

# Surveillance accuracy analysis of ADS-B supporting the separation service in western China

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## Disclaimer

- The views expressed in this article are those of the authors and do not reflect the official policy or position of CAAC.





# Outline

- Introduction
- The ADS-B evaluation system (AES) description
- Methods and content of surveillance accuracy analysis
- Flight test results
- Conclusion





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- **Introduction**
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# Introduction

- In western China, the terrain and meteorological condition is so complex that it is **not suitable** to construct **new radar stations**.
- Besides, due to the **limitation** of radar, such as the low data update rate and high installation and maintenance cost, a **new alternative** surveillance method is in dire need.





# Introduction

- ADS-B (Automatic Dependent Surveillance-Broadcast ): an up-to-date data-link-based surveillance technology which can be used for both air-ground and air-air application.
- A surveillance method that integrates the advantage of both communication and navigation means.
- Good surveillance performance such as accuracy, integrity, update rate, and reliability, and can be used for communication between aircraft.
- Considered as the backbone of the Next Generation Air Transportation System (NextGen).





# Introduction

- As a totally new surveillance method, before practically applied and operated in China, **abundant tests and evaluations** are necessary to validate the performance of ADS-B and guarantee the operational security.
- Based on this background, an ADS-B evaluation system (**AES**) is developed for the initial evaluation of ADS-B in China.





# Outline

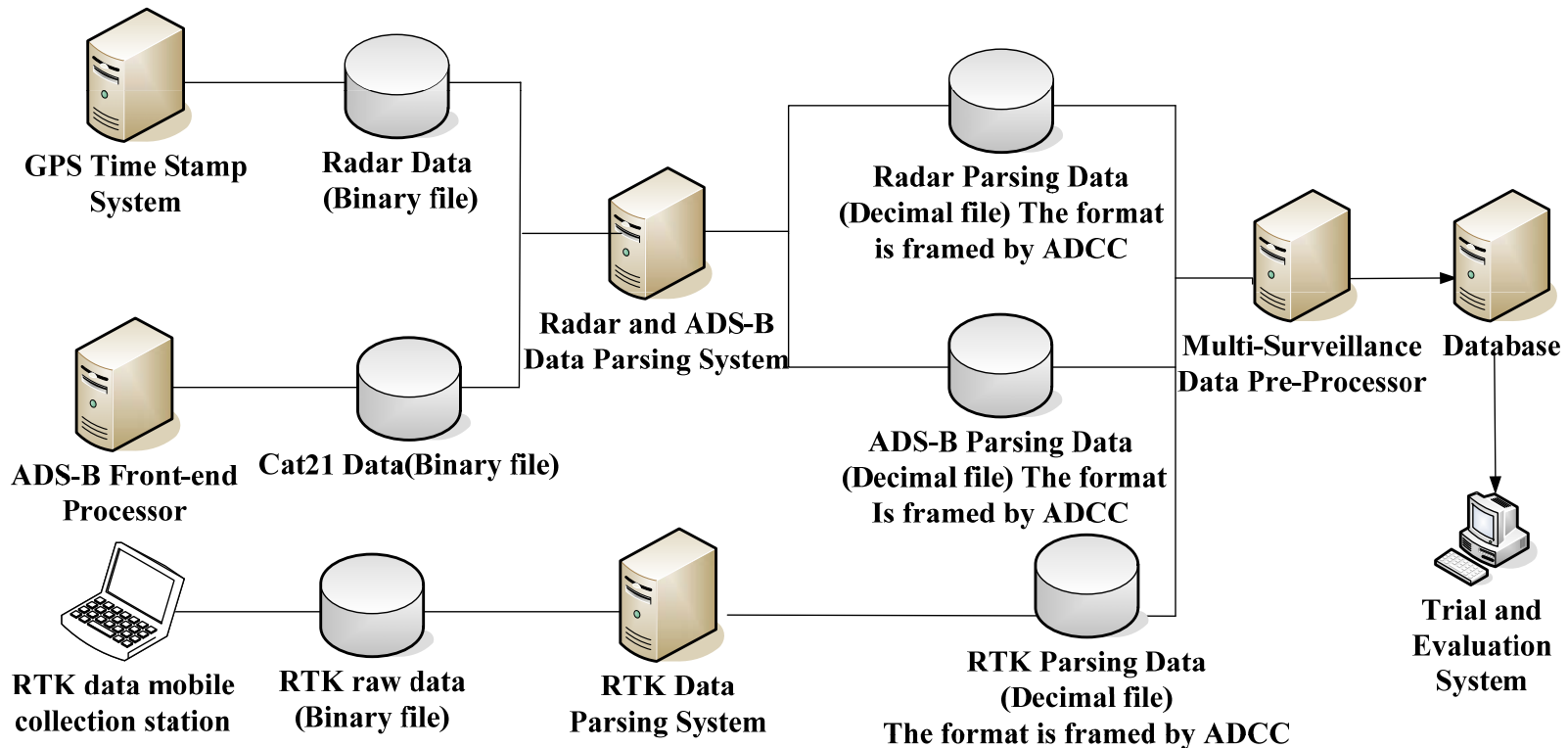
- Introduction
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# The ADS-B evaluation system description

## ■ The hardware framework of AES system





# The ADS-B evaluation system description

- The AES system, including:

- Data Acquisition Layer

- Multi-source Surveillance Integrated Data Processing System
    - Radar data time marking system
    - ADS-B data front-end process
    - RTK data processing and analysis system
    - Radar and ADS-B data analysis system





# The ADS-B evaluation system description

- The AES system, including:

- Data Evaluation and Display Layer

- accuracy evaluation (relating to accuracy quality)
    - integrity evaluation
    - false target probability (relating to accuracy quality)
    - reliability evaluation
    - range evaluation
    - position evaluation (relating to accuracy quality)
    - altitude evaluation
    - velocity evaluation
    - heading evaluation
    - error characteristic evaluation





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# Methods and content of surveillance accuracy analysis

- Accuracy evaluation
  - The **completely in-step** ADS-B, radar and RTK data is compared and the distance is calculated.
  - The **distribution of distance** between synchronized ADS-B and RTK data is compared with radar and RTK data.
  - The distribution of distance is defined as the message percentage **falling into some distance interval**.
  - The more the messages falling into larger distance interval are, the less accurate the data is.





# Methods and content of surveillance accuracy analysis

- False target probability
  - The ADS-B or radar data whose distance from baseline RTK data **exceeding some threshold** is counted.
  - The target measured with this kind of data is defined as **false target**.
  - The more this kind of data is, the less accurate the data is.





# Methods and content of surveillance accuracy analysis

- Position evaluation
  - The **real trajectory** according to ADS-B, radar and RTK position data is tracked and compared with each other.
  - The closer the distance between measured trajectory and RTK trajectory is, the more accurate the data is.





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# Flight test results

- To validate the **accuracy performance** of ADS-B data **supporting the separation service** in western China and compare with the radar data and RTK data using our evaluation system.
- Accomplished by flying airbus A319 during the Jiuzhai-Chengdu route on Dec.19, 2008.
- Data from three sensors, including one Secondary Surveillance Radar (SSR) in Chengdu and two ADS-B ground stations respectively in Chengdu and Jiuzhai.

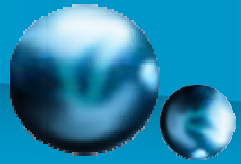




## Flight test results

- The **real time surveillance information** from these sensors is used for the accuracy evaluation.
- Comparison of **measured separation** between two specified points with true separation is made to **simulate the separation** between two aircraft.



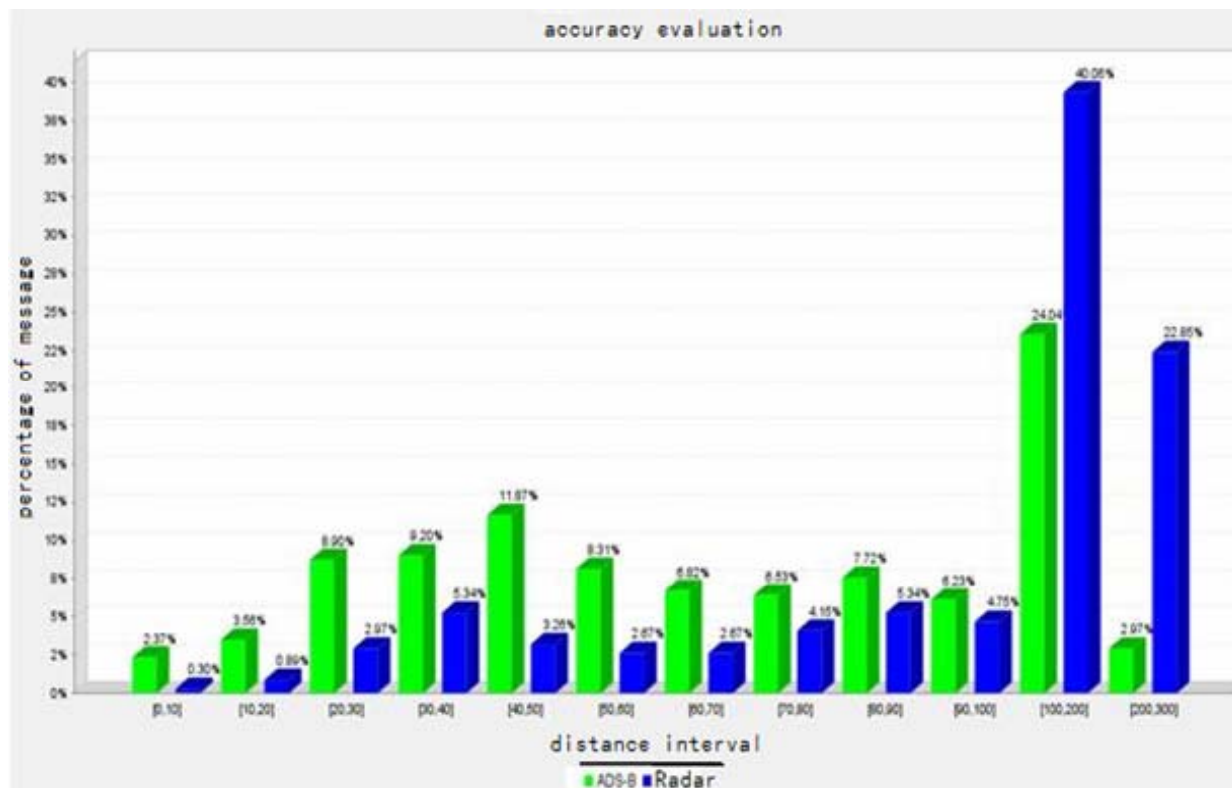


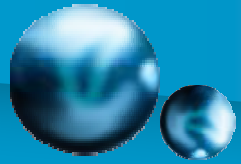
# Flight test results

- Accuracy evaluation

- For relatively small distance interval, the number of ADS-B message is **more than** radar.

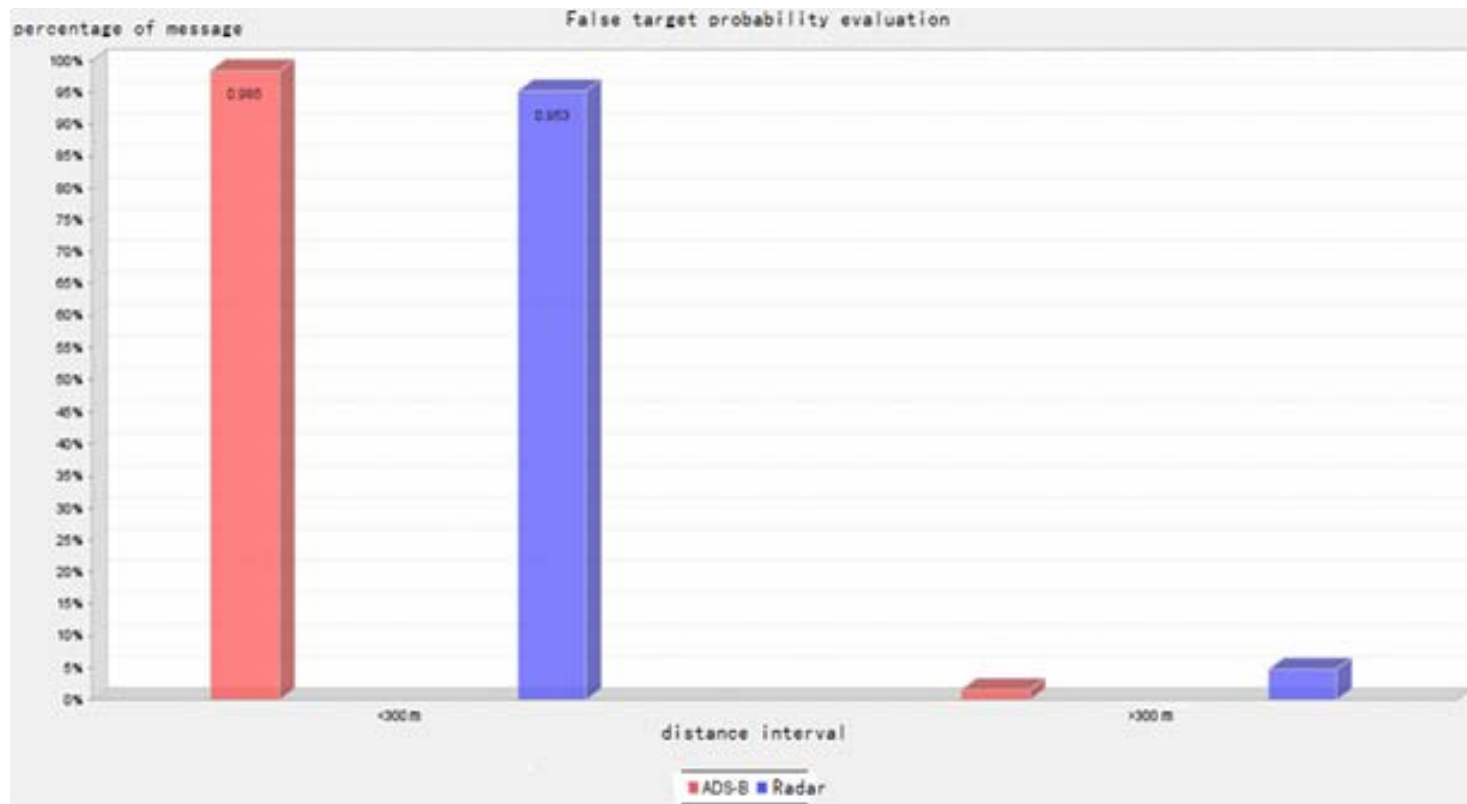
- It can be seen that ADS-B is **more accurate** than radar.





# Flight test results

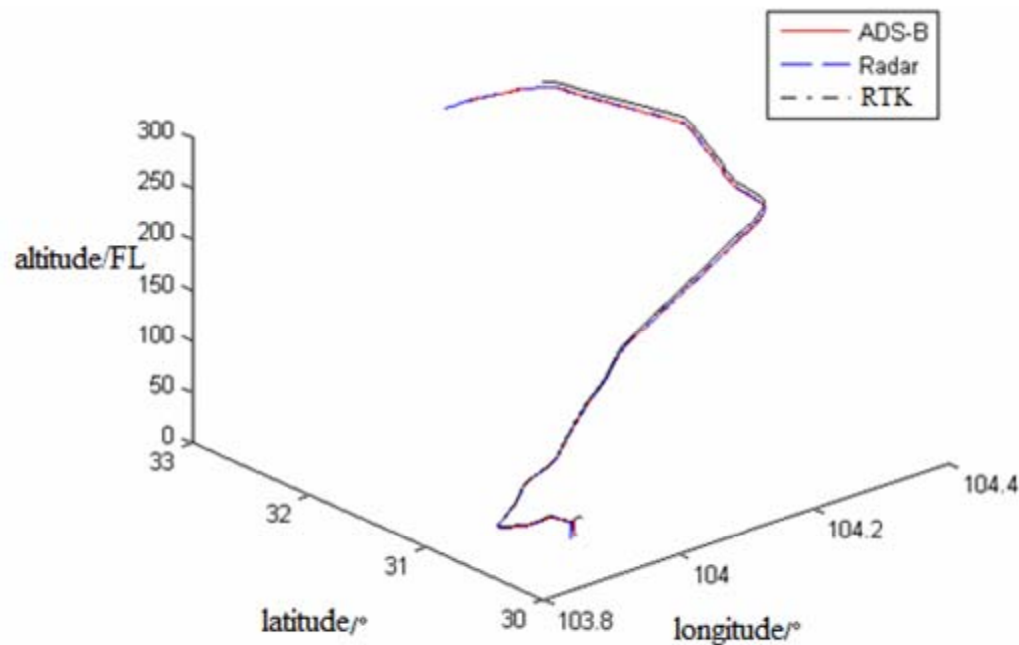
- False target probability
  - Both ADS-B and radar occupy a **small portion**.
  - False targets of radar are about **triple** ADS-B.
  - ADS-B is **more accurate** than radar.





# Flight test results

- Position evaluation
  - Three paths very **similar**, almost coincide, which can illustrate that ADS-B and radar can be used for surveillance in **relatively rough application**.



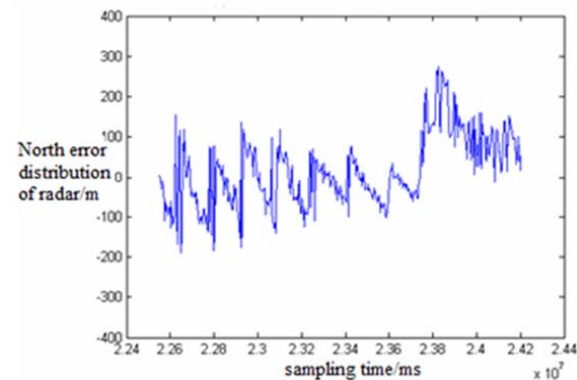
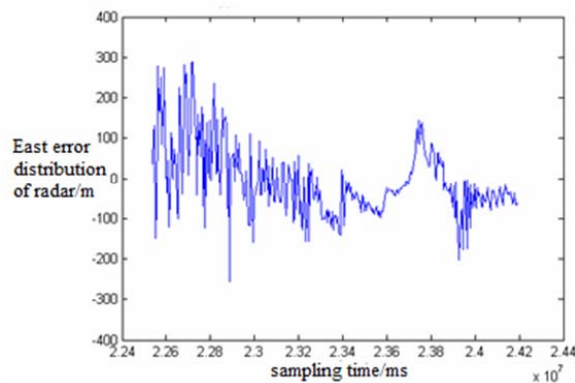
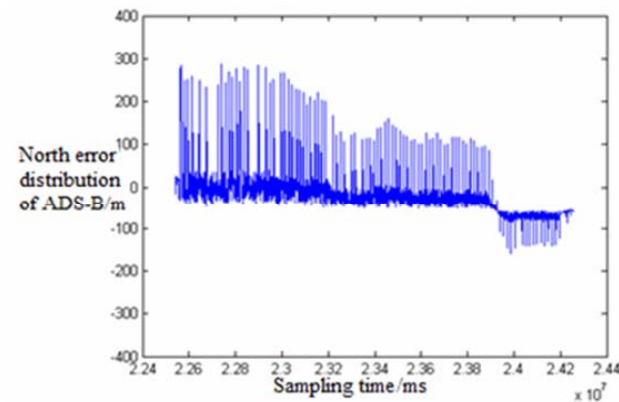
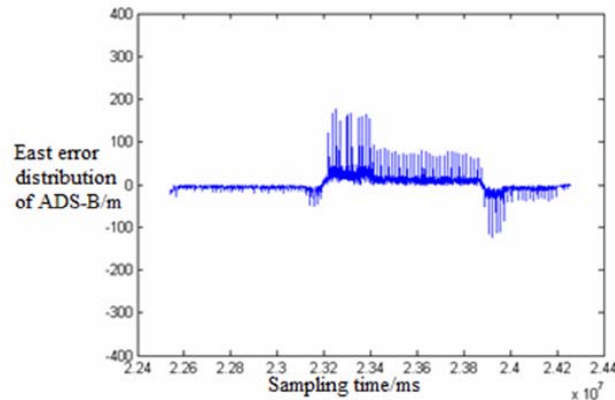


# Flight test results

- Position evaluation

- Most of ADS-B data is **the same as RTK data** both in the north and east directions.

- For radar data, the **fluctuation is a little wide.**





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## Conclusion

- The ADS-B evaluation system developed by CAAC is introduced in detail first.
- Then the methods and content of the **accuracy analysis** are summarized.
- With these methods, **flight test data** from Chengdu to Jiuzhai was collected and used to analyze the accuracy quality to support the separation service in western China.
- From the experiment results, it is obviously seen that the performance of ADS-B data is **much better** than radar and could **support the separation service** in western China.





# Thank you !

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