



Air ground coordinated RFI detection system in airport

9th ICG Workshop on GNSS Spectrum Protection and
Interference Detection and Mitigation

Zhen Weimin, Chen li, Jin Ruimin Yang Huiyun
China Research Institute of Radiowave Propagation

2021-8-24

| Contents |

01 Background

02 RFI analysis in aviation based on ADS-B data

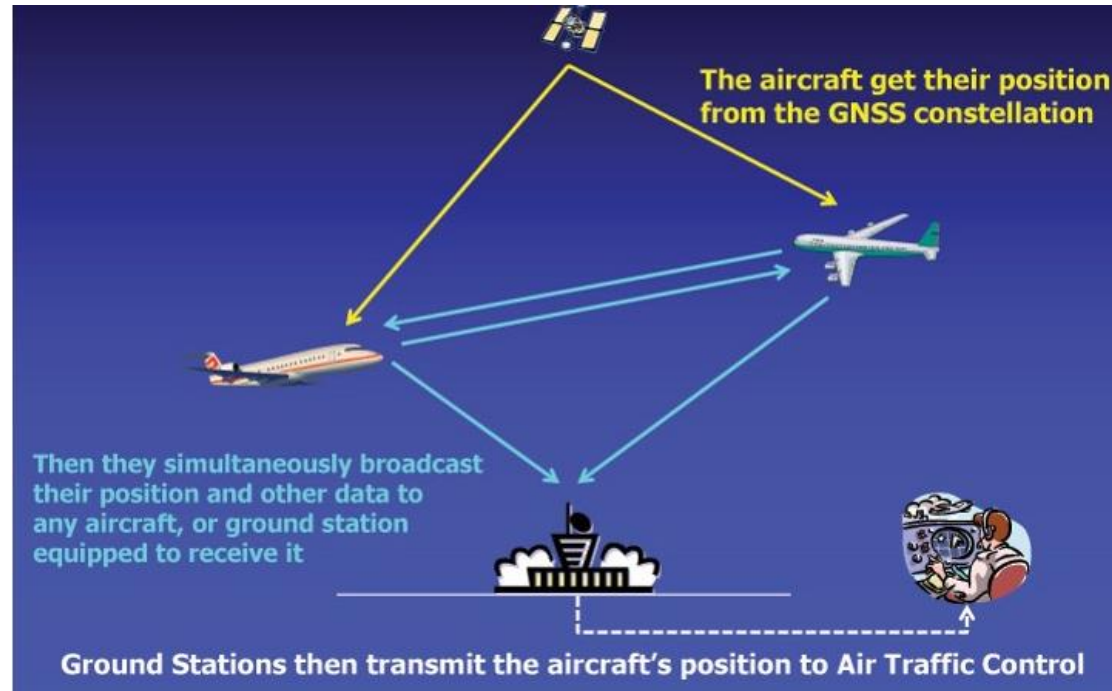
03 RFI detection and source localization

01 Background

- In recent two years, reports of GPS interference from pilot are received in middle east of China.
- ADS-B data are used for coarse positioning.
- Precise positioning is realized using ground and air-based RFI direction finding device.

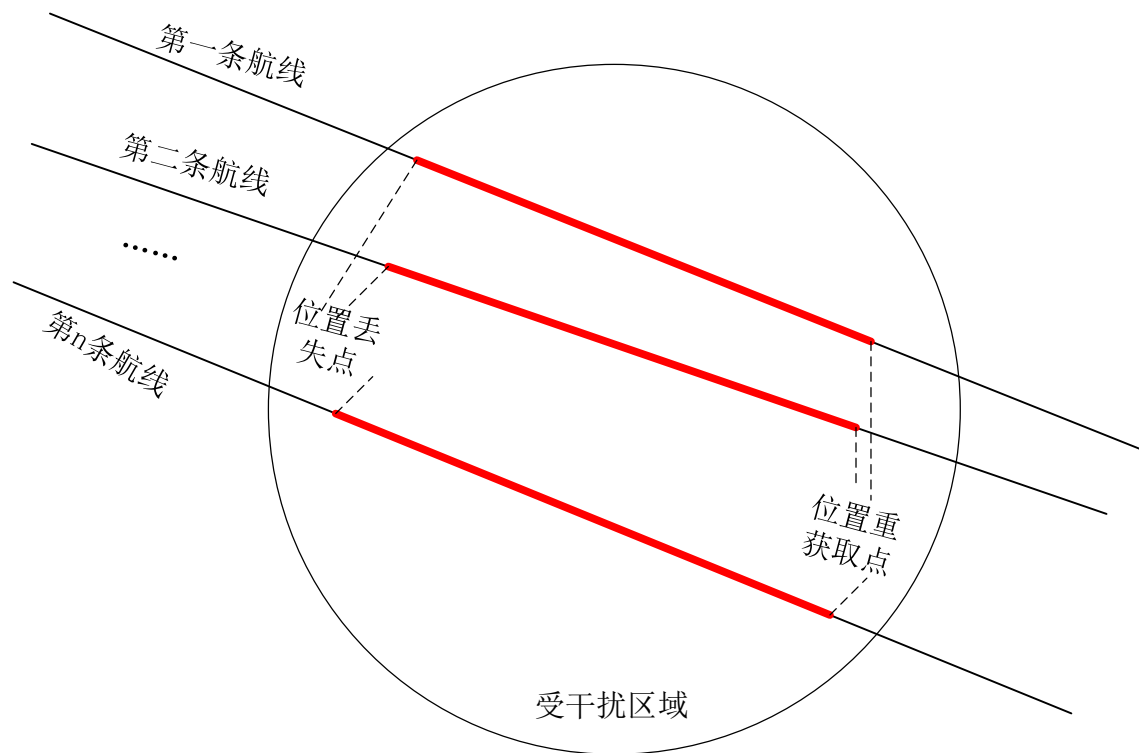
02 RFI analysis in aviation based on ADS-B data

(1) ADS-B



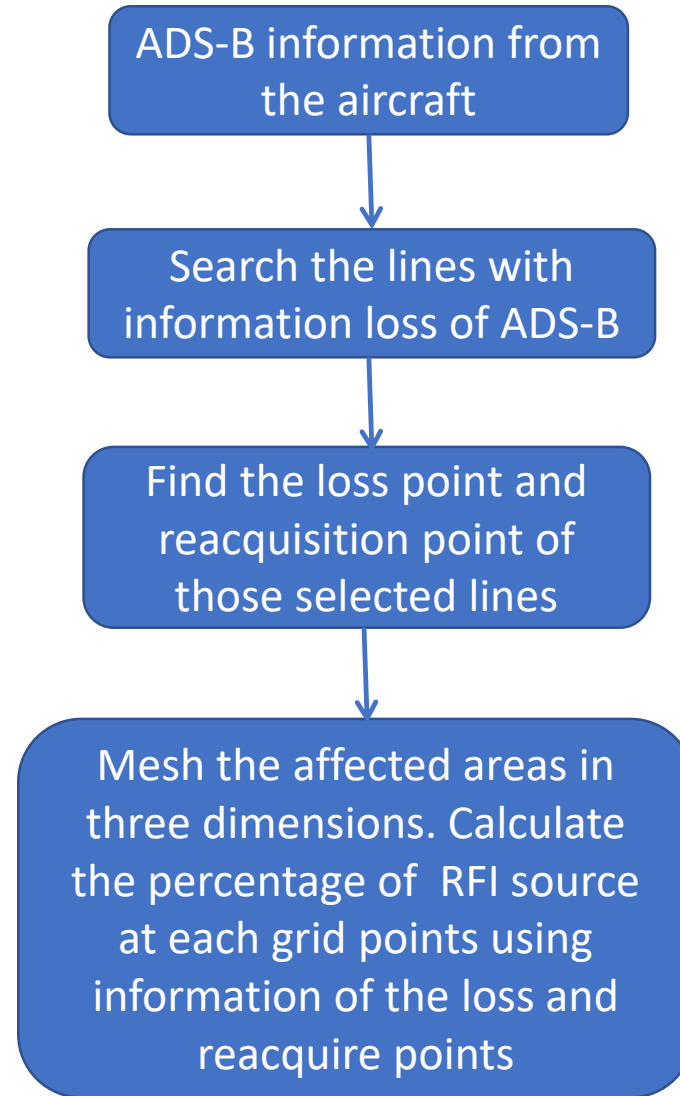
ADS-B information received on the ground station including latitude, longitude, aircraft heading information, velocity, GNSS availability etc.

(2) GNSS RFI localization based on ADS-B information



When GNSS of the aircraft is interfered, it may lose and reacquire position information as the aircraft fly near and away the RFI source.

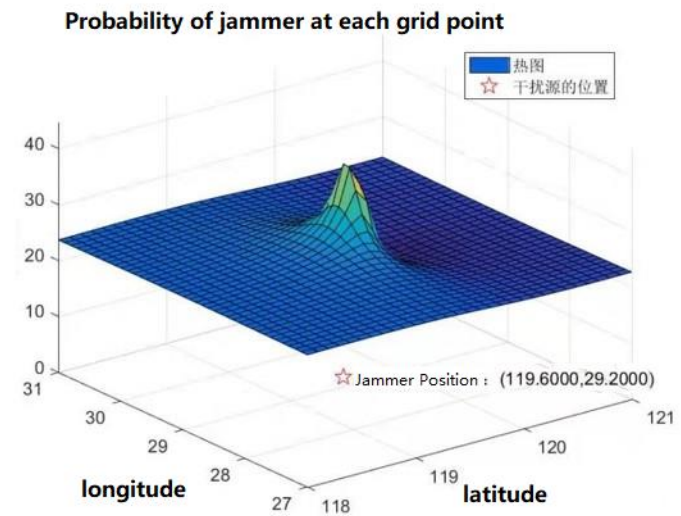
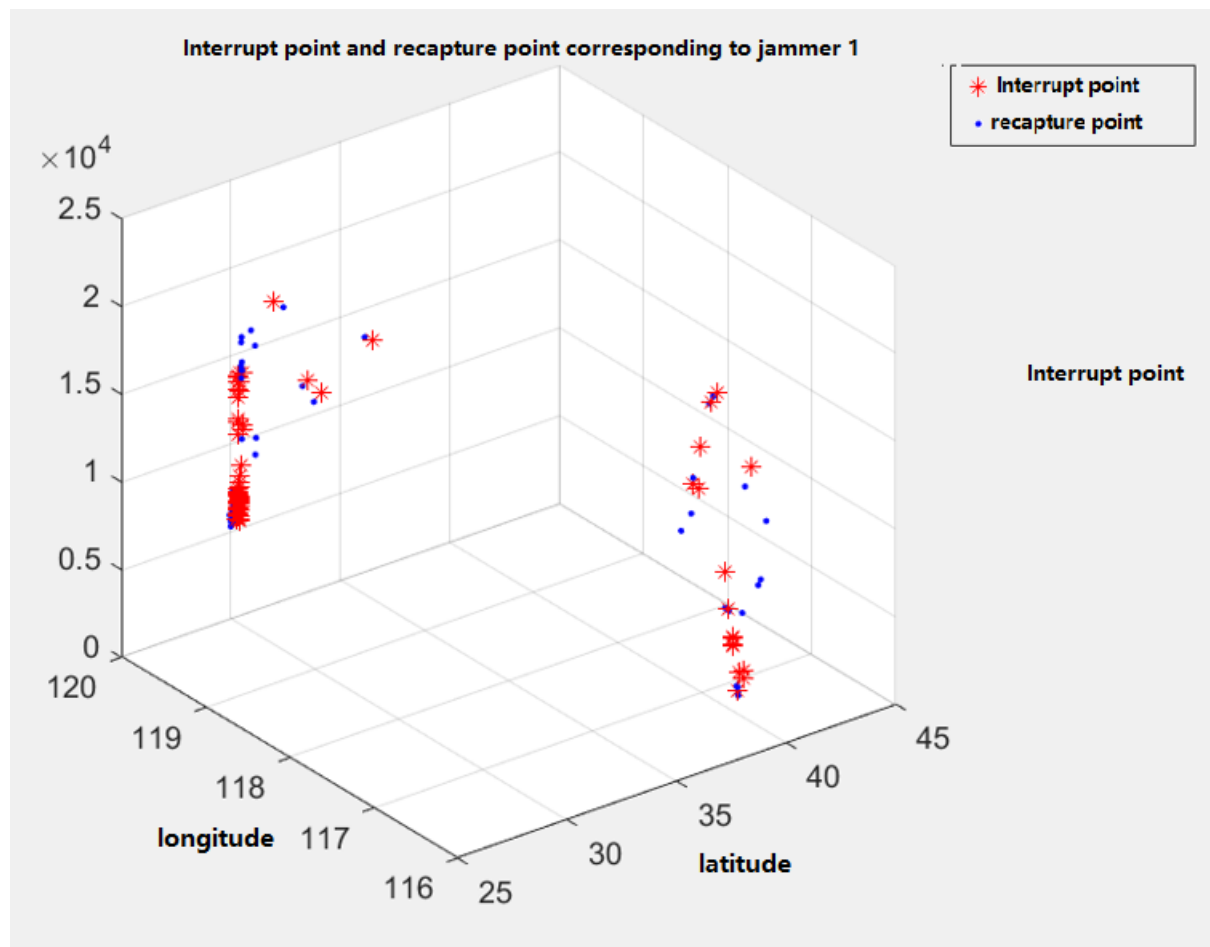
Points of GNSS signal losing and reacquiring of many aircraft can be used for localization of GNSS RFI source.



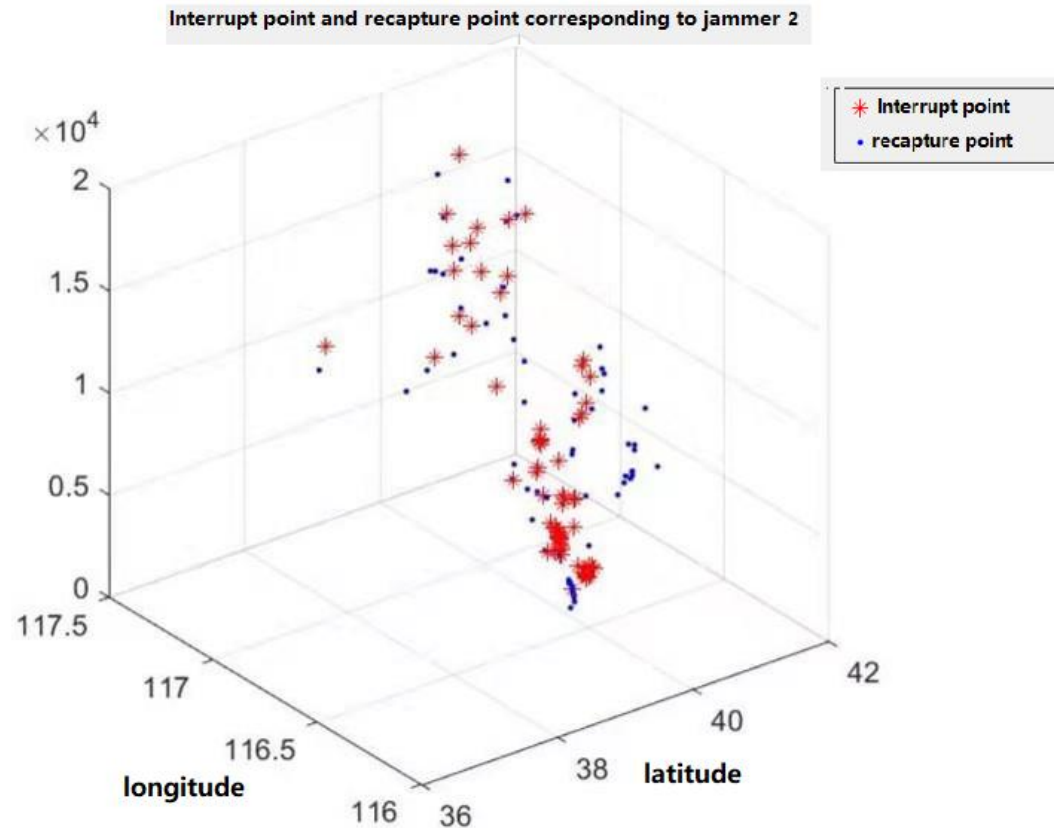
(3) ADS-B data analysis of interfered lines

- GPS loss of signal in ADS-B data occurs in totally 262 items during 2020.03.31-04.09.
- Clustering analysis is used for the ADS-B data. It is found that the interference is caused by two RFI sources.

Analysis results of jammer 1



Analysis results of jammer 2



The distribution of the loss points and recapture points obtained from ADS-B information is very messy, which is inconsistent with the route anomaly caused by fixed jammer, and the position of jammer cannot be determined by ADS-B information.

Conclusion from ADS-B data during the interference

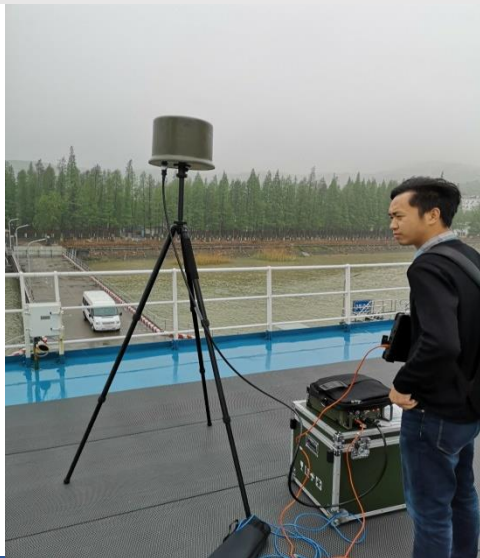
- (1) The interfered lines is accumulated lines at different times. So only when fixed RFI source is assumed, using ADS-B for coarse positioning can be realized.
- (2) From the analysis it can be found that there are two RFI sources during 2020.03.31-04.09.
- (3) The loss and reacquire point of the interfered lines caused by RFI source 1 is regularly distributed, which means that the source is fixed and can be precisely localized.
- (4) The loss and reacquire point of the interfered lines caused by RFI source 2 is not regularly distributed, which means that the source might be movable and difficult to be localized.

03 RFI detection and source localization

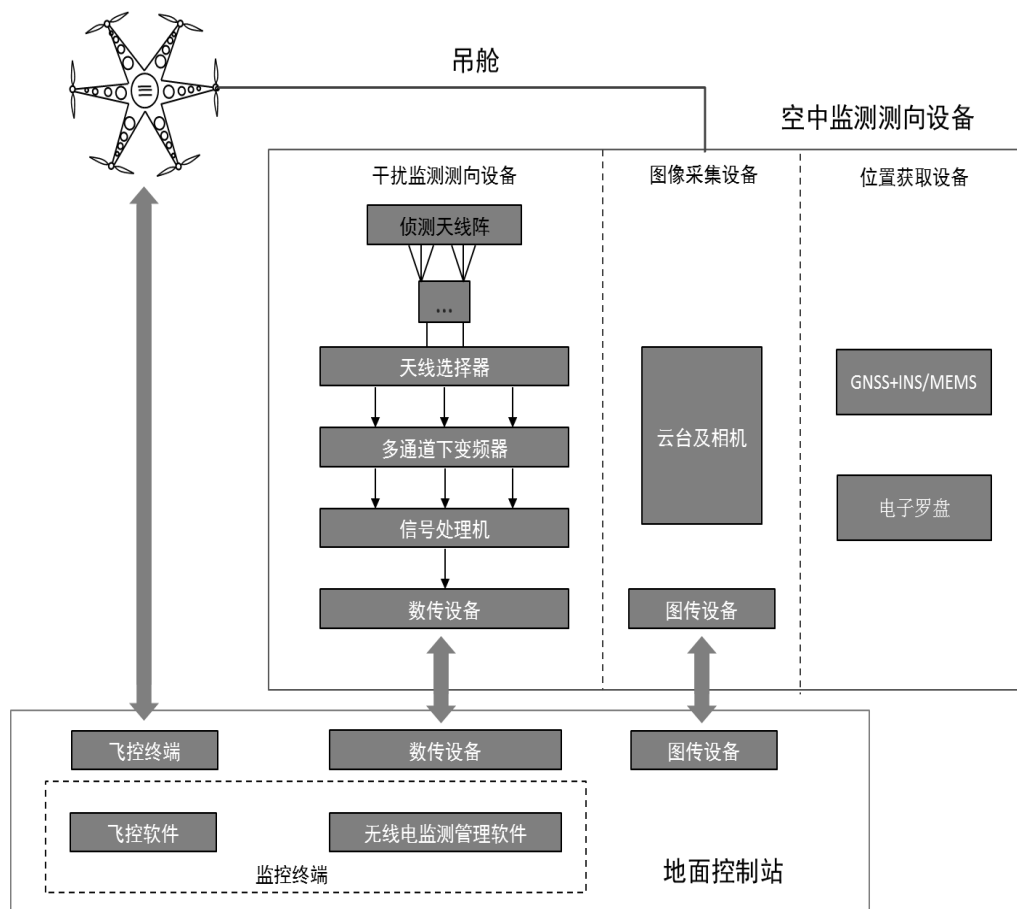
For FRI source 1, ground and air airborne RFI direction finding device are used to localize the source.

Ground RFI direction finding device

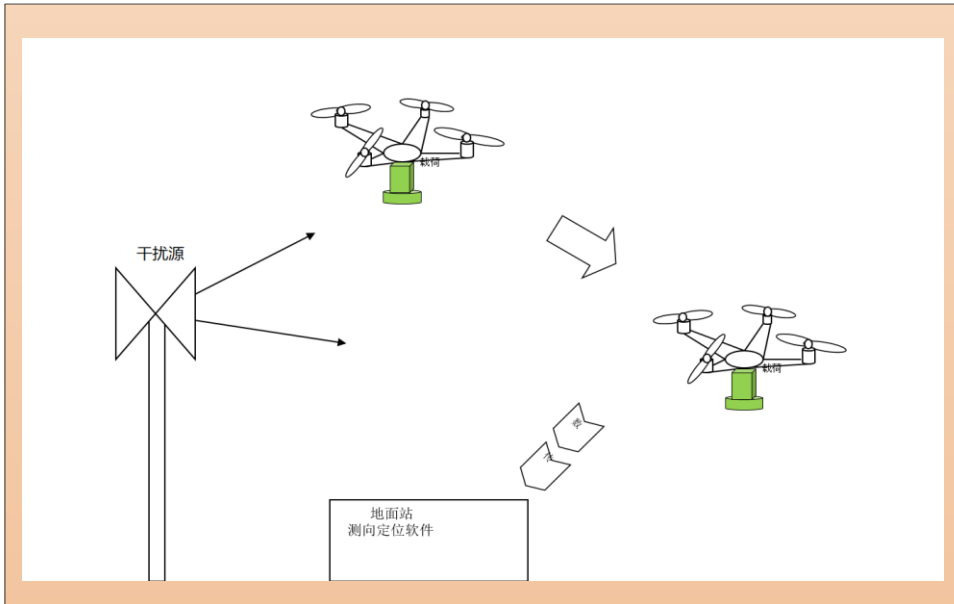
- RFI in 1G-3GHz detection and positioning.
- Signal analysis, recognition and direction finding of Multi GNSS multi frequencies (BDS: B1、B2、B3; GPS L1、L2、L5; and GalileoE1、GLONASS G1)



Airborne RFI direction finding device

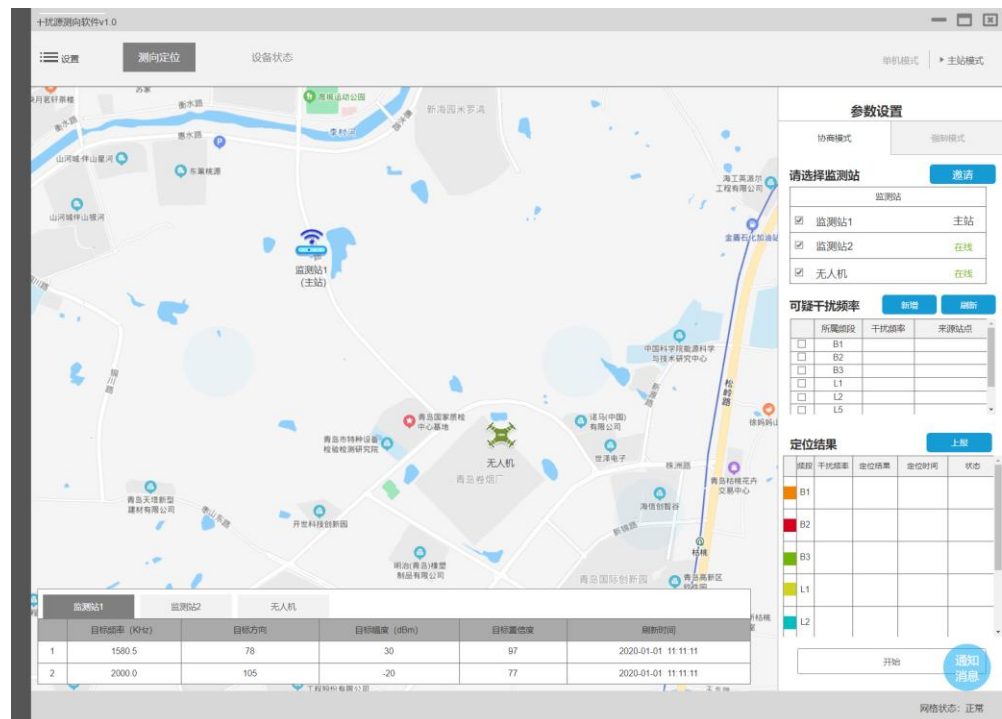
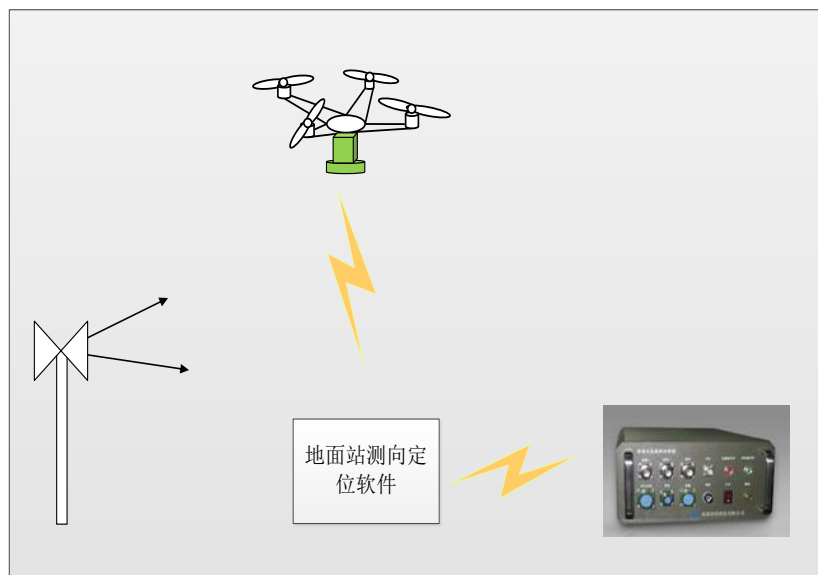


Multi points measuring with single airborne RFI direction finding device (for fixed RFI source)



- Airborne device measures the direction of the RFI at one point, the drone flies to another points, and measure the direction again. The RFI source can be localized with the direction finding results of two or more points.
- Can not be singly used for movable RFI source identification.
- Can be used for RFI detection in large region and not restrict by terrain and complex environment.

Air ground coordinated direction finding and localization



- The ground and airborne direction finding device measures the RFI at the same time and realize the source identification with cross positioning.
- Advantage: fast localization, localization of movable RFI

RFI source is identified as the device in fault which used for 4G mobile communication with the air ground coordinated mode.



Thank you!