Adapting 5G Telecom Service without Interfering with Aircraft Radio Altimeters - Feasible Solutions and Outlooks

Mr LEUNG Cheuk Yan, BEng (Hons) in Aircraft Engineering, Faculty of Science and Technology
Supervisor: Ir Mr YAU Kam Tong Anthony, Lecturer

Research Background

In December 2021, the rollout of the fifth-generation wireless telecommunications networks (5G) C band, with a ground base frequency of 3.7–3.98 GHz, in the United States created new flight safety risks.

This new ground base 5G C band frequency creates adjacent radio interference to existing aircraft radio altimeters at 4.2-4.4 GHz frequency during critical flight phases with a 200MHz frequency separation.

When interference happens, flight safety is at risk. Hence, feasible solutions are needed to maintain a balance between ground base 5G C band frequencies and aircraft onboard radio altimeters.

Objectives

In this research, four possible solutions are proposed to reduce adjacent radio interference :

1. Replacing existing aircraft radio altimeters with LiDAR (Light Detection And Ranging) technology
2. Adopting advanced radio filters on aircraft radio altimeters for better protection
3. Relocating the ground base station 5G C band frequency of 3.7-3.98 GHz to higher frequencies
4. Proposing a new aircraft radio altimeter adopting the concept of radio spectrum sharing technology named cognitive radio

Methodology

To determine feasible solutions for this project, performance evaluations are conducted as follows:

1. Conduct reliability tests on LiDAR technology
2. Conduct computer simulations on radio filters
3. Conduct stakeholders' analysis
4. Construct a radio altimeter schematic prototype based on the current radio spectrum-sharing technology
5. Establish a weighting system for solution evaluations

Weighting System for Solution Evaluations

The system's criteria and weightings are as follows:

1. Safety and regulations (50%)
2. Hardware support and modifications (15%)
3. Cost-effectiveness (15%)
4. Time required (10%)
5. 5G users' experience (10%)

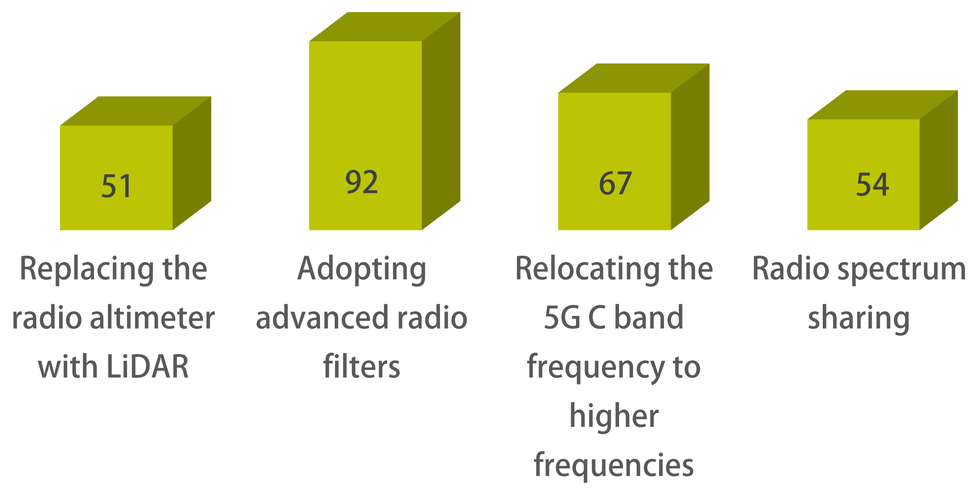
Project Findings

Replacing aircraft radio altimeters with LiDAR (Light Detection And Ranging) technology is impossible due to its low reliability in adverse weather conditions.

However, it is feasible to reduce interference levels by installing higher efficient radio filters and limiting the use of ground 5G C band 3.7-3.98 GHz frequency.

Radio spectrum-sharing technology could be adopted on aircraft with further studies and experiments.

Results of the Weighting System



From the findings, possible solutions are evaluated using the weighting system. It is found that, at 92%, using advanced radio filters would be the most efficient method, followed by relocating the ground 5G C band 3.7-3.98 GHz frequency at 67%.

Project's Recommendations

From the results of the methodology and the weighting system, this study recommends:

1. Installing advanced radio filters on aircraft radio altimeters and 5G C band ground stations
2. Reducing adjacent radio band usage near airport areas
3. Adopting radio-sharing technology in the future decades when this technology has matured.