International Civil Aviation Organization

Twenty Eighth Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/28) of APANPIRG

Bangkok, Thailand, 01 July -05 July 2024

Agenda Item 13: Innovation and new technologies

13.2 Sharing of States' initiatives on Innovation and New Technologies

IMPLEMENTING INTERFERENCE PREVENTION TECHNIQUES USING A HIGH-PERFORMANCE FREQUENCY SIMULATOR

(Presented by Japan)

SUMMARY

VHF communications has increased along with aviation demand. In Japan, VHF intermodulation occurred when the airspace was reorganized to expand air traffic control capacity. This paper introduces measures introduced by Japan to prevent frequency interference caused by intermodulation.

1. INTRODUCTION

1.1 Japan Civil Aviation Bureau considered ways to expand air traffic control capacity in order to respond to the future increase in demand for air traffic, not only for flights departing from and arriving in Japan, but also for aircraft passing over Japan.

1.2 Accordingly, at Fukuoka FIR, where Japan controls air traffic, the airspace was divided into three. Fukuoka ACC is in charge of the high-altitude sector, Tokyo ACC is in charge of the low altitude sector in eastern Japan, and Kobe ACC is in charge of the low altitude sector in western Japan.

1.3 As a result, many A/Gs placed in western Japan had been changed its frequencies by 2023. Also, eastern ones are also planned by 2024.

2. DISCUSSION

2.1 During an airspace realignment in western Japan, an event occurred in which a different frequency from the one transmitted was received at a different site. After the analysis, we have confirmed that the problem was intermodulation caused by the combination of harmonics of different frequencies. In the end, the problem was resolved by inserting a transmission filter and adjusting the squelch level.

2.2 To address this issue, JCAB developed and introduced a simulator that is capable of performing radio wave analysis with higher performance than the simulator it had been using. This simulator not only performs coverage analysis considering terrain data, but also has a newly added

function of A/G intermodulation analysis. The intermodulation was reproduced using actual intermodulation by odd harmonics. This event was resolved by inserting a filter to suppress the harmonics in the transmitter and receiver. It was possible to recreate it exactly was in the newly developed simulator.

2.3 An example of frequency intermodulation study is shown below. No problems due to intermodulation have occurred during the current A/G frequency change in eastern Japan as a result of preliminary analysis of the risks, and the frequency change work is being implemented smoothly. The frequency causing the unintended interference may be easily identified, and the cause can be quickly eliminated. The parameters required for this analysis are location information in terms of latitude, longitude, and altitude, and 17 parameters related to the performance of the radio equipment.

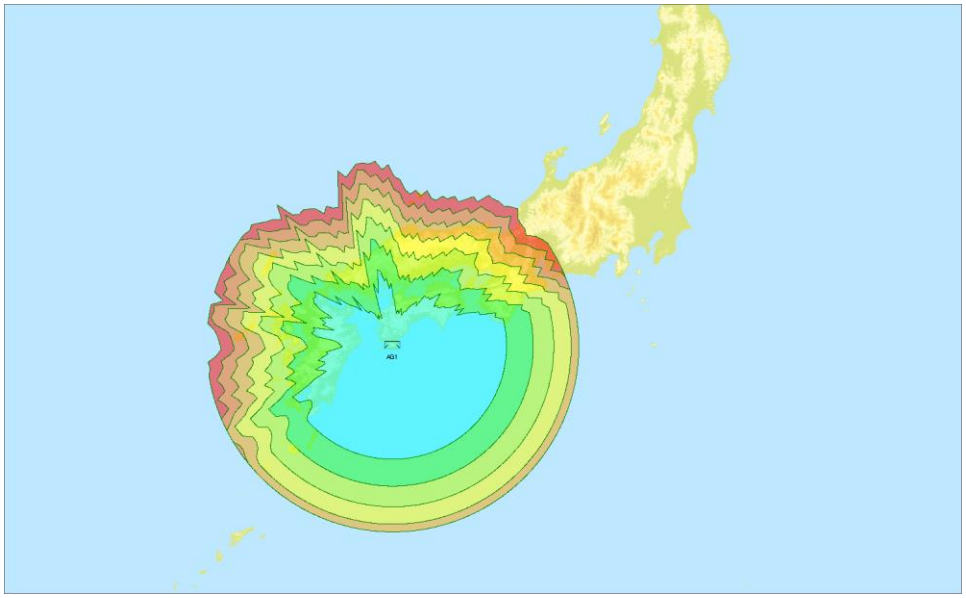

Fig 1. Image of coverage.

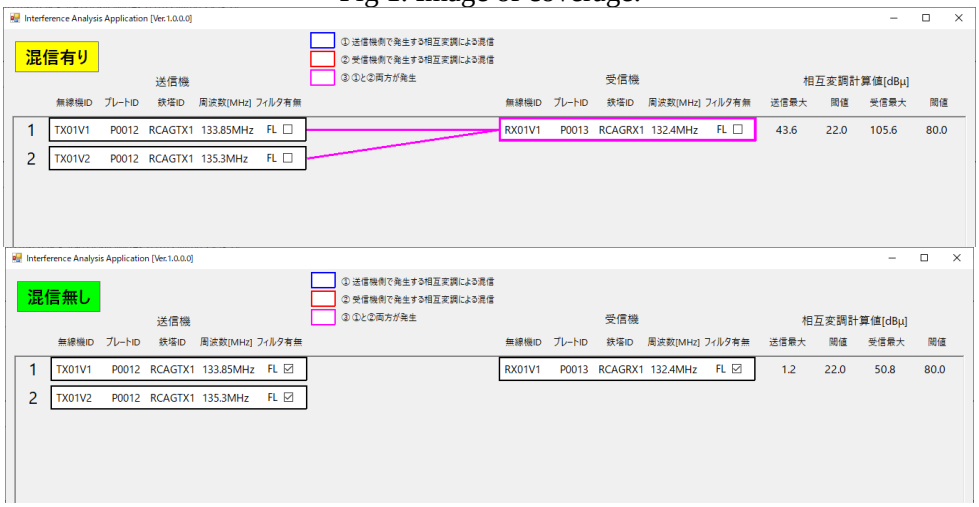

Fig 2. Image of interference Analysis application.
Upper: Intermodulation occurred.
Lower: Intermodulation has been resolved by filter insertion.

The basic principle of this verification is to check whether or not a filter is required after entering parameters, but it is also useful to check whether or not the assigned frequencies are available. Here,

the analysis was performed only on the two affected radio waves, but it is possible to analyze up to 30 frequencies at the same time.

2.4 In addition to A/G, it is also possible to analyze the spatial signal characteristics of radio waves emitted by VORs, ILSs, and other air navigation radio facilities, as well as the effects of obstacles and other factors. By using terrain data, it is now possible to analyze on a desk what previously had to be analyzed by flight inspections from now on, such as the verification of simulated radio waves from newly constructed facilities and the confirmation of the effects of wind power generation facilities and other structures on radio waves, thereby enhancing the sophistication of air traffic control technology operations.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate.

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