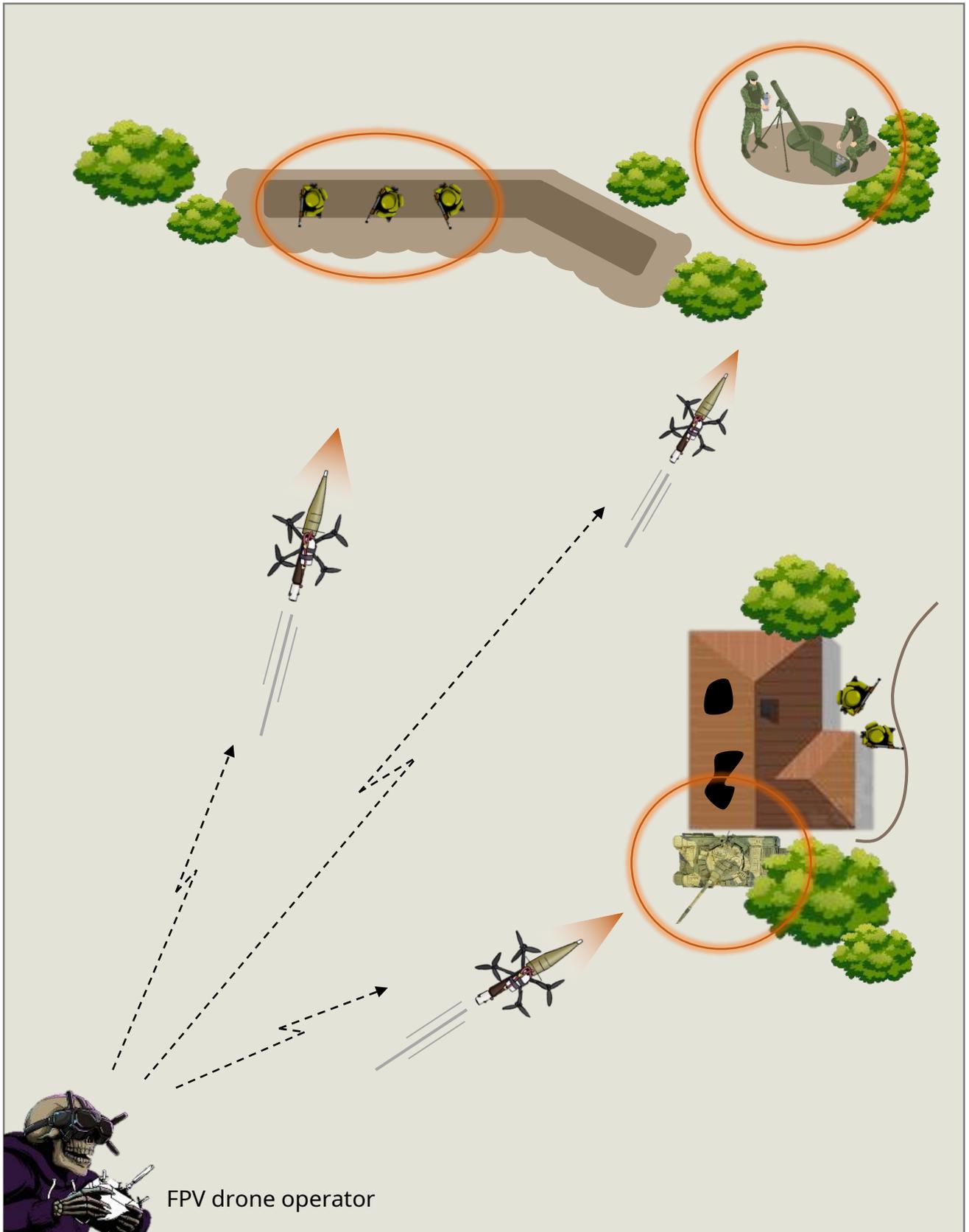
The most common method of combat use. It consists of detecting a target with a reconnaissance drone and transmitting the coordinates to the FPV operator for its destruction. Video recording of the destruction of the object is carried out by the reconnaissance UAV.



## 2. "Free Hunting"

(FPV strike on pre-detected objects and positions)

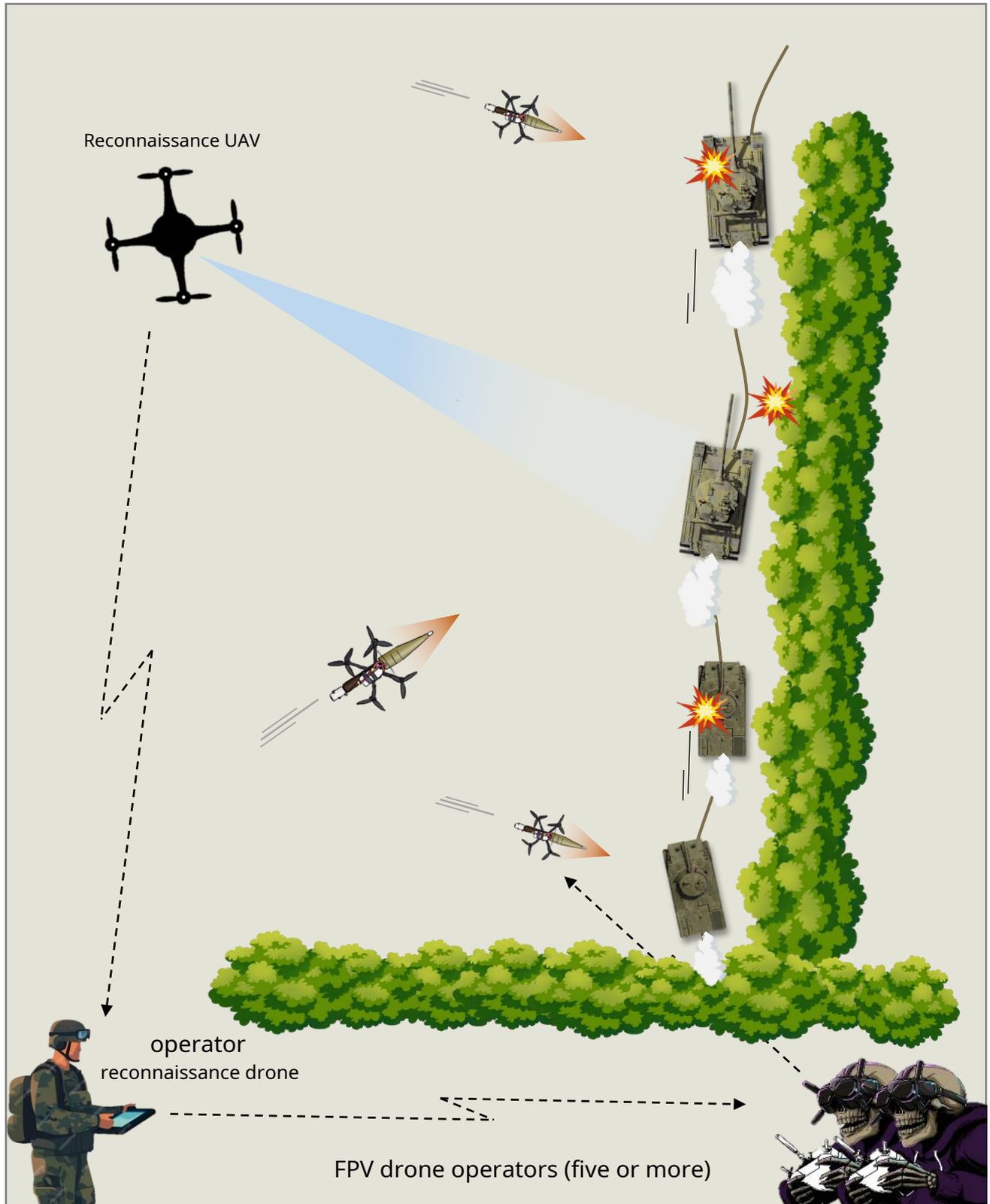
The essence of this method is to independently carry out strikes with FPV drones on previously exposed enemy objects and positions.



### 3. "FPV swarm"

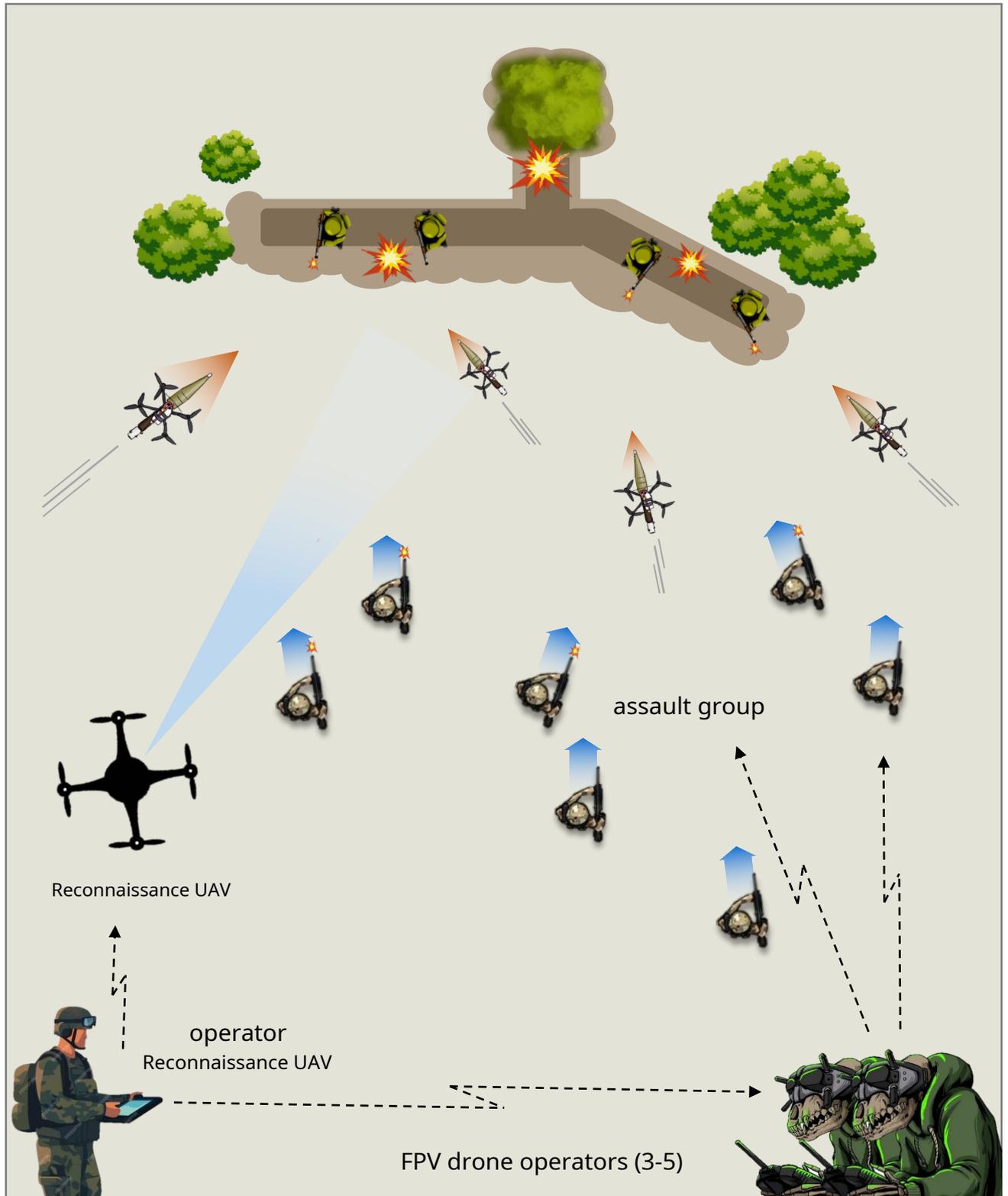
(FPV group strike on selected targets, objects)

The method is based on the discovery of targets (objects) by a reconnaissance UAV and the mass impact of kamikaze drones to destroy them. As a rule, the total consumption is 5-12 devices. Video recording of the destruction of the object is carried out by a reconnaissance drone. It is possible to combine FPV drone strikes with artillery and mortar fire.



#### 4. "Escorting the attack of the assault group with FPV drones" (fire support for the actions of advancing units)

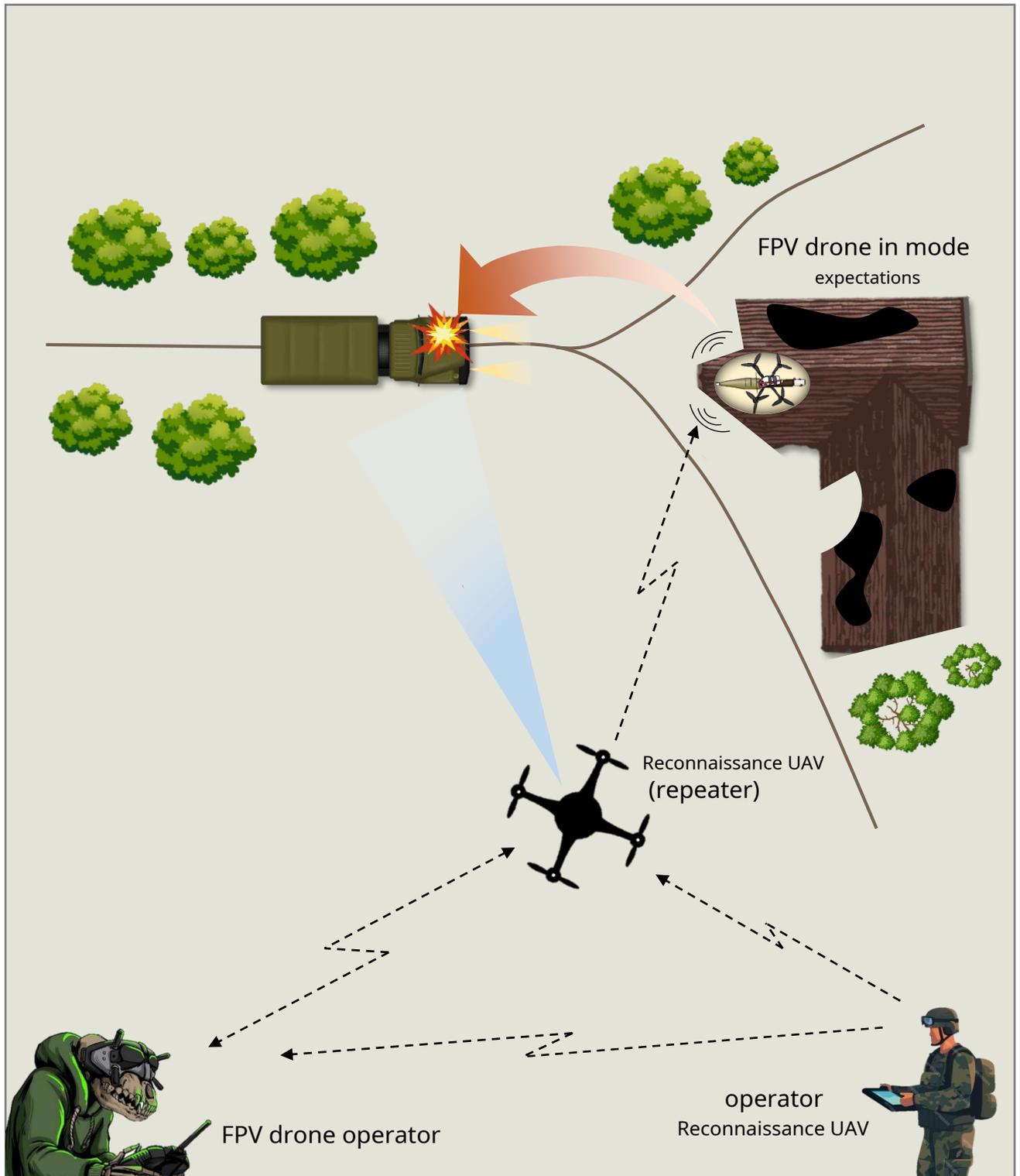
This method involves sequentially attacking positions with FPV drones during the advance and offensive actions of the assault group. Control and coordination of the actions of units and operators is carried out through a reconnaissance UAV. It is possible to combine FPV drone strikes with artillery and mortar fire.



### 5. "FPV drone in ambush"

(landing and waiting - observation - surprise attack on target)

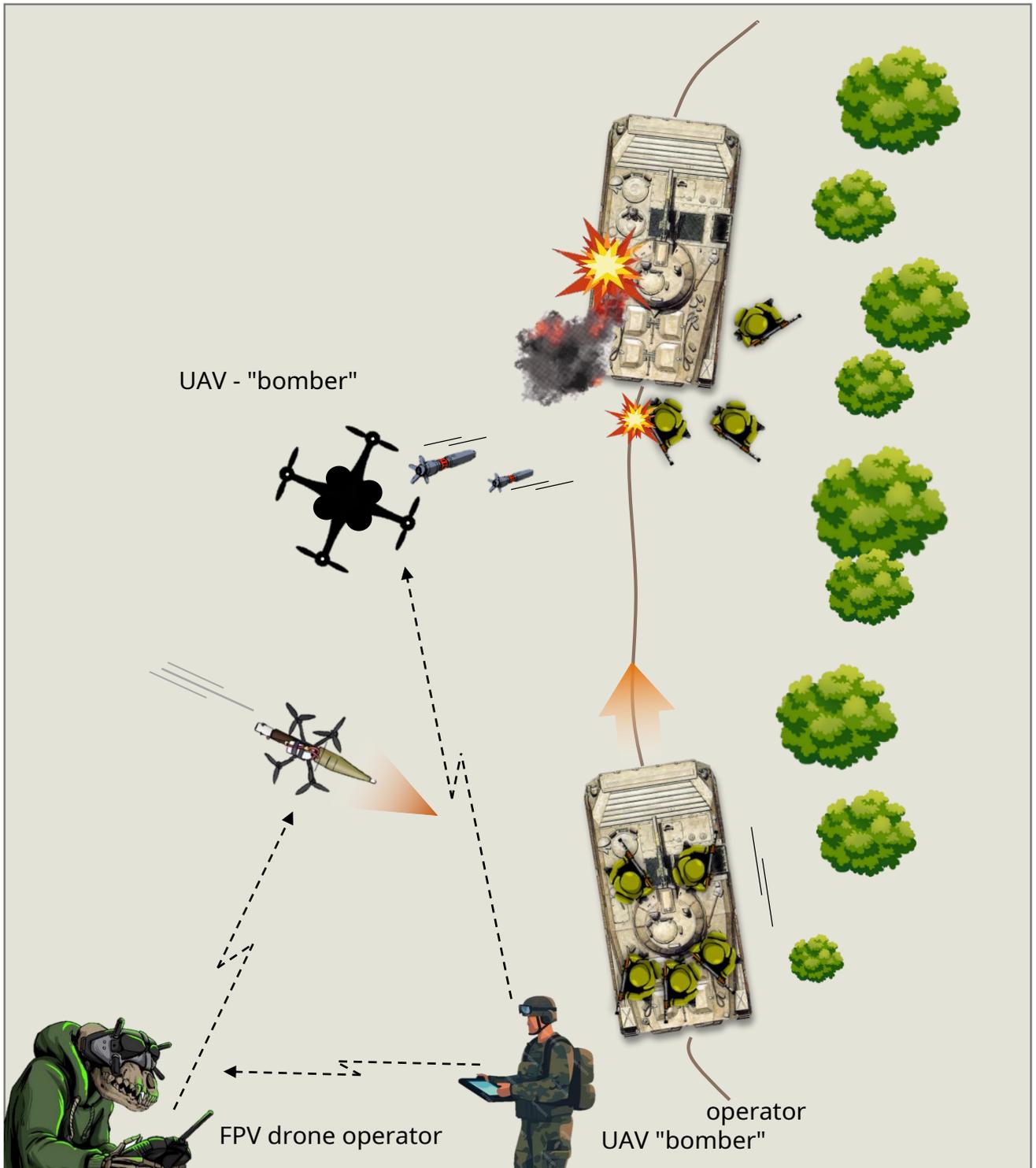
The tactical method is based on landing and taking a hidden position by the FPV drone near busy roads, intersections, places where equipment and personnel may be concentrated, followed by a sudden attack on the target. When working in tandem with a UAV repeater (reconnaissance): depth - more than 5 km, waiting time - up to 6 hours (only the control channel receiver is on). At night, attacks are possible using the headlights of moving vehicles, or using an FPV drone with a thermal imager.



## 6. "Combination Strike"

(FPV strike on target - dropping ammunition from a "bomber" drone)

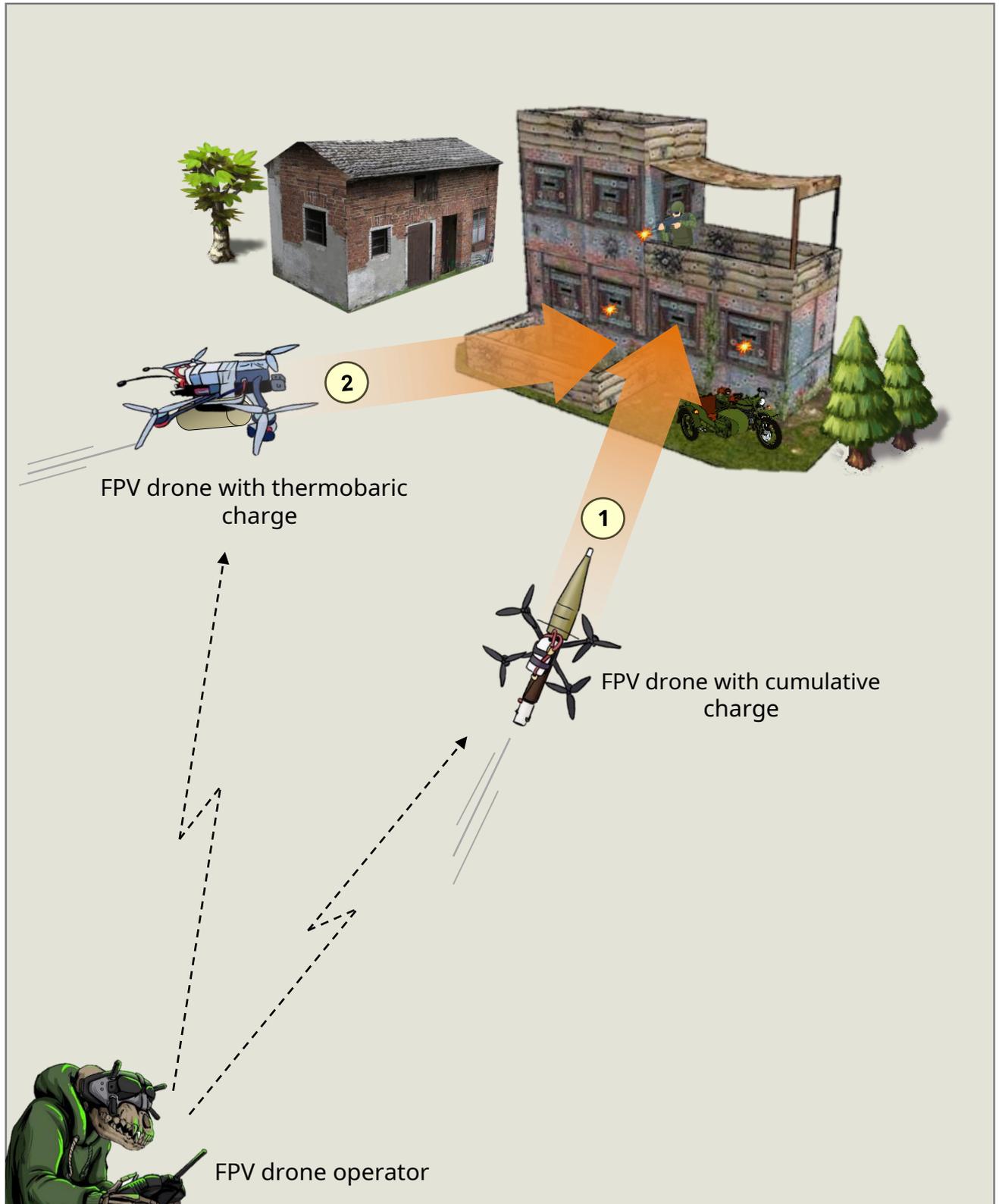
This method involves solving the joint task of FPV drones and a UAV "bomber" to inflict complex fire damage on identified targets. After the destruction (disabling) of armored vehicles (objects) by an FPV strike, the drone "bomber" drops ammunition on personnel during evacuation. Another option: inflicting fire damage on personnel (unarmored vehicles) by drops in order to immobilize them, followed by the use of FPV drones.



## 7. "Double Impact"

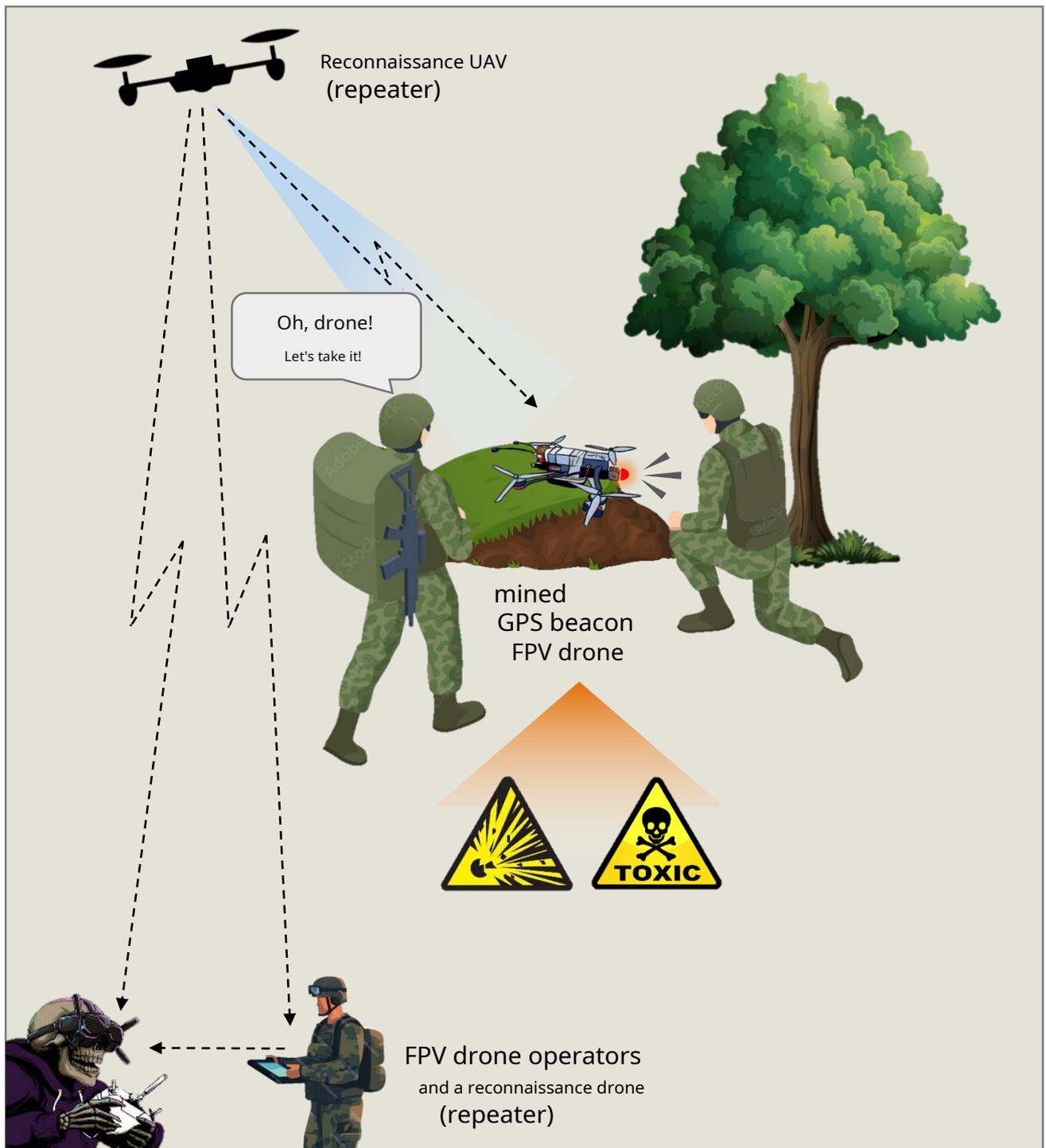
(use of two or more FPV drones with different charges to breach a shelter and destroy personnel)

In order to destroy manpower in protected shelters, several FPVs are used in sequence: the first with a cumulative charge - to penetrate the barrier, the second, as a rule, with a thermobaric action to inflict fire damage on personnel in internal premises.



## 8. "FPV trap" (variants)

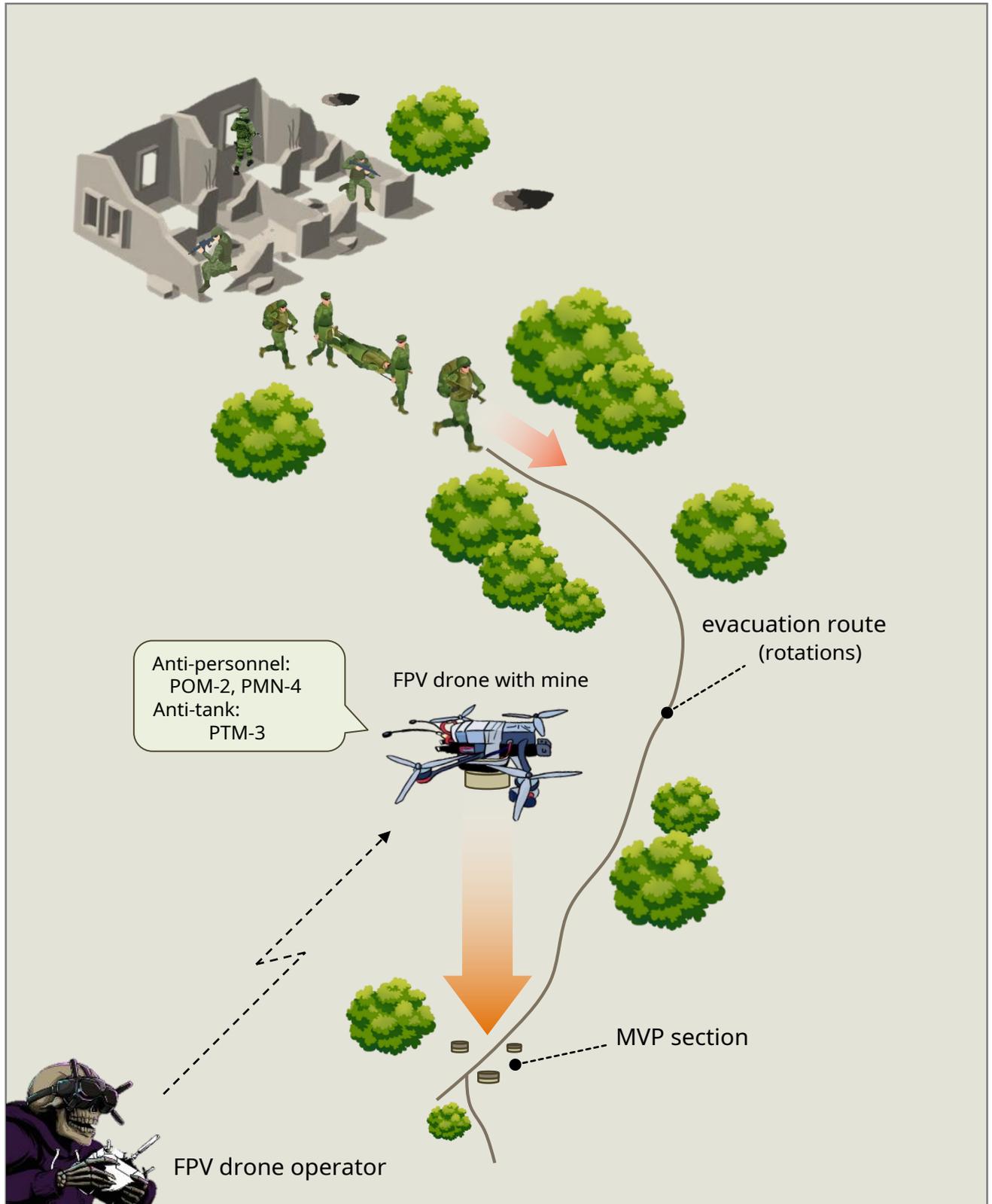
- landing of the drone and emitting a sound signal - when approaching (capturing) the FPV operator carries out a controlled detonation via the reconnaissance UAV (repeater);
- when its position changes (due to a "jonik" type device) – self-detonation (in addition, it is possible to install a magnetic target sensor on the metal);
- placing a 20-50 g charge into the drone structure, which is activated when it is dismantled;
- built-in GPS beacon, its tracking and "arrival" to the signal location;
- treatment of the FPV drone body with highly toxic blistering agents



## 9. "FPV-miner"

(delivery and installation of anti-personnel (anti-tank) mines, camouflaged IEDs on rotation and evacuation routes)

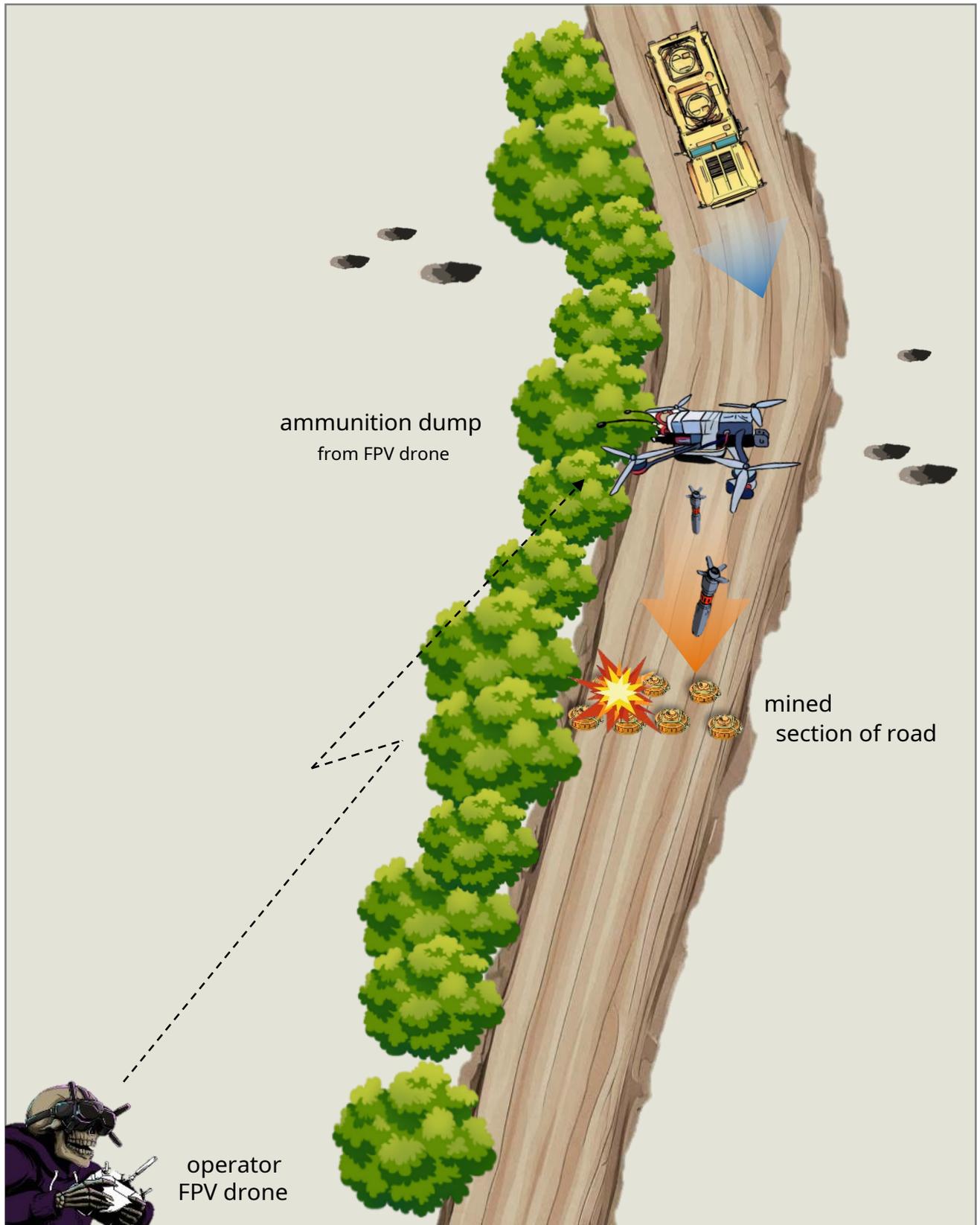
This tactical technique is used for covert installation of anti-personnel, anti-tank mines, as well as camouflaged IEDs by FPV drones on rotation routes, evacuation routes or near positions (objects) to destroy manpower and equipment.



## 10. "FPV-sapper"

(dropping ammunition or installing a charge on mines)

Demining of an area, usually roads and paths, is carried out by dropping ammunition from an FPV drone or by installing a surface charge on openly located and uncamouflaged mines.



## 11. "FPV reset"

(dropping ammunition on target)

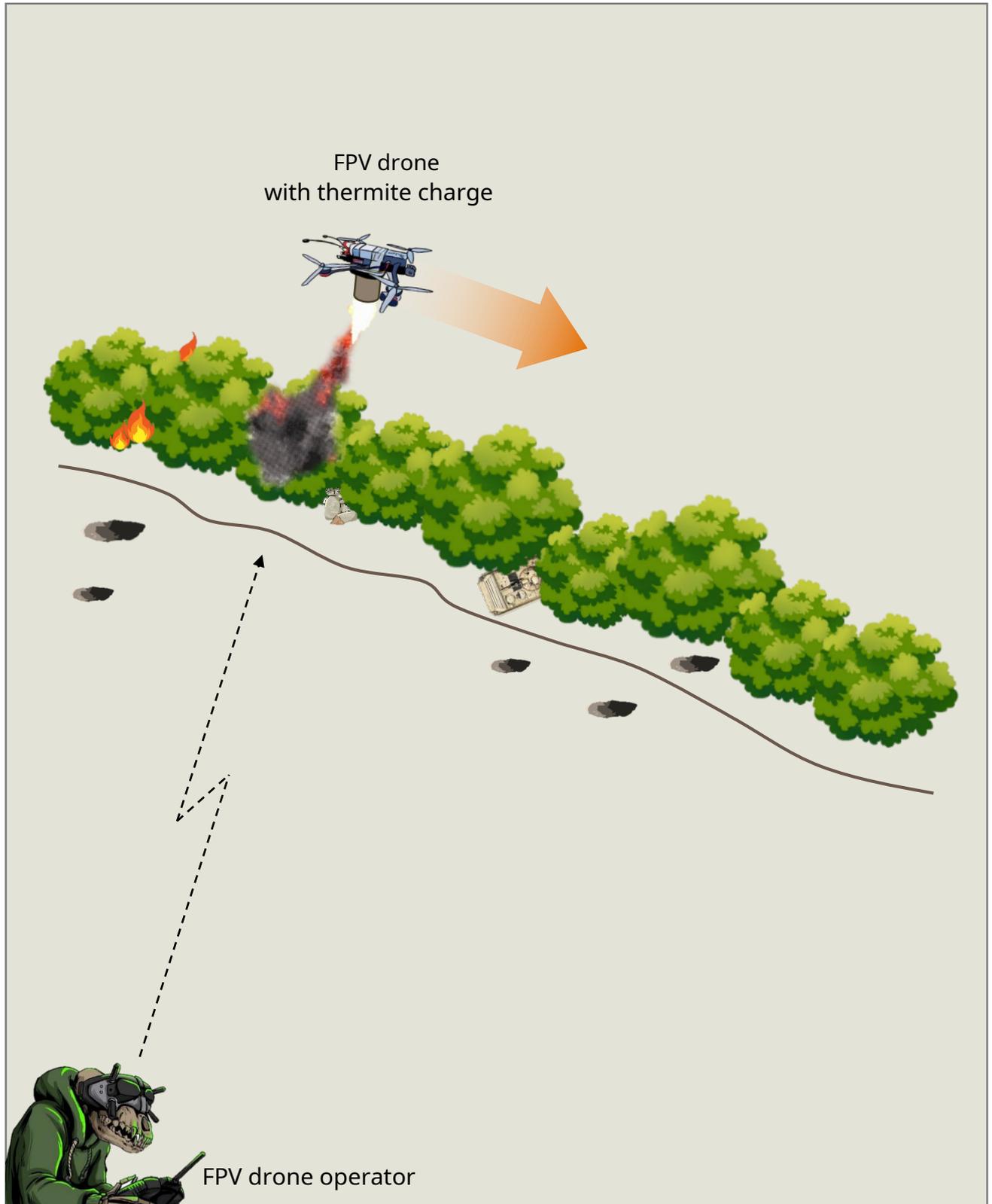
The tactical method involves dropping ammunition from an FPV drone to destroy personnel in open terrain or in a poorly protected shelter ("hole"). The reconnaissance UAV directs the FPV to the target. There have been cases of using ammunition with toxic substances. In addition, this method is often used to drop payloads to friendly troops.



## 12. "FPV-dragon"

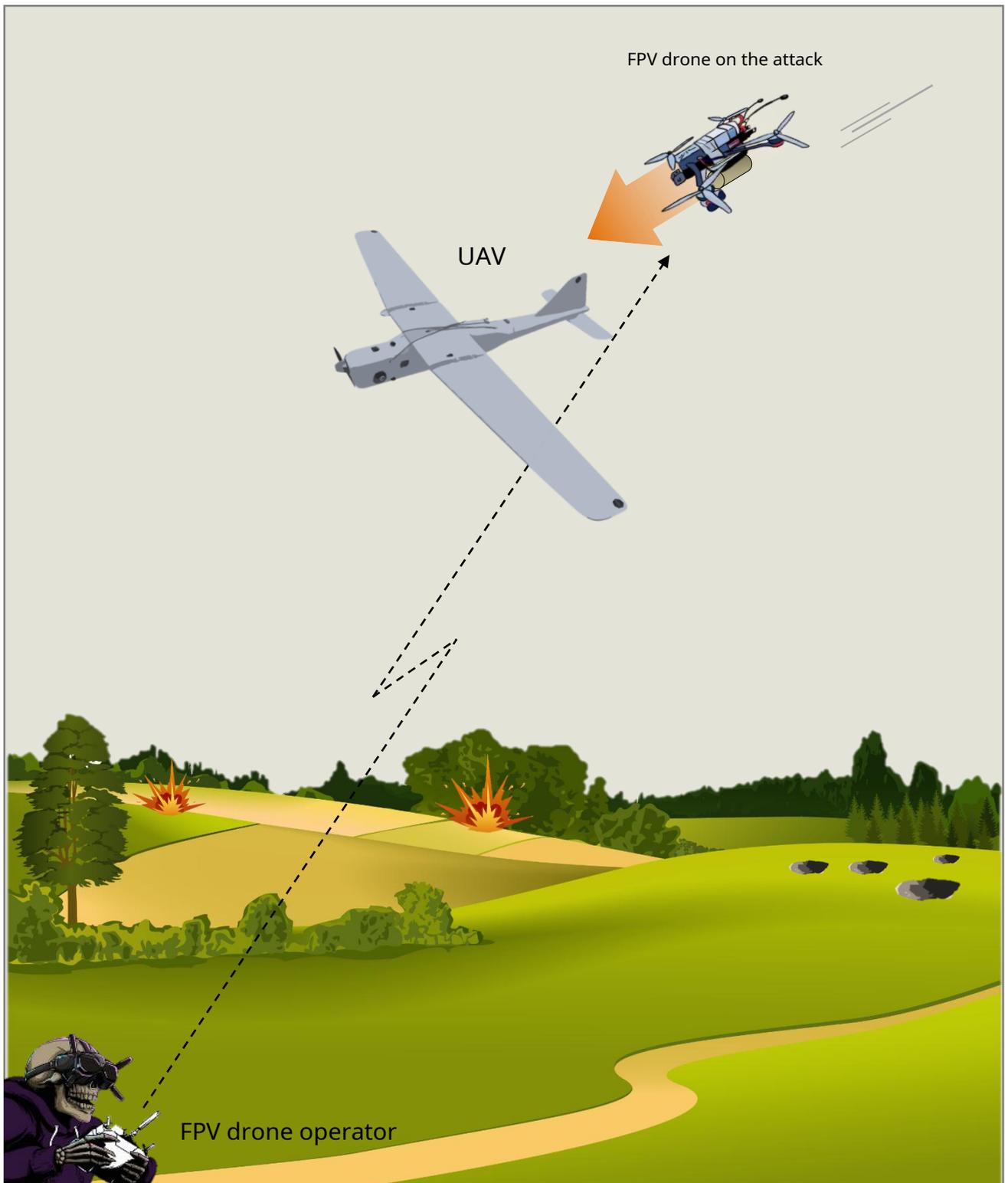
(spraying incendiary mixture over enemy positions)

For the purpose of setting fire to and incapacitating personnel, equipment, openly located ammunition and property, an FPV equipped with a thermite charge (based on a 120-mm artillery incendiary munition) is used. The average height of spraying the incendiary mixture is 20-50 m. Burning time is up to 2 minutes, temperature is over 2300 degrees C.



### 13. "FPV-PVO" (UAV destruction)

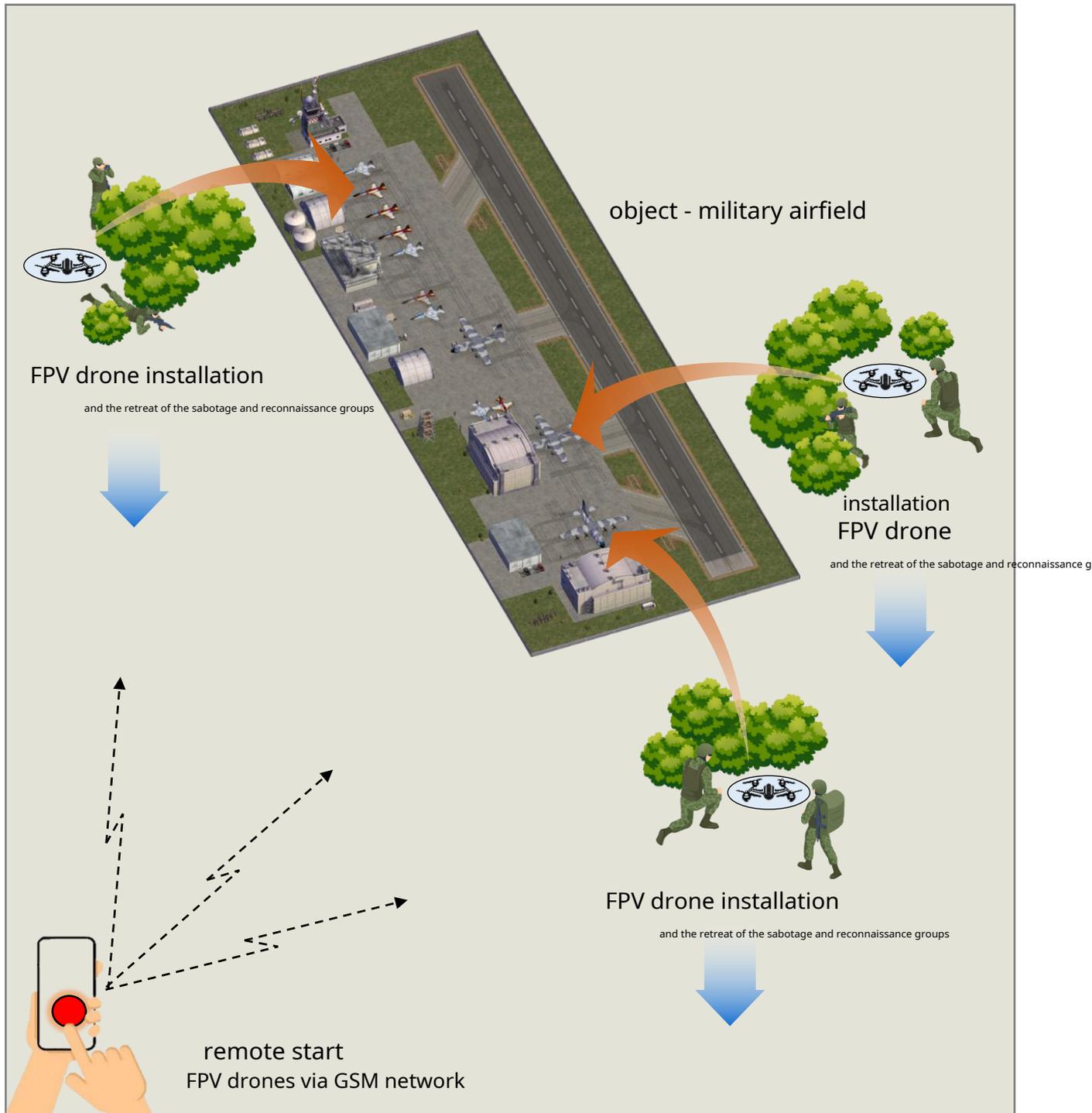
FPV drones are used to combat reconnaissance UAVs of the aircraft type and hexacopters. When UAVs are detected by radio-technical means (operating altitude – up to 3 km, speed – up to 110 km/h), FPV drones are launched to intercept and destroy them. UAVs are disabled by detonating a fragmentation charge when approaching or by ramming. Target designations are carried out by the radar operator.



## 14. "FPV-saboteur"

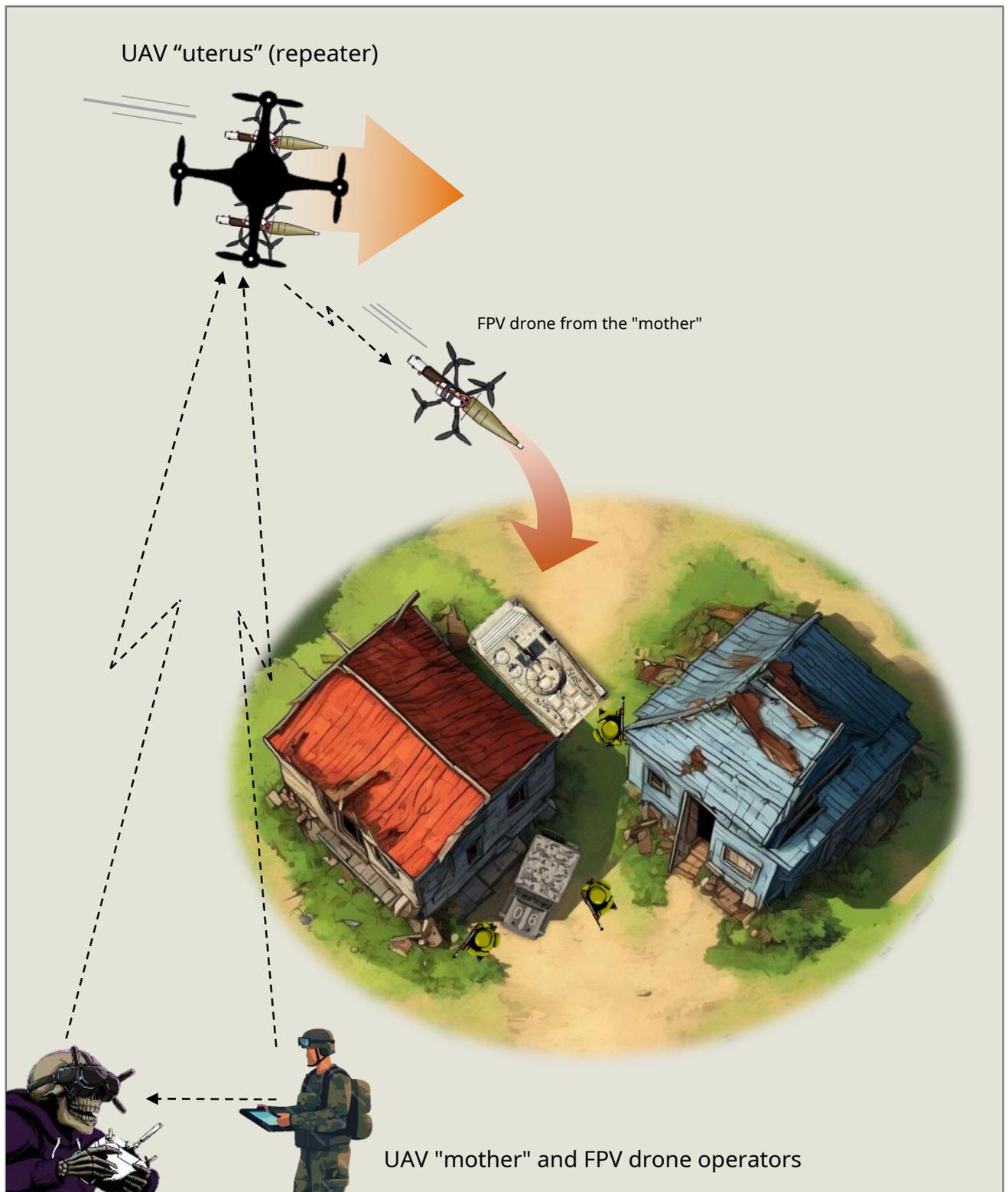
(hidden installation of FPV drone sabotage and reconnaissance missions at objects in the rear – remote (activating them according to pre-loaded coordinates)

This method of using FPV drones is used by sabotage and reconnaissance groups to destroy (disable) enemy military equipment and facilities. After the sabotage and reconnaissance group has covertly installed kamikaze drones (4-6 pcs.) near the facility at a distance of up to 2-3 km and switched to the "standby" mode, the UAVs are remotely activated by a GSM network signal to strike targets in accordance with pre-loaded coordinates.



### 15. "FPV-on the uterus" (increase in combat radius)

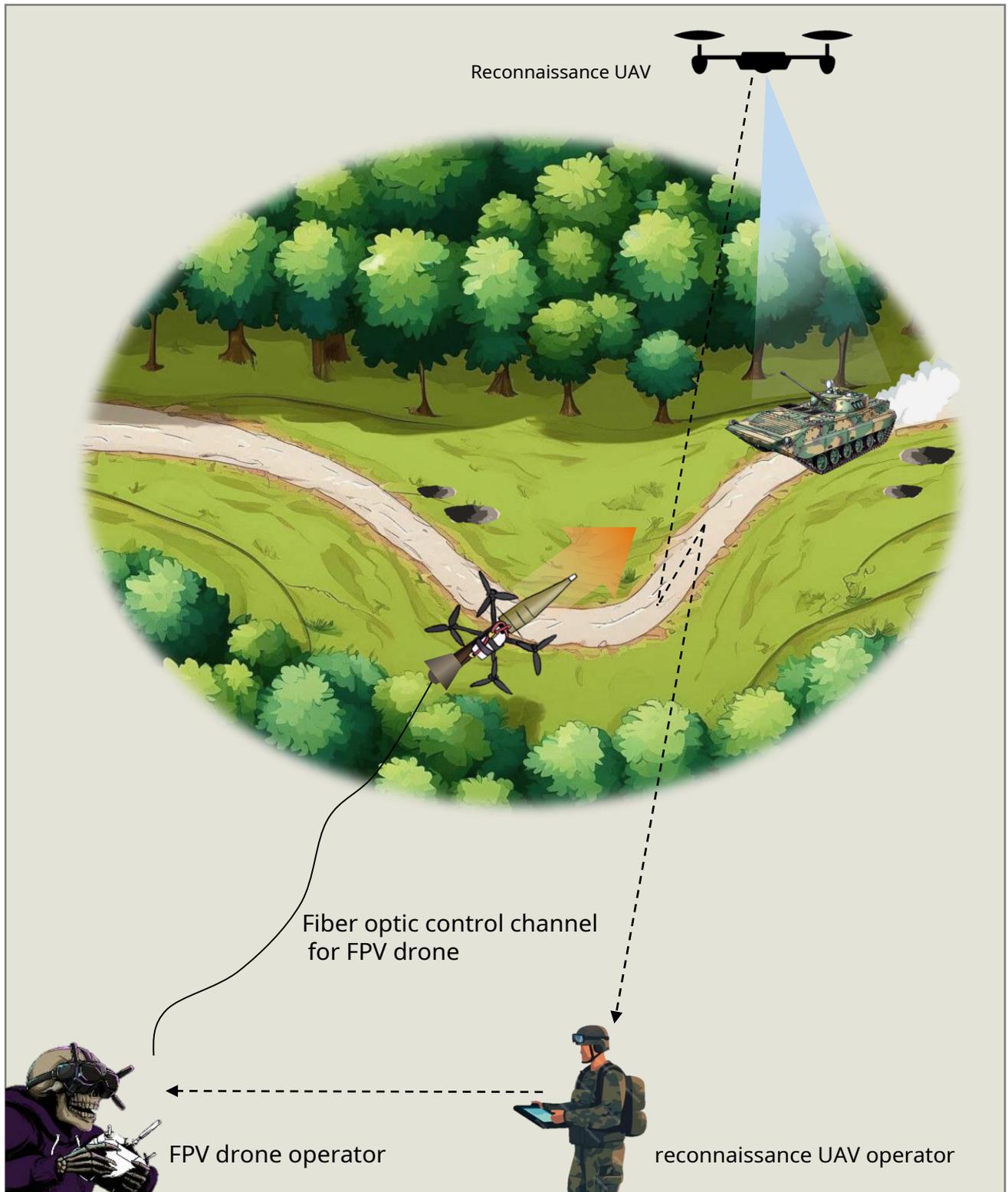
In order to increase the combat radius of FPV drones, UAVs are used - the "mother" of both the aircraft and "copter" type, which also act as a retransmitter. The carrying capacity is two or three FPV. At the same time, depending on the type of "mother" they can be "mothers" for FPV drones can be up to 60-70 km. In addition, unmanned boats (B



## 16. "FPV-on-wires"

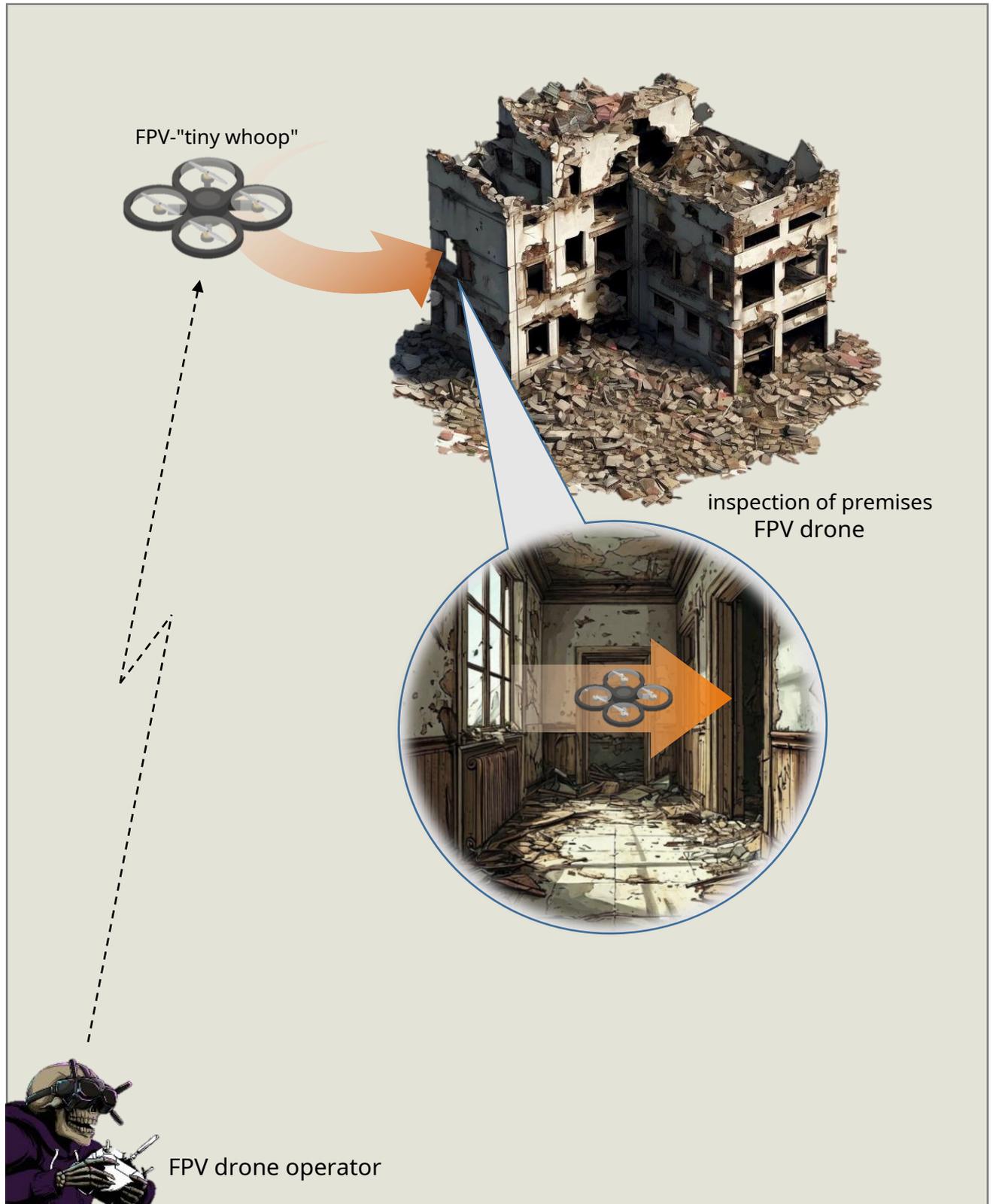
(ensuring stable control of the drone)

To ensure stable control of the FPV drone from the impact of electronic warfare systems and guaranteed target destruction at a range of up to 10 km (in some models up to 25 km), UAVs on a fiber-optic cable are being introduced. A characteristic feature of their use is the clarity of the video image to the final point of the route. Features of use - preventing abrupt maneuvers, avoiding fires along the route.



### 17. "Inspection of buildings" (control of premises inside buildings)

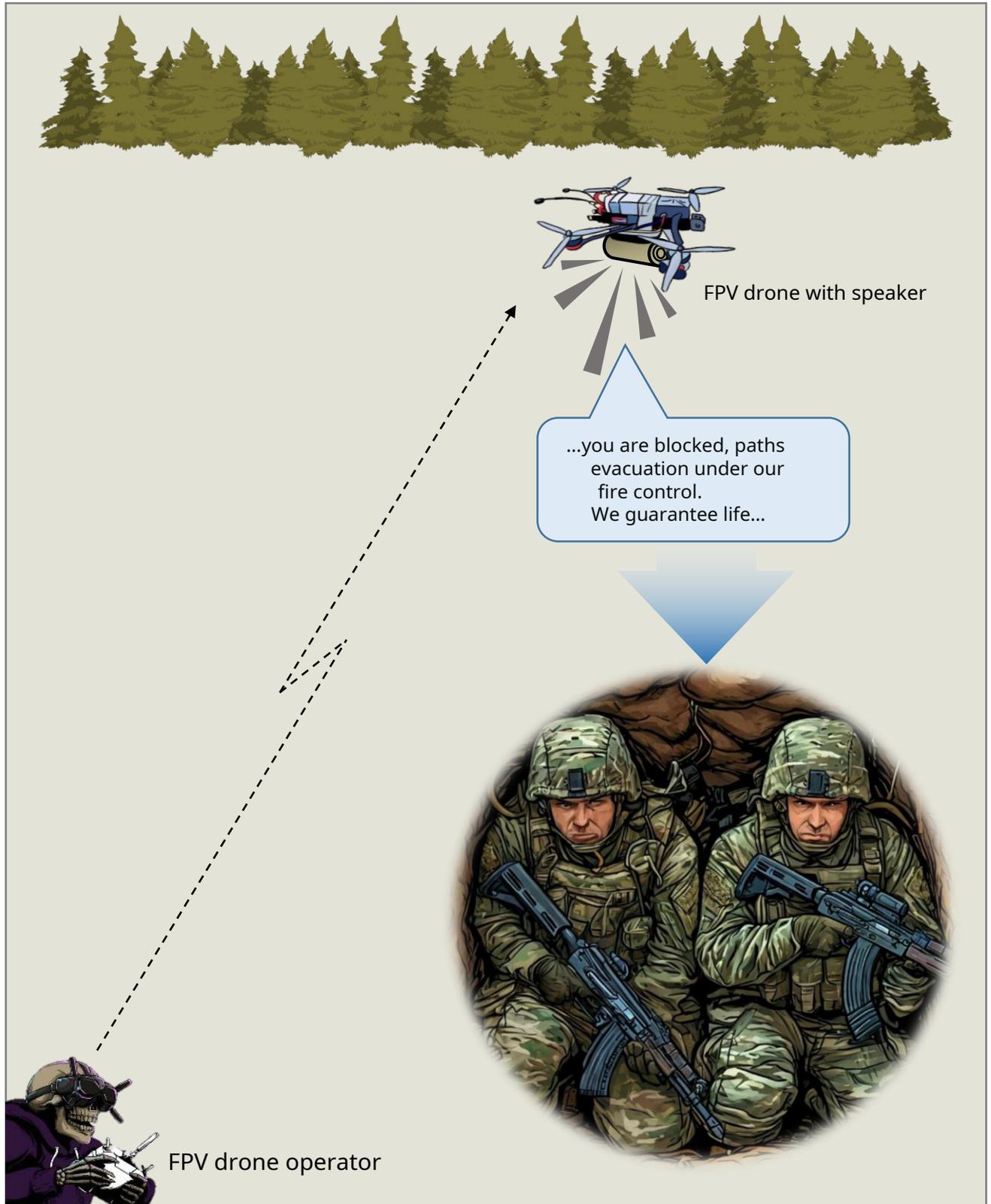
To detect the enemy and control the interior of buildings during assault operations, short-range FPV drones "tiny whoops" (microcopters with blade protection) are used. General performance characteristics: dimensions up to 100 mm in diameter, weight - up to 50 g, flight time - up to 4 min. Communication range (in buildings) - up to 500 m.



### 18. "FPV-swearing speaker"

(information and psychological impact on the enemy)

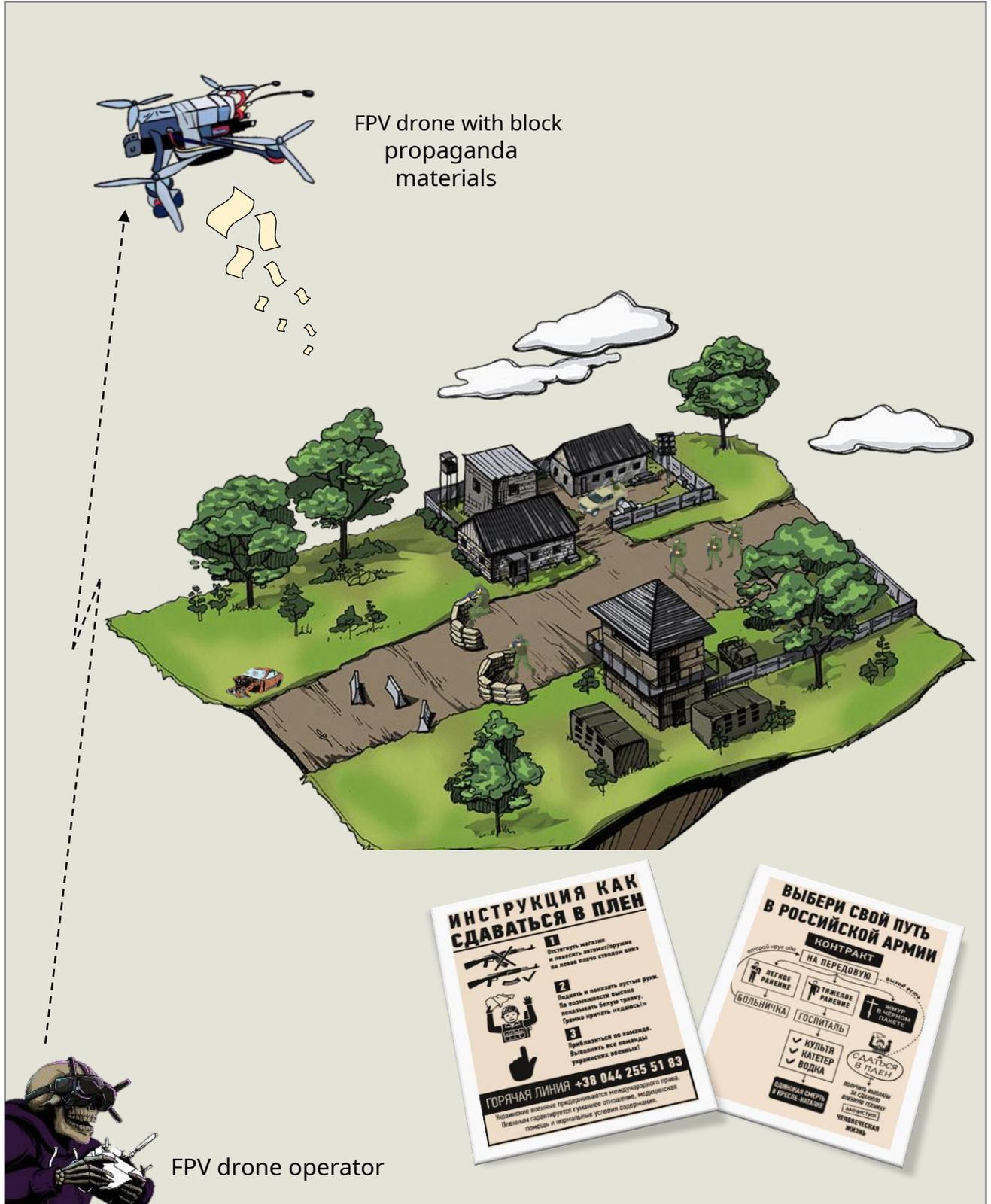
In order to reduce the morale of the personnel and force them to surrender, FPV drones with speakers for broadcasting audio messages are sent to the positions. Hovering height is up to 50 m.



## 19. "Scrolling"

(dropping leaflets from an FPV drone onto enemy positions)

As part of the information and psychological impact on personnel and the population, FPV drones are used by the enemy to drop leaflets. The weight of the printed materials dropped is up to 2 kg (about 200 leaflets).



## IV. Methods of countering FPV drones

The fight against FPV drones requires a comprehensive approach to protection against UAVs in the form of **active** and **passive** activities that must be implemented both within the unit and as individual elements by each service member.



### **TO active events include:**

**detection and destruction** calculations of kamikaze drone operators (probably launch sites, the presence of antennas, a specially prepared site for launching FPV, traces of dismantling ammunition, packaging and boxes, inconspicuous cars, repeaters on high-rise buildings and infrastructure elements);

**early detection of UAVs** (visually, audibly, detector signal or analysis) congestion) and **notification** (receiving a command or message from a senior officer, observation post, neighbors about the presence of a drone in the area of your operations);

**electronic countermeasures** by means of electronic warfare radio frequencies of control channels transmission of video signals and satellite navigation;

**reducing the time spent in the probable zone of destruction due to speed** vehicle (motorcycle type "induro" at a speed about 80 km/h covers 5 km in 4 minutes);

**fire impact**- destruction of drones by small arms fire, primarily from smoothbore guns (up to 50 m);

**mechanical action**- capture of drones by using them at close range distances (20-30 m) of special devices - "net throwers";

**maneuver**- actions of personnel to avoid being hit by a drone (dispersal, taking cover, active movement in open areas when there is a threat of defeat);

**provision of logistics** ammunition, water, food subdivisions on the LBS through the use of "heavy copters" and ground robotic systems for delivering cargo and evacuating the wounded.

As a promising method of countering UAVs, developments are underway **optical impact** on the drone's camera by using a laser device with a wide light beam.

**Passive activities:**

**additional fortification equipment of positions**(Preparation anti-drone niches and "holes", bends at the entrance to dugouts and shelters, installation of hanging protective nets and barriers);

**camouflage of positions and equipment**(installation of camouflage nets with incorrect geometric shape with a distance to the equipment of 0.3-0.5 m in the shade of trees and bushes, inside destroyed buildings, the use of heat-protective capes, monitoring of unmasking signs from a drone);

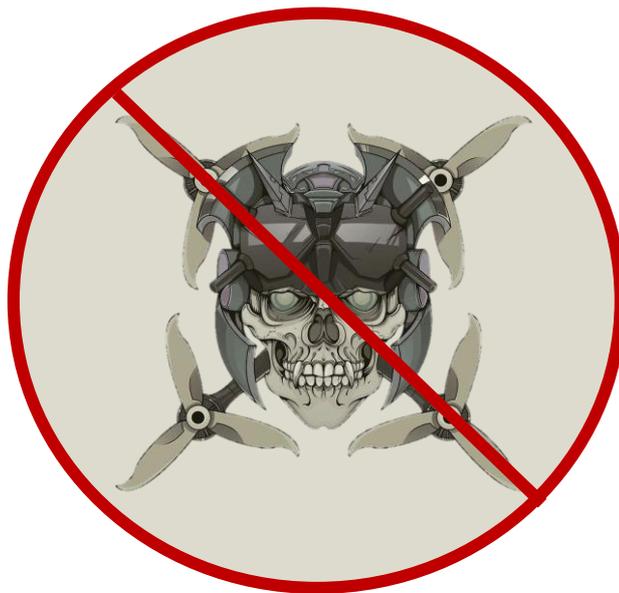
**creation of false positions**(equipped with heat and light sources) **with the installation of models of military equipment and transport**(including unsuitable ones) to exploitation) and imitation of their activities;

**protective net equipment**(screens) from fishing nets on routes rotation, evacuation of personnel, delivery of ammunition, water and food;

**installation of hanging protective elements**(canopies, awnings)and **"dome" electronic warfare systems on equipment;**

**taking into account weather conditions, terrain features and time of day** at planning active actions and movements;

**setting up aerosol curtains, creating smoke sources in positions** (objects)and **routes of movement**(including false ones).



## **General recommendations for personnel to counteract FPV drones (based on SVO experience)**

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The number of UAVs at the front is growing exponentially. Drone duty in the air has led to decentralization and a reduction in troops at the front. Where there used to be a platoon, now they make do with a squad. Where there used to be a "support", there are now three "holes" of 2 people. Both sides are trying to minimize movements on the LBS. One "armor" can attract up to a dozen "birds", and 2-3 drones participate in the race for a soldier. In the LBS area, reconnaissance drones, "bombers" and FPV crews take turns in their sectors to conduct surveillance in readiness for work. Some search, others strike.

### **Disguise.**

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**1.** Camouflage yourself from aerial surveillance by using canopies, fabric nets, branches, grass, foliage. The following things reveal positions: polyethylene film, white bags, household garbage, fresh earth, movements of fighters.

**2.** You are less visible from the air if you: are not moving; are in the shadows buildings (objects); you sit, not lie down (reduce your dimensions); you match the color of your uniform with the terrain, that is, you don't fuss and don't "show off."

**3.** It is better to move and hide in the shadow of trees and slopes. Do not make sudden movements. movements and do not run - it is noticeable. Relatively safe time and weather - twilight, night, fog, rain. Protective capes from "hothouses" - in the subject.

**4.** Place and camouflage equipment in forest belts, along (inside) buildings and hangars, change its location, equip the simplest camouflaged canopies. Pay special attention to covering car windows - they glare. If the enemy is in the north, put the equipment behind the building on the south side.

**5.** Do not place transport near the positions, put it in a hidden place quick "move". Collect all the garbage in bags and a separate pit. Scattered packages of rations, cans, plastic bottles, polyethylene perfectly unmask the position. To control the camouflage "quietly" launch your drone and inspect the area to identify unmasking signs.

**6.** Camouflage nets are always needed in large quantities. When installed change their configuration when you are doing this, the more unclear and blurry the silhouette, the more difficult it is to detect the object. Satellite dishes heat up, they should be hidden in a hole and camouflaged from both daytime and thermal imaging cameras.

**7.** Create false positions with telltale signs. Establish Use models of military equipment or disabled transport. Simulate their activity. Make a fire at night in empty shelters, place "trench" candles.

**8.**At night, keep the lights on. Light from a cigarette, a campfire, light flashlights, headlights, phone screens – attracts drones like moths to a flame.

**9.**Conversations "about life" only in shelter. No need to "huddle" with cigarettes-kami, if you get bored. Don't wander around your positions without doing anything. If you're called on command, warn another soldier. The main criterion for detecting you by the enemy from the air is movement during the day and heat reflections at night. Keep quiet, try to communicate in whispers and gestures, listen to sounds.

### **Fortification and transport.**

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**10.**When equipping a trench, make a side niche at the bottom - it will protect against shrapnel during shelling, FPV strikes and ammunition drops. Exits from dugouts are in the shape of the letter "G". Hang a protective blanket at the entrance to the shelter. Equip a second entrance to the dugout (the first may be blocked by a hit).

**11.**As obstacles forPrepare FPV drones before positions and secure cord anti-drone curtains made of 4-5 mm thick ropes: length – 6 m, height – up to 4 m, interval between hanging ropes – 20 cm.

**12.**Another option for protection is to install screens made from cheap fishing rods. nets (length – up to 80, height – 4 m, cost up to 1000 rubles) – they are invisible to the operator, equip additional awnings and canopies. No ingenuity – no shelter!

**13.**It is advisable to be in position (at a distance)20-30 m) prepared in advance prepare and install smoke grenades to be used in the event of a threat of kamikaze drone strikes. Each has instant-action hand-held smoke grenades.

**14.**The presence of additional protective elements on equipment ("visors", "grills", shields, nets, chains, anti-fragmentation protection in the form of 1 cm thick rubber pieces on "self-tapping screws") will increase the survivability of the crew and passengers when attacked by drones. The main thing is not to overdo it.

**15.**The desired ideal option for electronic warfare equipment at a platoon position: spectrum analyzer and UAV detector, device for intercepting video images from FPV drones, portable broadband "dome" electronic countermeasure system, individual mobile "suppressors". On the equipment - a mobile version of the "dome system. Bold, but it doesn't hurt to dream.

**16.**Get a proven drone jammer on equipment is military happiness. Do not cover it with a camouflage net. Monitor the battery charge of the miracle device. It is sad when you thoughtlessly "shut off" the machine during a task and unknowingly remain without a "dome". Wait for evil spirits...

**17.**In order to combat the "hunters" of aircraft-type UAVs, It is necessary to install onboard electronic warfare systems.

**18.**How else can you influence the video transmission channel? flying enemy FPV drone? To detect it, you can use an FPV monitor or glasses, with which you search for a transmission channel (usually 5.8 GHz). On the video transmitter of your drone, the same channel and maximum power are set. After launch, interference is created in the control channel of the video transmission (the drones "work" on the same frequency).

**19.**Mechanical robotic platforms and "heavy" drones for providing logistics of ammunition, water, food and evacuation of the wounded significantly reduce personnel losses from FPV drones. We are waiting with impatience.

### **Actions when a drone is detected.**

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**20.**Always listen to sounds, feel the "sky". Primary detection by sound (you can hear better at night), then visually. Spread your ears like Cheburashka and keep your eyes peeled. Notify in a timely manner. Treat all UAVs as hostile.

**21.**Learn to distinguish Maywick from FPV. The first one works quieter and smoother. no, the second one is more piercing and has sharp changes during acceleration.

**22.**In order to increase safety, the movement should be carried out (at the right time and place) based on the analysis of enemy drone activity in a specific combat zone (the enemy knows about the "gray" time).

**23.**Try to avoid the "postcard", move along the plantings, in populated areas point - from building to building. The interval in the "troika" is at least 5 m. It is advisable to move covertly along the "troikas" to the checkpoint (shelter).

**24.**The reconnaissance drone is a harbinger FPV. If you are on the move (including on vehicle) detects an enemy UAV – do not lead it to yours. Take cover, wait, observe and do not reveal the positions of your unit. In a landing – lean against a tree trunk and do not move.

**25.**Always control the "sky" in sectors during movement. Keep your distance and notice the nearest shelters (destroyed buildings, "holes", plantings, bushes, etc.) for a "dash" when there is a threat of being hit by a drone. A shell crater, as a "safe place" - will act as a grave. Do not gather "in a bunch" in one place. Dispersion, maneuver and speed.

**26.**I heard FPV – take cover immediately. If you are on a "postcard" – do it sudden sharp movements. Leave the operator's observation sector, (fall) to the side when attacking. The masters of the "shuttle" run have a better chance. It is advisable to practice.

**27.**If the drone is in close proximity (20-30 m) - not worth trying "freeze" in the hope that he won't notice and will fly past. Move the tomatoes! Salvation is in reaction and movement.

**28.**Firing from small arms is ineffective (small target size, high speed). In addition, when shooting, you are static, which makes it easier for the operator to aim the drone. At close range (up to 50 m), there is a chance for a shooter (better two) with hunting or pump-action shotguns. To prepare them, practice on "skeet".

**29.**There have been cases of the operator playing with the "victim". If you are quick and skillful dodge, hide behind cover (a 40 cm tree trunk is also an option), and can also attack the drone by throwing a "club" or other objects - the chances of survival increase. Almost fixed.

**30.**When driving a vehicle, pay special attention to monitoring the "sky" from the outside. rear and flanks (up to 80% of FPV drone attacks are on the rear and sides of the vehicle).

**31.**In dangerous areas, move at the maximum safe speed. Do not choose long routes. If you detect a kamikaze drone, it is advisable to move to the side (preferably to a forest plantation, to buildings), stop and quickly disperse. The chances of escaping from FPV along the route are negligible.

**32.**When the car stops, everyone leaves the vehicle very quickly, no one "huddles" and argues over who will unload the ammunition. Otherwise, the priority of the target increases. Time is against you.

**33.**To improve survivability and ensure cargo logistics in the LBS area The availability of high-speed motorcycles such as "induro", "buggy", quad bikes with trained drivers contributes. At the same time, electric models ensure noiseless movement and higher sensitivity of drivers and passengers to early detection of drones by sound.

**34.**Extreme driving requires serious training of drivers. Training be able to identify and remember landmarks during the day and then find them at night.

**35.**When detected FPV drone on the ground (especially if it "beeps" near the positions) do not run to it joyfully with your fingers spread in the hope of a new trophy. It may be a "trap". Do not approach from the camera side (the cameraman is waiting for you to appear in the frame), do not touch, mark with a marker, report to the commander. The specialist will figure it out.

## V. Conclusion

Thus, the technical leap in the application and adaptation of FPV drones to the modern theatre of military operations has led to a significant expansion of the range of combat missions they perform.

The demand of combat units for trained and equipped kamikaze drone crews exceeds the supply on the war market. Innovative development of this type of weapon will undoubtedly entail the search for and implementation of new technical solutions and methods of counteraction (electronic, optical, mechanical, etc.), and will also lead to the creation of separate structural units (crews), both for their use and for combating them. At the same time, in the near future, individual elements of counteraction will affect each serviceman of combat units. Competitions in the category of confrontation "drone - anti-drone" are just beginning ...



**No effort, no catch  
and the enemy drone!**

