Design and Real-Time Implementation of an Embedded Anti-Jamming UAV Communication Architecture Using Adaptive Frequency Hopping, Intelligent Channel Switching, and Hybrid Optical Fiber Backup Control System

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Unmanned Aerial Vehicles (UAVs) are widely used today in photography, surveying, inspection, and recreational activities, where maintaining a stable wireless connection is essential for safe and reliable operation. However, UAV communication systems are highly vulnerable to radio-frequency interference, especially in crowded wireless environments. Even brief signal disruptions can cause loss of control or mission failure. In this project, I designed and implemented a jam-resilient embedded communication system specifically for small UAV platforms. The system uses adaptive frequency hopping to automatically switch transmission channels when interference is detected, helping maintain a stable and reliable link. To evaluate the system's performance, I conducted experimental testing and compared three scenarios: conventional fixed-frequency communication, frequency hopping operation, and a fiber-optic control setup used as a reference model. The experimental results showed a clear reduction in packet loss and improved communication stability when frequency hopping was applied under interference conditions. These findings demonstrate that implementing interference-resilient embedded communication strategies can significantly enhance UAV reliability and operational safety.

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