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Drones for Tree Trimming (FPL)

EMI Shielding for Drones

Introduction

As currents move through a high voltage transmission line, a magnetic field is created around the cable. The strength of the field increases with proximity to the cable and can interfere with or destroy electronic devices. Additionally, signals from other electronic devices and buildings can interfere with radio transmissions. Therefore, drones operated in such environments must be properly equipped so that their functionality is not compromised by this electromagnetic interference. This technical review summarizes some methods and commercially available products for protecting drones from these sources of interference.

External Shielding

Electromagnetic interference from nearby network towers, Wi-Fi routers, or microwave antennas can be mitigated through external shielding. This form of protection involves surrounding the entire main body of the drone with a conductive material, effectively creating a Faraday cage. As external magnetic forces are applied from waves in the drone's environment, the electric charges within the cage's material will redistribute to cancel out the external magnetic effects [8].

Currently, the most common "Faraday cage" method of external shielding for drones is building the frame itself with carbon fiber and enclosing the internal circuitry. With their high conductivity, certain carbon fiber composites can provide a shielding effect of up to 55 dB for waves in the 1-18 GHz range [2]. While this method can reliably shield the drone's circuitry and antenna, it may reduce the strength of the signal between the drone's radio transmitters and as a result, its operating range. This can be addressed by increasing the sensitivity of the drone's antenna and using an amplifier to increase the strength of the transmission signal, or by moving the antenna to the exterior of the drone.

Alternative faraday cage methods also include painting the drone with a conductive coating or covering it with conductive tape. Both conductive tape and coating are sold to meet various shielding specifications, allowing users to choose and apply the shield appropriate for the environment they will

operate their drones in. For example, conductive tape can be used to shield a broader range of signals (down to 10 MHz) than the carbon fiber frame with the same effectiveness of around 60 dB [7]. However, while these externally applied methods offer a greater range of shielding customization, they are more prone to damage from obstacles or weather during flight. The shield loses effectiveness once coating is scratched or tape adhesive loses strength, and if damaged, the entire shield must be reapplied [1]. The additional weight added by tape (18 g/ft^2 [7]) or coating (0.003 g/ft^2 [1]) is not a significant disadvantage when compared to a carbon fiber frame without any externally applied shield.

Internal Shielding

In addition to external shielding, the drone can also be protected inside the frame. This is typically achieved by covering the circuit boards with similar conductive shielding material, with SnapShot EMI shields produced by XGR Technologies being one example. Once the drone's circuit boards are designed, these shields can be thermoformed to fit the boards. This method offers a greater flexibility in the drone's internal layout since the shield can be conformed to any board layout without taking up additional space [5]. Due to stress created by drone vibrations though, the soldered joints used to attach internal shields can eventually wear out. This can create gaps in the Faraday cage and decrease shield reliability over time [5].

EMI Resistant Positioning Systems

Drones used in engineering applications often require highly precise location systems to carry out their tasks. As a result, these drones often use Global Navigation Satellite Systems (GNSS) to provide real-time position information while in flight. Real-Time Kinematic drones carry an onboard GNSS receiver that gathers data from both satellites and a base station on the ground, which allows it to correct any error in satellite signals caused by electromagnetic interference or atmospheric delays. The D-RTK 2 Mobile Station is a base station sold by DJI that can function in the presence of strong magnetic fields, working with GPS data to help drones achieve positioning accuracy within 1 centimeter [4]. This information can then be used in conjunction with camera sensors to position the drone for high precision tasks.

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