International Civil Aviation Organization

Eighth Meeting of the Surveillance Implementation Coordination Group (SURICG/8)

Bangkok, Thailand, 6 – 9 June 2023

Agenda Item 7: Report on surveillance ground system and avionics performance monitoring and improvement in compliance

A RADAR DATA QUALITY MONITORING TOOL

(Presented by China)

SUMMARY

This paper introduces a tool aiming to monitor and analyze radar data quality, using r data, and discusses the difficulty of identifying false information.

1. INTRODUCTION

1.1 To ensure that the radar data entering the ATMAS meets the system requirement, we have developed a tool to monitor and analyze radar data quality, based on previous research on radar data quality.

1.2 The metrics used in the tool refer to the minimal set of performance parameters proposed by SURICG/7 WP12_CHN AI.7 - Suggestions of Performance Parameters of Radar System and relevant Test Methods for APAC Region, and combine the metrics that must be paid attention to in the equipment operation and maintenance work.

1.3 During the development and usage of the system, we have found difficulties in the identification of some false information and the calculation of related metrics. It is suggested that the RSUR working group will provide methodologies in this regard.

2. DISCUSSION

2.1 The tool is used to monitor the quality of the radar data accessed by ATMAS. It collects radar data from radar data splitter of the ATMAS, which corresponds to interface D2 of the *Applicable Surveillance System* in the RSUR draft manual.

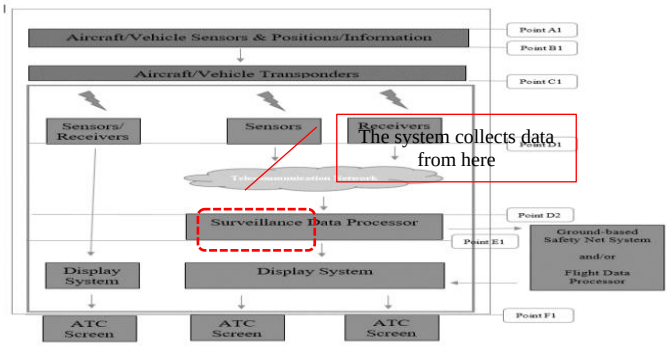

Figure-2 The Source Interface for the Analyzing Radar Data

2.2 The tool is provided for equipment monitoring staff to monitor the quality of radar data in real-time. The tool mainly provides the following functions:

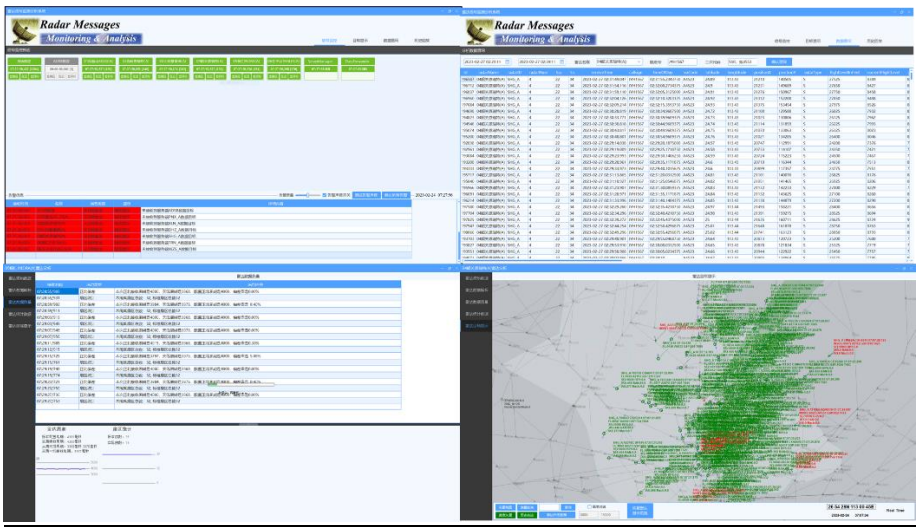

Figure-2 The Function Display Interface of the Tool

- Data monitoring and alerting. It supports up to 128 channels of radar data quality monitoring, and provides alerts according to the quality monitoring of the channel signal.
- Real-time radar data quality monitoring. The system will calculate the quality metrics of each data channel in real-time, including link transmission quality and radar data quality.
- Radar data quality statistics. Statistics and analysis of radar data metrics of a channel based on long-term stored data.
- Data recording and playback. Including radar data received by the system and calculated data quality metrics.
- Airspace situation display. ASD interface is provided to display single-channel or multi-channel radar target situations in real-time, which is convenient for equipment monitoring staff to view radar data.

2.3 The tool has been put into use in many places. At the Guangzhou ACC Center, the tool monitored the radar data of 64 channels. In the past few years, it has provided great help to equipment operation and maintenance.

- The timely alarm of the system enables the equipment operation and maintenance staff to deal with the failure in time and avoid the impact caused by abnormal data on the operation of the ATMAS.
- Comprehensive radar data quality analysis report enables technicians to quickly determine the reasons for radar performance degradation.
- Through long-term data statistical analysis, some radar performance degradation can be found in advance, and timely maintenance can be carried out.

Data quality metrics monitored by the system

2.4 Currently, the tool supports the calculation of the following quality metrics for each channel of radar data. Since the vast majority of current radars use Eurocontrol's ASTERIX, the ASTERIX is used as an example to explain the calculation method of the metric.

Table-1 The Quality Metrics of the Radar Data

Categories	Metric	Note
Link transmission quality metrics	Maximum Transmission Delay	The delay is calculated using the packet reception Time minus the Time of Day in the packet. If the channel radar does not use GNSS time-stamping, only the standard deviation metric is calculated.
	Minimum Transmission Delay	
	Average Transmission Delay	
	Std Dev of Transmission Delay	
	Stability of the Receiving Period Time	The difference in reception time of two consecutive true north reports and antenna period.
	Radar Service Report Effective Ratio	There are 32 ASTERIX sector messages per antenna period. The metric is expressed as the actual number of received sector packets divided by 32.
PSS Radar data quality metrics	Data Format Error Rate	The ratio of packets that do not conform to the ASTERIX ICD.
	Data Item list	Summarize the data items contained in the radar data of this channel, such as SSR code, speed, altitude, DAPs, etc.
	Stability of the Reporting Period Time	The difference in Time of Day of two consecutive true north reports and antenna period.
	Effective Ratio of Data Items	Based on the data item list, the effective ratio of each Data item is calculated
	Error Density of SAC/SIC codes	Number of SAC/SIC errors per day
	Error Density of SSR code	Number of SSR code errors per day
	Large Deviation Density of Height	If the height/position difference between two adjacent packets of the same target exceeds the threshold, it is regarded as a large deviation. The metric is expressed as the number of large deviations the occurs per day.
	Large Deviation Density of Position	
	Valid Mode A/Mode C Detection Rate	The statistics were based on the validated and garbled flags in the ASTERIX entries.
	Probability of Detection	Corresponds to the minimal set of performance parameters
	Accuracy	
	PSR/SSR Combination Rate	
	Coverage Distance Analysis	The maximum detection range of the radar is estimated based on the data of a certain period time.
	Target and Sector Matching Rate	Based on the mechanism of radar detection, the target's position should be near the corresponding angle of the current sector. If the deviation between the azimuth angle of the target and the angle of the sector message is too large, it is regarded as a mismatch. This metric is expressed as the number of matched target packets divided by the total number of packets in this channel.

<u>The difficulty of false information identification</u>

2.5 Depending on the requirements of the operation, we focus on the ratio of false information in the radar data. However, there are some critical error information, which are difficult to be identified by software programs or evaluated by appropriate estimation metrics.

2.6 A typical example is the identification of false targets, especially the identification of false targets detected by PSR. We have tried to develop several software versions to identify false targets, but none of them have achieved ideal results.

2.7 In addition, when two related data items in the radar data are inconsistent, it is also difficult to determine which one is the false information. For example, the emergency flag bit and the special SSR code, when the ADS-B data emergency state is set to General Emergency, but the SSR code is not set to 7500/7600/7700; We know one of the data is false, but we can't quickly determine which is false.

2.8 We have noticed that there was a description of false information and a definition of the False Target Density/FTGDEN metric in the RSUR draft manual. However, no false information judgment method and calculation method were described. It is suggested that the RSUR working group will provide the judgment method of the false information and provide the specific calculation method of the relevant metrics.

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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