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**ALGORITHMS FOR USING FIREFIGHTING AIRCRAFT TO EXTINGUISH FOREST FIRES**

Forest fires are one of the most dangerous and destructive disasters worldwide, causing significant ecological and economic damage. One of the most effective ways of combating forest fires is by using firefighting aircraft. This scientific thesis aims to review and analyze the different types of algorithms used in firefighting by aircraft, including their application on different terrains, and the prospects of using these algorithms in Ukraine.

There are different types of algorithms used in firefighting by aircraft, including fixed-wing aircraft, rotary-wing aircraft, and unmanned aerial vehicles (UAVs). Fixed-wing aircraft are typically used for initial attacks on large forest fires, while rotary-wing aircraft and UAVs are ideal for small and localized fires. [1] One of the most common types of algorithms used in firefighting by aircraft is the drop pattern algorithm, which involves releasing water or fire retardant on a specific pattern to maximize the effectiveness of the firefighting operation. The coverage level algorithm is another commonly used algorithm, which determines the amount of water or fire retardant needed to cover a specific area. The discharge pattern algorithm is used to determine the most effective way to distribute water or extinguishing agent from a firefighting aircraft over a specific area to suppress the fire. This algorithm takes into account the aircraft's speed, altitude, and other factors to determine the optimal drop pattern. [2]

The following equations describe the discharge pattern algorithm [3,4]:

* Discharge rate (Q): the volume of water or extinguishing agent discharged per unit time
* Coverage area (A): the area to be covered by the water or extinguishing agent
* Ground speed (v): the speed of the aircraft relative to the ground
* Altitude (h): the height of the aircraft above the ground
* Nozzle spacing (L): the distance between nozzles on the aircraft
* Swath width (W): the width of the area covered by each drop
* Drop spacing (D): the distance between drops

The table below summarizes the equations used in the discharge pattern algorithm:

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| --- | --- |
| **Equation** | **Description** |
| Q = f(P) | The discharge rate is a function of pressure |
| A = L × D | The coverage area is equal to the nozzle spacing times the drop spacing |
| W = v × h × tan(α) | The swath width is equal to the ground speed times the height above ground times the tangent of the angle of the nozzle |
| D = W × sin(β) | The drop spacing is equal to the swath width times the sine of the angle between the flight path and the drop pattern |
| L = K × h | The nozzle spacing is a function of the aircraft altitude |
| K = f(P,θ) | The nozzle spacing is a function of pressure and the angle of the nozzle |
| β = f(v,h) | The angle between the flight path and the drop pattern is a function of ground speed and altitude |

These equations allow for the determination of the optimal drop pattern based on the specific conditions of the fire and the aircraft being used for firefighting. The discharge pattern algorithm is a crucial tool in maximizing the effectiveness of firefighting operations and minimizing damage caused by wildfires. Different terrains require different types of algorithms for firefighting by aircraft. For example, mountainous terrain requires a different approach than flat terrain. In mountainous terrain, helicopters and UAVs are preferred due to their ability to maneuver easily and reach hard-to-reach areas. On the other hand, fixed-wing aircraft are ideal for flat terrains since they cover a larger area. [5]

The use of algorithms in firefighting by aircraft is gaining momentum globally. In Ukraine, the forestry industry is vital to the economy, and forest fires can have a significant impact on the country's economy and environment. Therefore, there is a need to adopt and implement firefighting algorithms to combat forest fires effectively. The use of UAVs in firefighting operations is still relatively new in Ukraine, but it presents a significant opportunity for the country to improve its firefighting capabilities. UAVs can reach remote and inaccessible areas, providing real-time data and situational awareness, which can help in decision-making and optimizing firefighting efforts. In conclusion, algorithms are critical in firefighting by aircraft, and their application is dependent on the type of aircraft, terrain, and the specific firefighting operation. The use of UAVs presents a significant opportunity for improving firefighting capabilities in Ukraine, and there is a need for the country to adopt and implement these technologies to combat forest fires effectively.

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