

Latest Progress in Air Traffic Control Radar Technology of Nanjing **NRIET** Industrial Co., Ltd.

■ July 7th 2026

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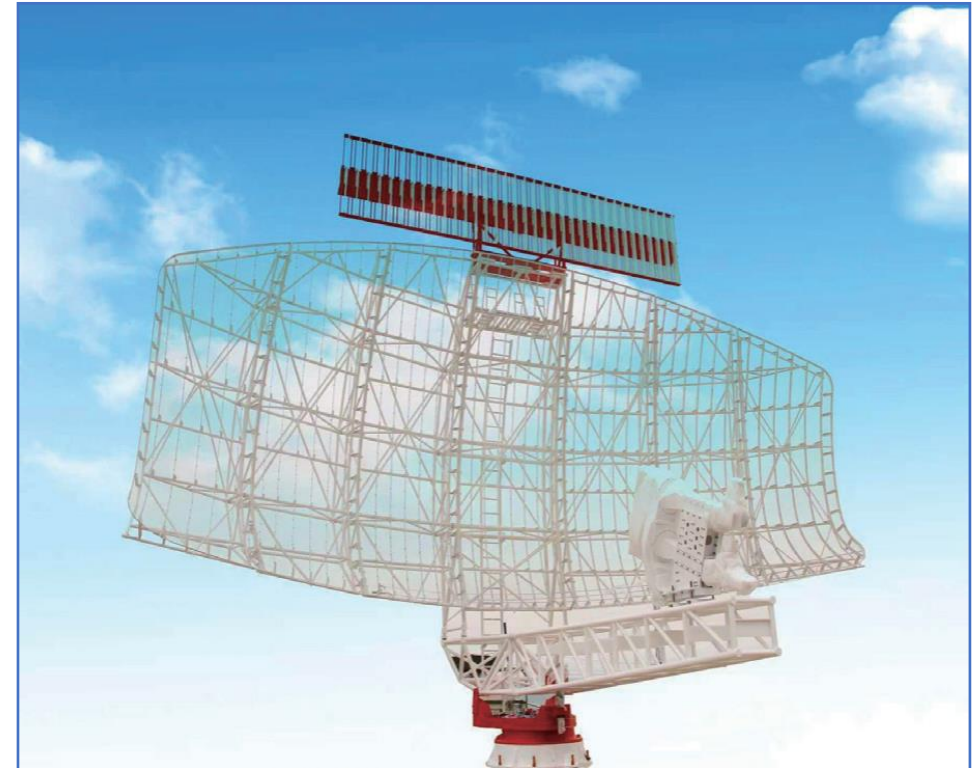
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Other Solutions

Introduction to Air Traffic Control Radar

NRIET

- Air Traffic Control (ATC) radar utilizes the principle of electromagnetic wave reflection to conduct all-weather, high-precision detection of aircraft within airspace, providing dynamic parameters such as the target's three-dimensional coordinates, speed, and heading.
- It serves as the "eyes" of air traffic management, offering the most fundamental and critical data support for control decisions and flight scheduling, and is an indispensable core facility in the civil aviation operation system.



Introduction to Air Traffic Control Radar

NRIET



Absolute Safety

It continuously tracks aircraft dynamics, rigorously safeguards flight safety margins, accurately identifies and alerts to the risk of air conflicts, and builds an insurmountable safety bottom line for flight operations.



Efficiency Leap

Via precise Radar data, it optimizes route planning, airport terminal sequencing, reduces ground delays, and effectively improves flight regularity and overall operational efficiency.



Global Synergy

It provides a global airspace picture for controllers and flight crews, as to ensure a consistent understanding of the airspace situation among multiple parties and support rapid collaborative responses to emergencies.

Introduction to Air Traffic Control Radar

NRIET



Independent Detection Mechanism

Capable of independent scanning without target cooperation, enabling autonomous discovery of targets within airspace.

Primary Surveillance Radar (PSR)

- ☂ **Non-Collaborative Assurance** : Operates without airborne transponder cooperation, acting as a safety barrier for non-responding targets.
- 🕒 **Information Output** : Provides azimuth and distance, but cannot identify flight identity, altitude, or other details.
- ⚡ **Environmental Sensitivity** : Susceptible to terrain occlusion and meteorological clutter, requiring complex filtering algorithms.



Air-Ground Collaborative Interaction

Adopts two-way "ground interrogation-airborne transponder" communication, which is the core factor to modern ATC.

Secondary Surveillance Radar (SSR)

- 📡 **Responsive Output** : Relies on airborne transponders for feedback, building a precise air-ground surveillance network.
- 📊 **Multi-dimensional Data** : Acquires flight number, altitude, speed, and aircraft identification codes.
- 🌐 **Coverage & Anti-jamming** : Active signals have low attenuation, wide coverage, and strong clutter resistance.

Application Fusion : PSR provides fundamental "seeing" capability, while SSR delivers precise "recognizing" identification. Combined, they have contributed in building a complete airspace safety monitoring system.

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Primary Surveillance Radar

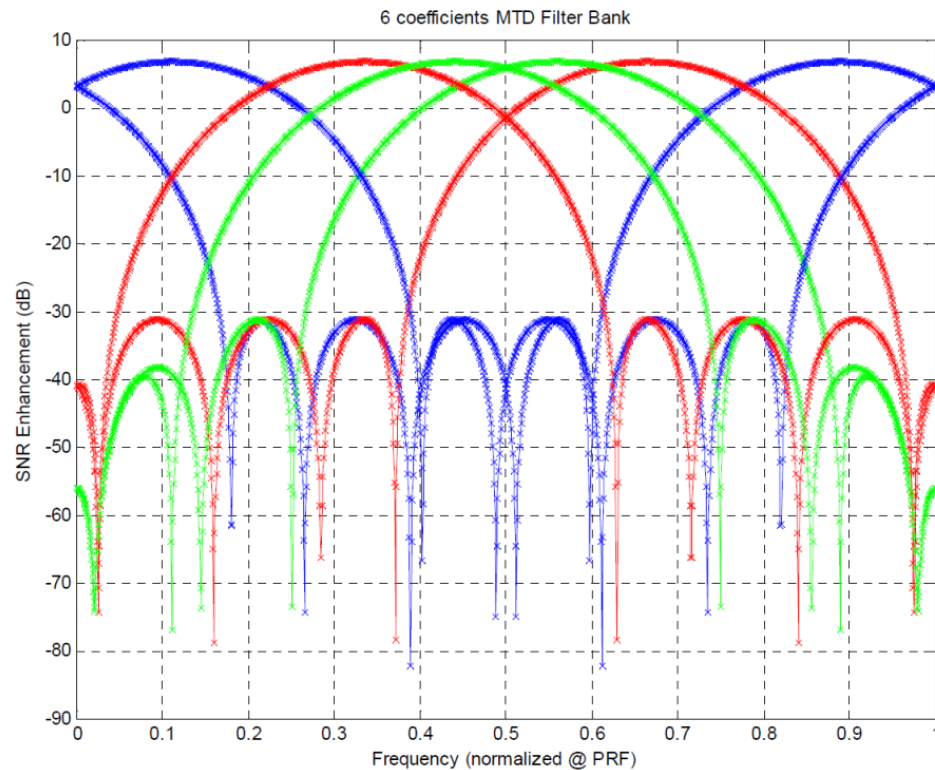
- Primary surveillance radar is a fixed radar adopting **full-solid-state, coherent, pulse compression**, and moving target detection system, which is mainly used for **the approach surveillance of airport terminal area** and approach control area, and can provide the range, bearing, speed, heading and contour information of cumulus and cumulonimbus clouds near the airport, so as to provide timely, accurate, and 24-hour uninterrupted intelligence support for airport aircraft takeoff and landing.



Latest Progress | Clutter Suppression

AMTD Mode

- ground clutter
- normal weather clutter



FIR Filters Bank of AMTD Mode



Latest Progress | Clutter Suppression

Special moving clutter

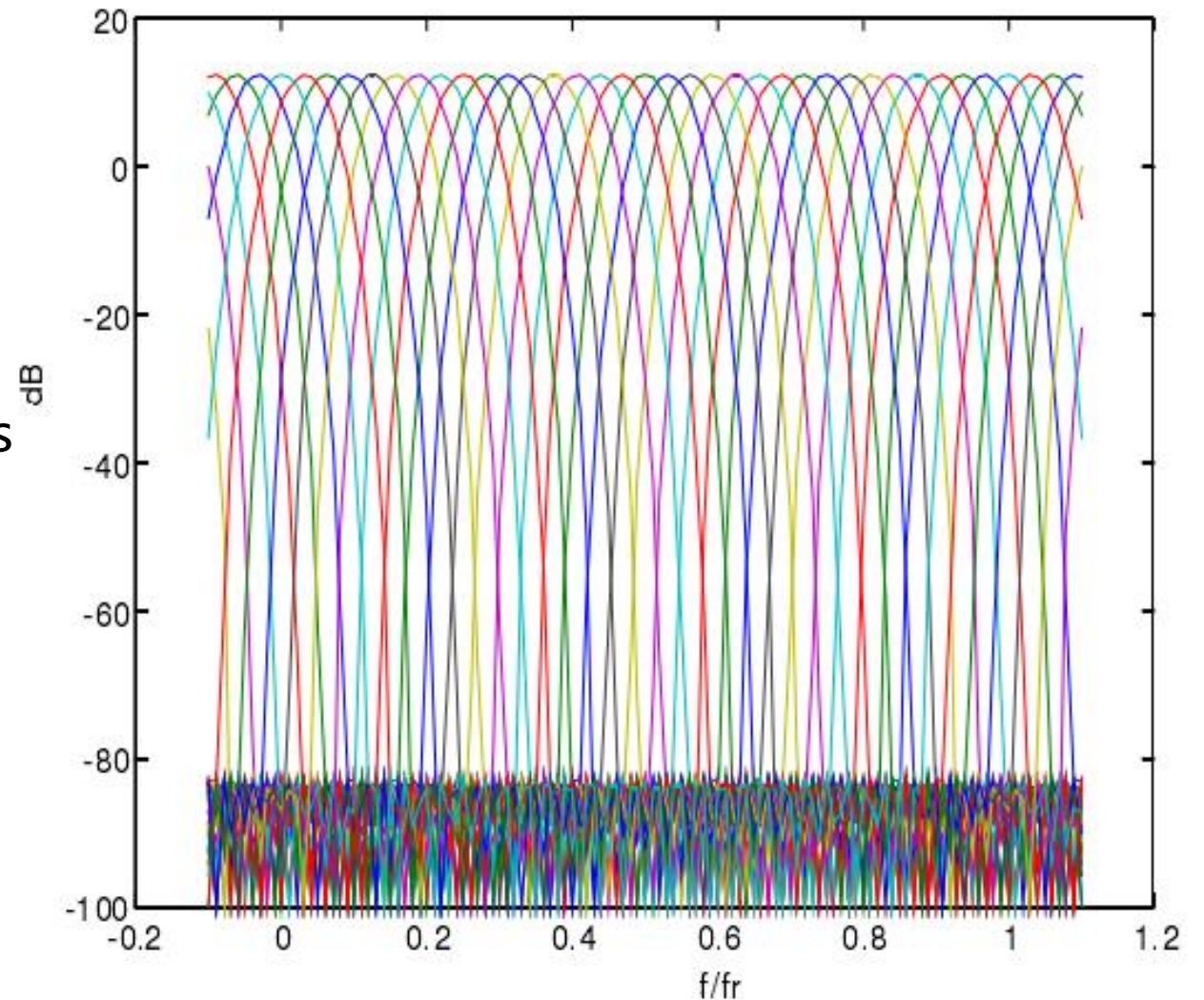
- abnormal sea clutter
- wind farm clutter



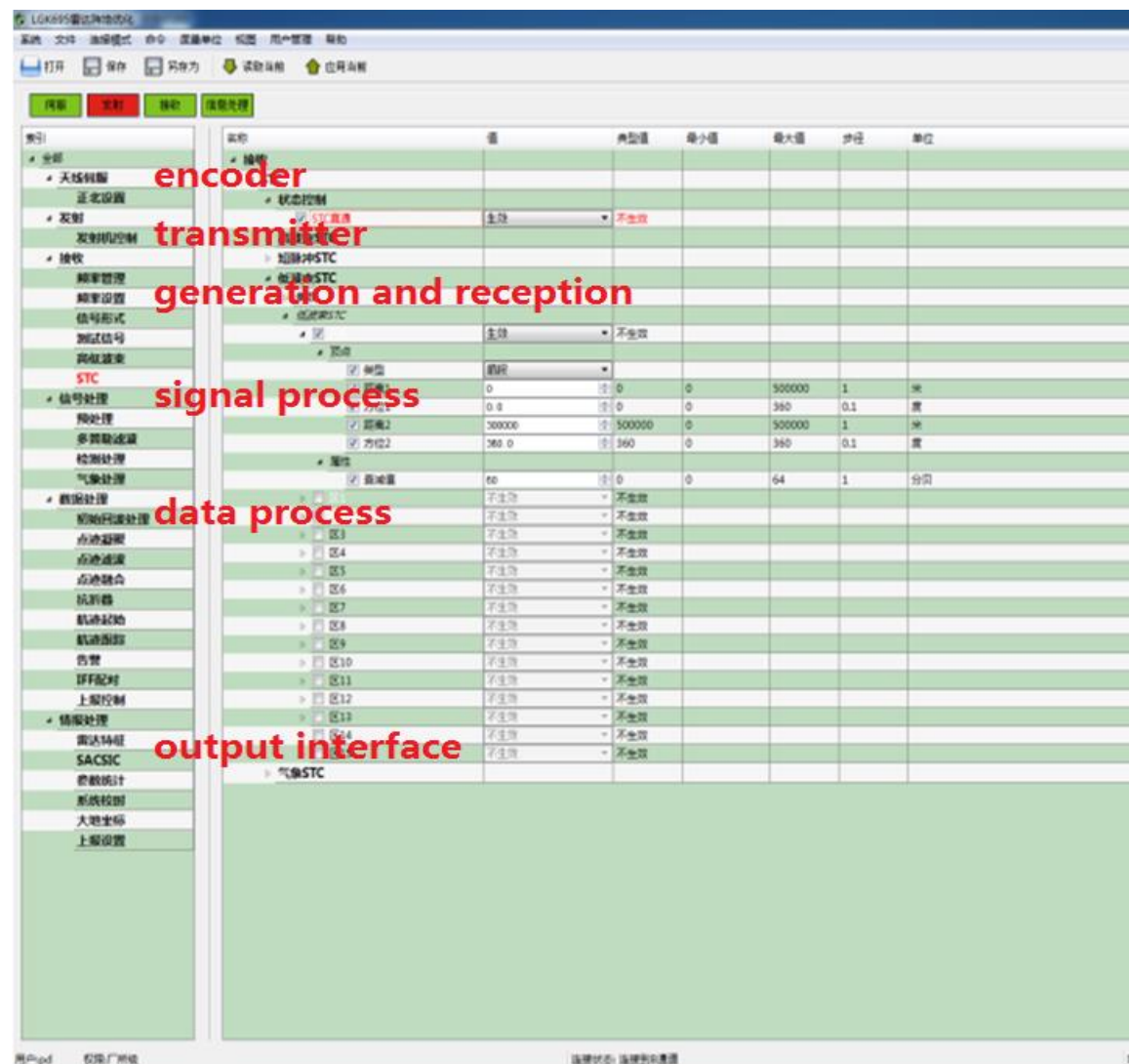
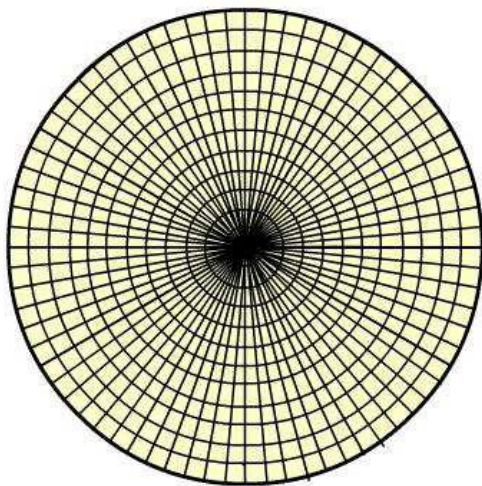
Latest Progress | Clutter Suppression

Pulse Doppler Mode (PD)

- high pulse repetition frequency (PRF)
- good suppression ability for slow targets
- ambiguity problem in ranging
- commonly used in airborne radar

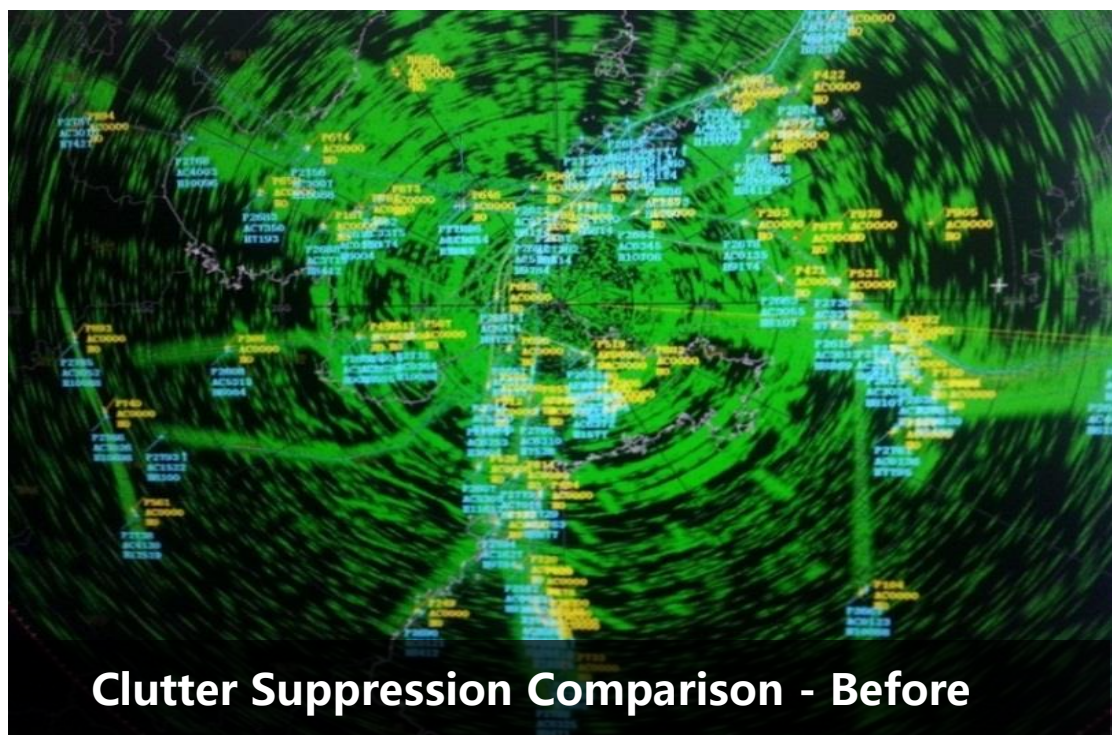


- auto-adaptive clutter maps
- adaptive Doppler filtering
- plot quality evaluation and filtering
- automatic track initialization
- site optimization software

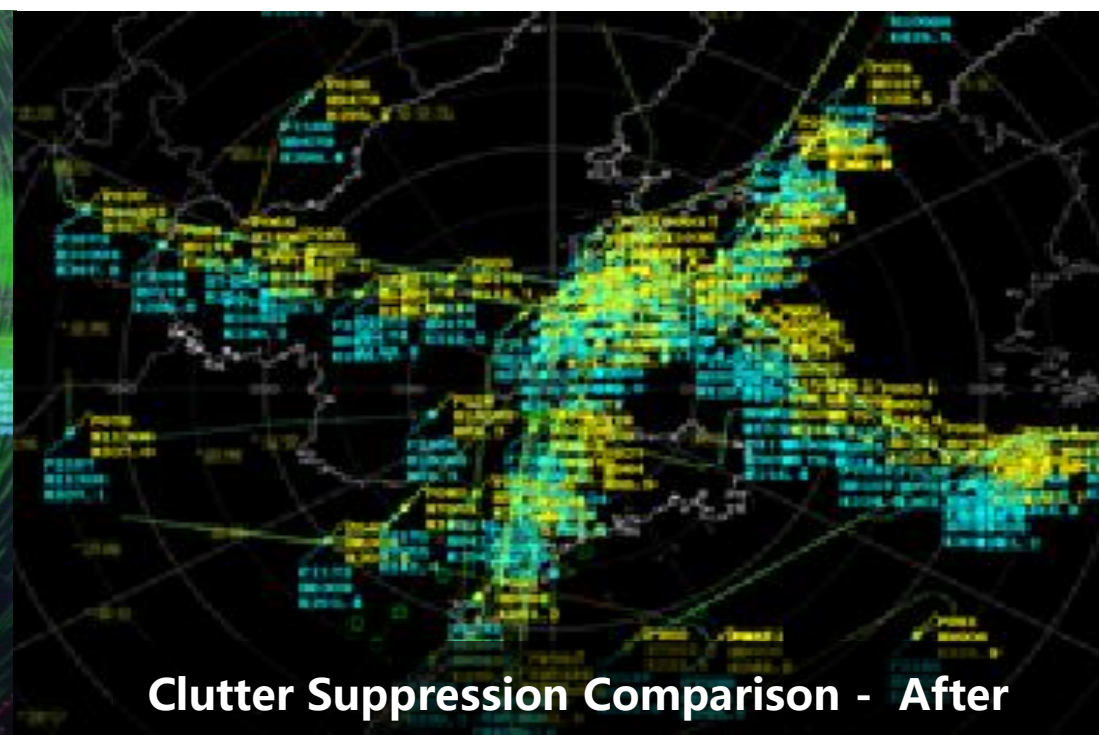


Latest Progress | Clutter Suppression

- Combining the PD working mode with refined signal processing enables the radar to deliver excellent detection performance under complex clutter environments.
- This technology has been successfully deployed on air traffic control radars at **Wuhan and Zhuhai** Airports in China.



Clutter Suppression Comparison - Before



Clutter Suppression Comparison - After

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Secondary Surveillance Radar

- SSR adopts **all-solid-state monopulse system, modular and digital design, with basic and enhanced Mode-S**, which can provide information of range, bearing, barometric altitude, identification code and other special signs of military and civil aircraft equipped with on-board transponders within the coverage area of the power, and it is suitable for monitoring of airways and terminal areas.



Latest Progress | Performance Enhancement

《Technical specification of ATC secondary surveillance radar》(MH/T 4010-2024)

No	Support Transaction	Detailed Content
1	Optimize Interrogate Control	1) Intermittent Lockout; 2) Co-ordinate Interrogate Control in cluster;
2	Broadcast	Comm-B Broadcast (Downlink);
3	Co-ordinate Surveillance	1) Use of II/SI Codes; 2) Mode S Protocols; 3) All-call Lockout; 4) Coverage Map Configuration; 5) Target Handover
4	ADS-B	Extended Squitter Protocol

Latest Progress | Performance Enhancement

Datalink Broadcast include Comm-A broadcast(Uplink) and Comm-B broadcast(Downlink)

The screenshot displays the Datalink Broadcast software interface, which includes a radar map on the left and several control panels on the right.

Display And Control DAP

Current BDS report

Select BDS code: BDS(0,5) Rollcall

Ask Period (0-255): 5

No.	BDS code	Interrogation cycles(s)
1	BDS (1, 0)	60
2	BDS (1, 7)	180
3	BDS (2, 0)	18
4	BDS (4, 0)	4
5	BDS (5, 0)	4
6	BDS (6, 0)	4

Basic Information - A0137 BDS Info

A code: A0137 Address: 781851

Flight No: CSN8695 Country: China

Range: 103.99km Azimuth: 90.00°

Height: 7795m Speed: 686.90km/h

Course: 334.29° SAM: 99

Flight State: No alert, no SPI, aircraft airborne

BDS Info: (4,0) (5,0) (6,0)

Display And Control DAP

Datalink Broadcast

Mode: 20 Channel No.: 0x01

Comm A: 00 00 00 00 01 00 00 00 00 00 00 00 Apply

Downlink Broadcast Data

☐ Pause

Time	Address	Track Number	Service Type	Service Data
18:00:30	78088b	492	Downlink Broadcast	10 03 0a 80 ed 00 00 00
17:59:12	780854	261	Downlink Broadcast	10 03 0a 80 f9 00 00 00
17:58:49	78088b	492	Downlink Broadcast	10 03 0a 80 ed 00 00 00
17:58:28	408142	442	Downlink Broadcast	10 03 0a 80 ed 00 00 00
17:57:57	78088b	492	Downlink Broadcast	10 03 0a 80 ed 00 00 00
17:56:17	78088b	492	Downlink Broadcast	10 03 0a 80 ed 00 00 00
17:55:56	408142	442	Downlink Broadcast	10 03 0a 80 ed 00 00 00
17:55:29	408142	442	Downlink Broadcast	10 03 0a 80 ed 00 00 00

Basic Information - BDS(1,0) BDS(1,7) Other BDS code BDS

Address code: 781831 A code: 0137

Azimuth: 90.000000 Range: 103.986966

Basic capability: CSN8695 Country: China

Flight state: SPI, aircraft airborne Height: 7795 m

ACAS: ACAS RLS, ACAS RBL, ACAS RBR, ACAS RA

- Comm-A Broadcast(Uplink):SSR send message to Aircraft, message content include Mode, Channel No. and other user data;
- Comm-B Broadcast(Downlink):SSR extract message from Aircraft, message content include real-time airborne information(BDS10、 BDS20、 BDS30).

Latest Progress | Performance Enhancement

Radar Interrogate Control

- The SSR supports a 12-cycle interrogation mode configuration to achieve continuous interrogation control during antenna scanning
- Lockout control support Intermittent Lockout (lockout cycle and non-lockout cycle alternate)

Control and parameter setting

Control Of Working Modes

◆ ATCRBS Mode ◆ S Mode

First cycle	Second cycle	Third cycle	Fourth cycle
AC	AC	NoMode	NoMode
Fifth cycle	Sixth cycle	Seventh cycle	Eighth cycle
NoMode	NoMode	NoMode	NoMode
Ninth cycle	Tenth cycle	Eleventh cycle	Twelfth cycle
NoMode	NoMode	NoMode	NoMode

All-call parameters in the first cycle

ATCRBS(AC)
ATCRBS Mode: 3/A

Response Probability
Response Probability: 1/2

Roll-Call parameter

Locking status
◆ Unlocked
◆ Locked

Locking cycle: 30 s
Unlocking cycle: 30 s

Cycle

All-call cycle (2-20): 3.200 ms
Roll-call cycle (2-20): 3.500 ms

Work Control

Tx control
◆ ON ◆ OFF

Selection of internal and external triggers
◆ Internal ◆ External

STC control
◆ Enable ◆ Invalid

PPC control
◆ Enable ◆ Invalid

Radar Power
Coverage: 450.000 km **Apply**

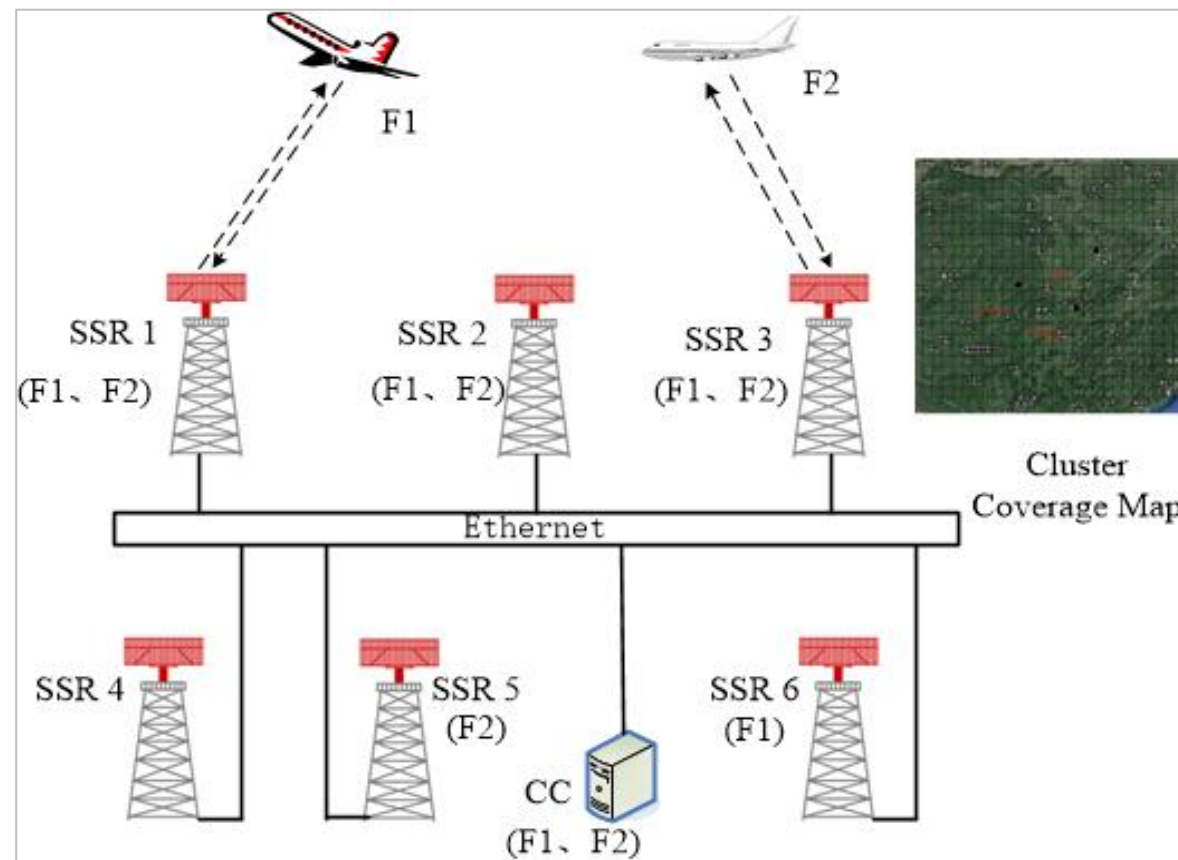
Repetition Frequency Setting
Repetition frequency stagger: ☒
Repetition frequency: 312 Hz

Radar Parameter
After clicking the [Save] button, the parameters on this settings interface will be saved in the radar computer. The saved setting is automatically loaded upon the next startup. **Save**

Close

Latest Progress | Surveillance Co-ordination Service

- **Surveillance Co-ordination Service:** A group of Mode S SSR(max 6) establish a cluster, then together complete the air target surveillance task.
- The technology of Surveillance Co-ordination Service include the correct use of II/SI codes, Mode S protocols, all-call lockout, coverage map configuration and target handover.

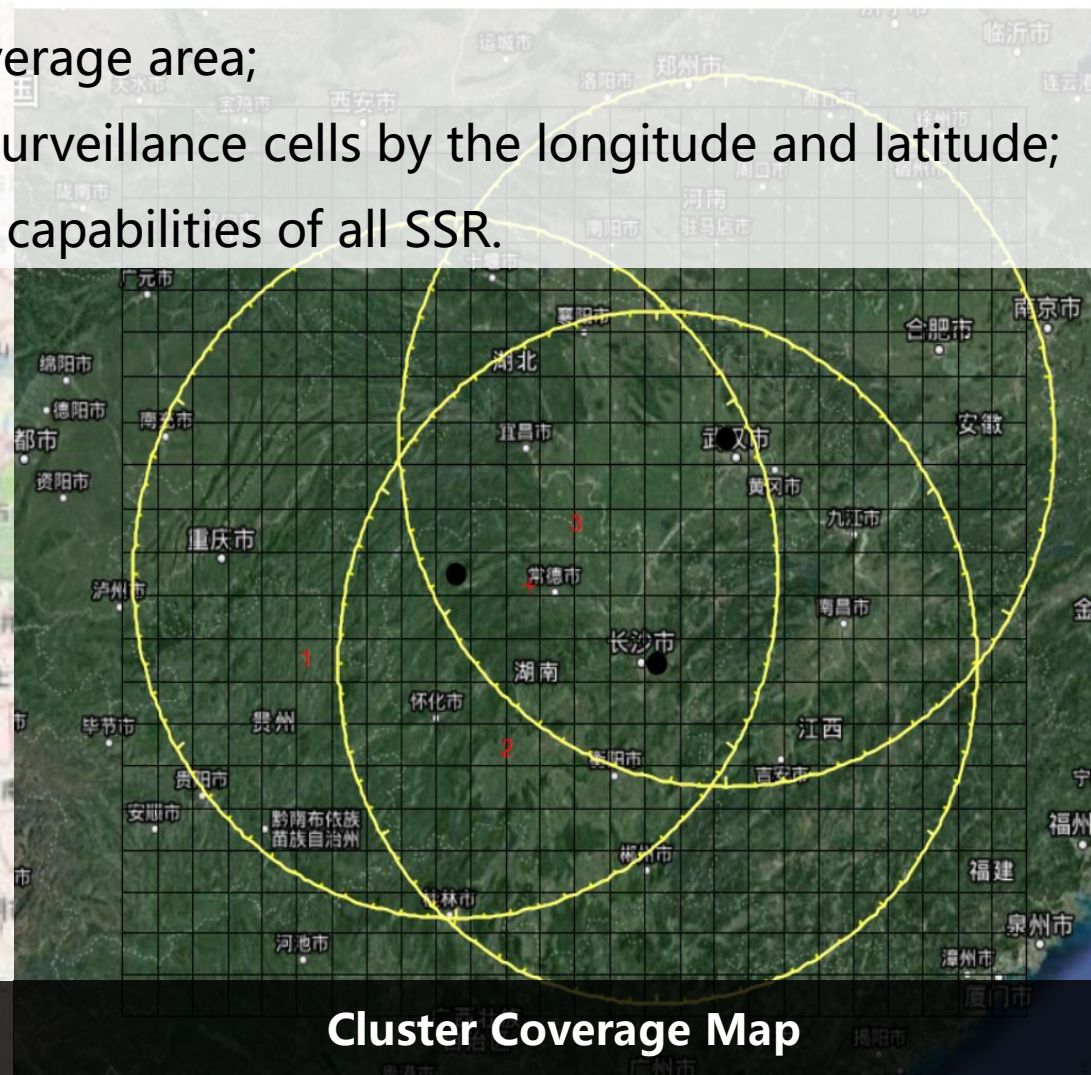


Latest Progress | Surveillance Co-ordination Service

- The Mode S SSR in cluster have overlapping coverage area;
- The cluster coverage area is divided into many surveillance cells by the longitude and latitude;
- Each surveillance cell can define the interrogate capabilities of all SSR.



Cluster Coverage Area

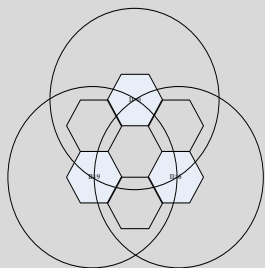


Cluster Coverage Map

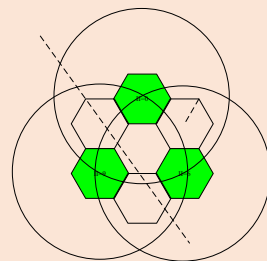
Latest Progress | Surveillance Co-ordination Service

Surveillance Co-ordination Service Features:

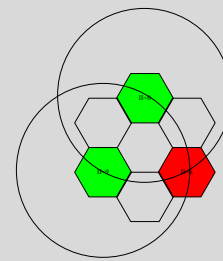
The SSR in the cluster perform unified interrogation control, which greatly reduces airborne radio-frequency signals and effectively avoids mutual interference.



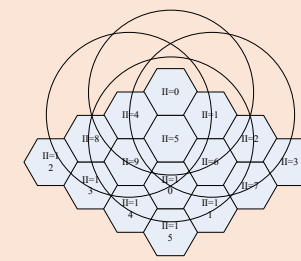
This effectively eliminates surveillance blind zones and false target problems associated with single SSR, while expanding coverage and enhancing tracking accuracy.



Cluster-wide S-mode interrogation control is implemented, which enhances the overall surveillance efficiency of the system.

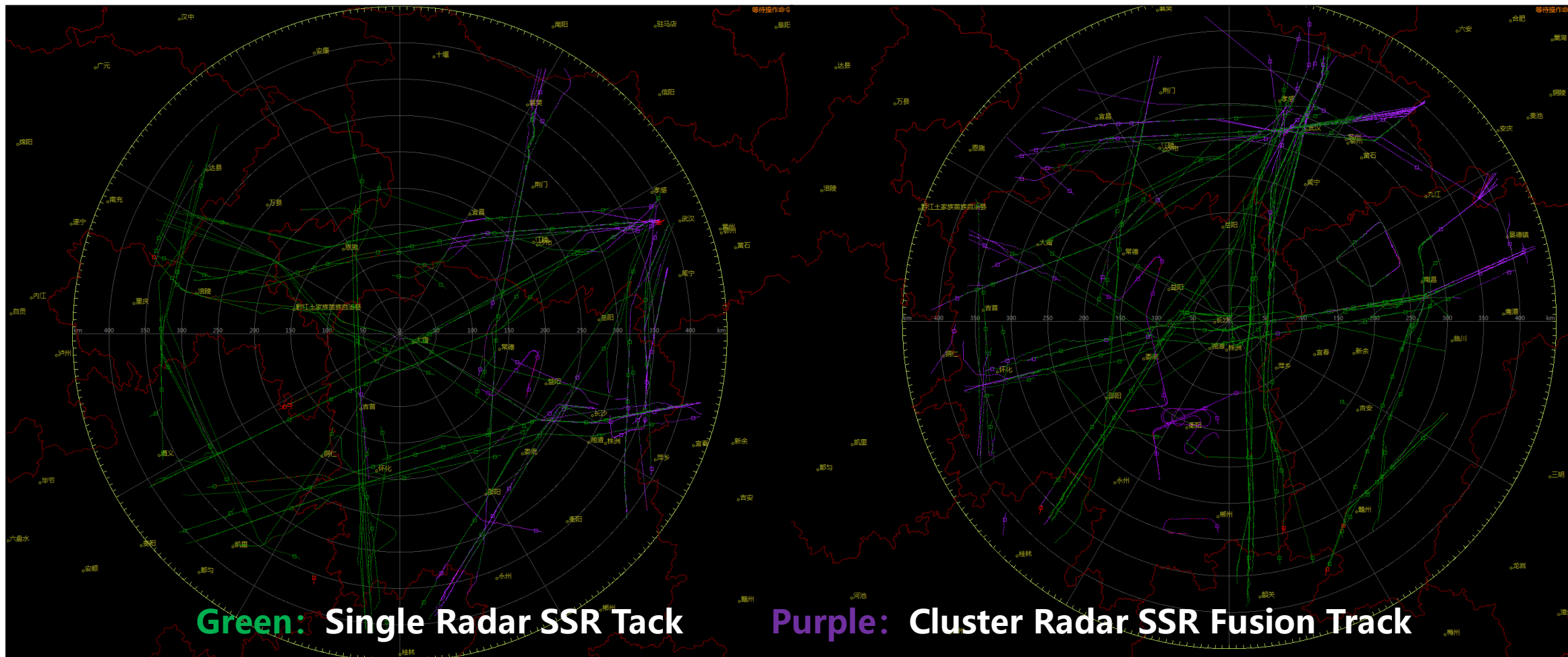


All radars in the cluster operate with a common II/SI code, thereby overcoming the inherent scarcity of II (15) and SI (63) code resources.



Latest Progress | Surveillance Co-ordination Service

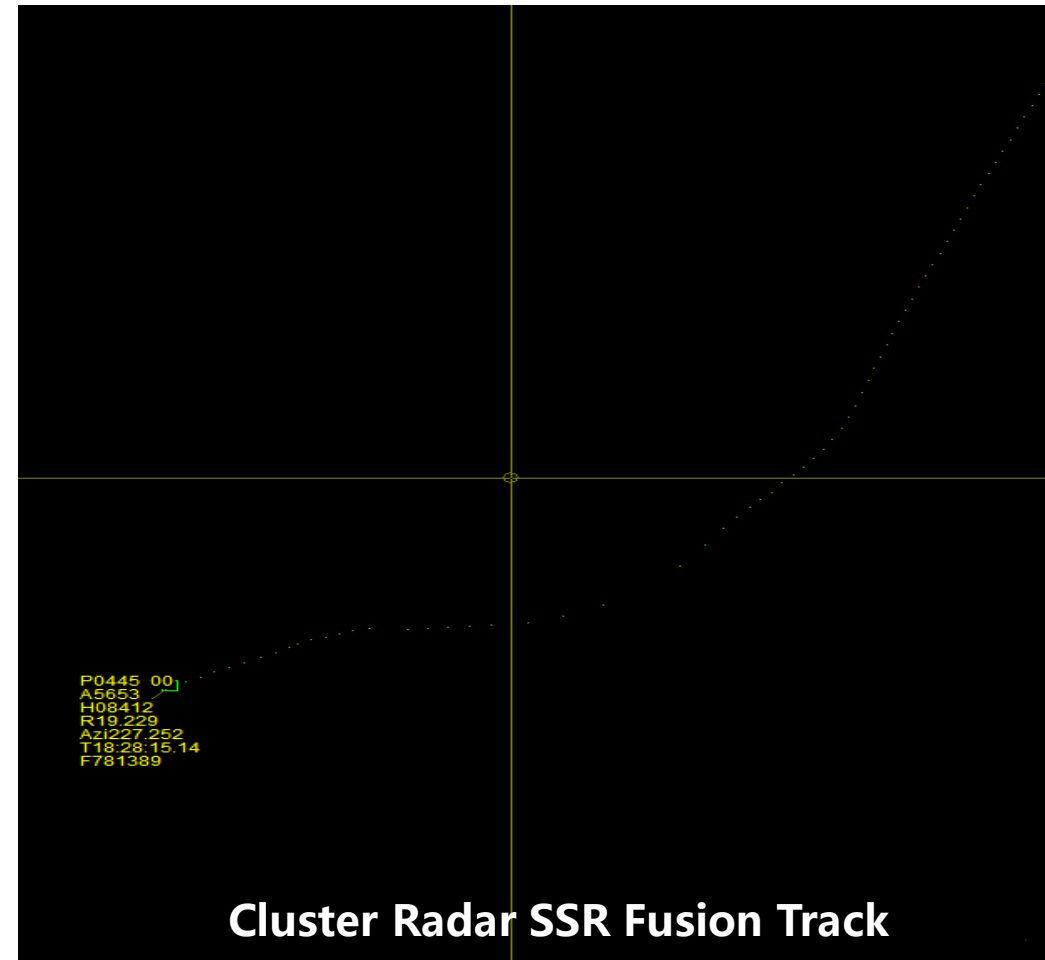
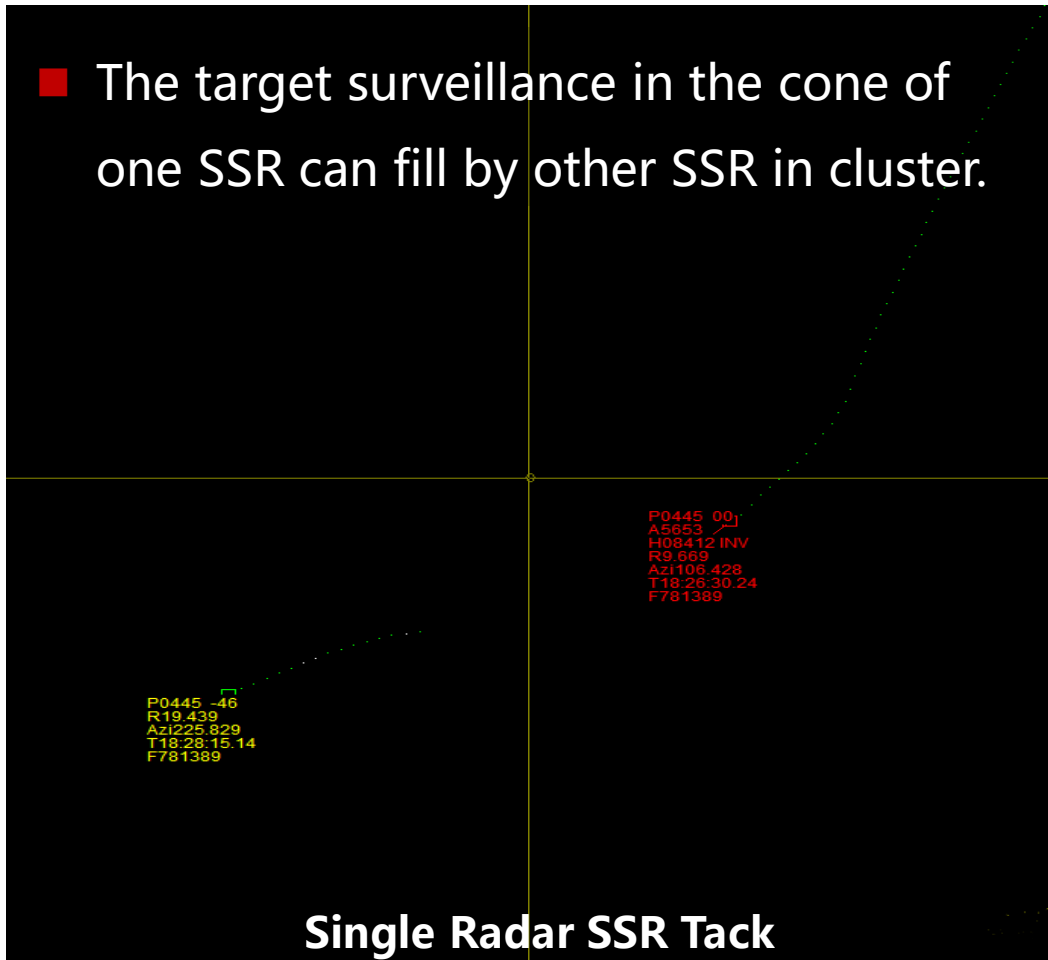
SSR Power Enhancement



Latest Progress | Surveillance Co-ordination Service

Radar Cone Fill

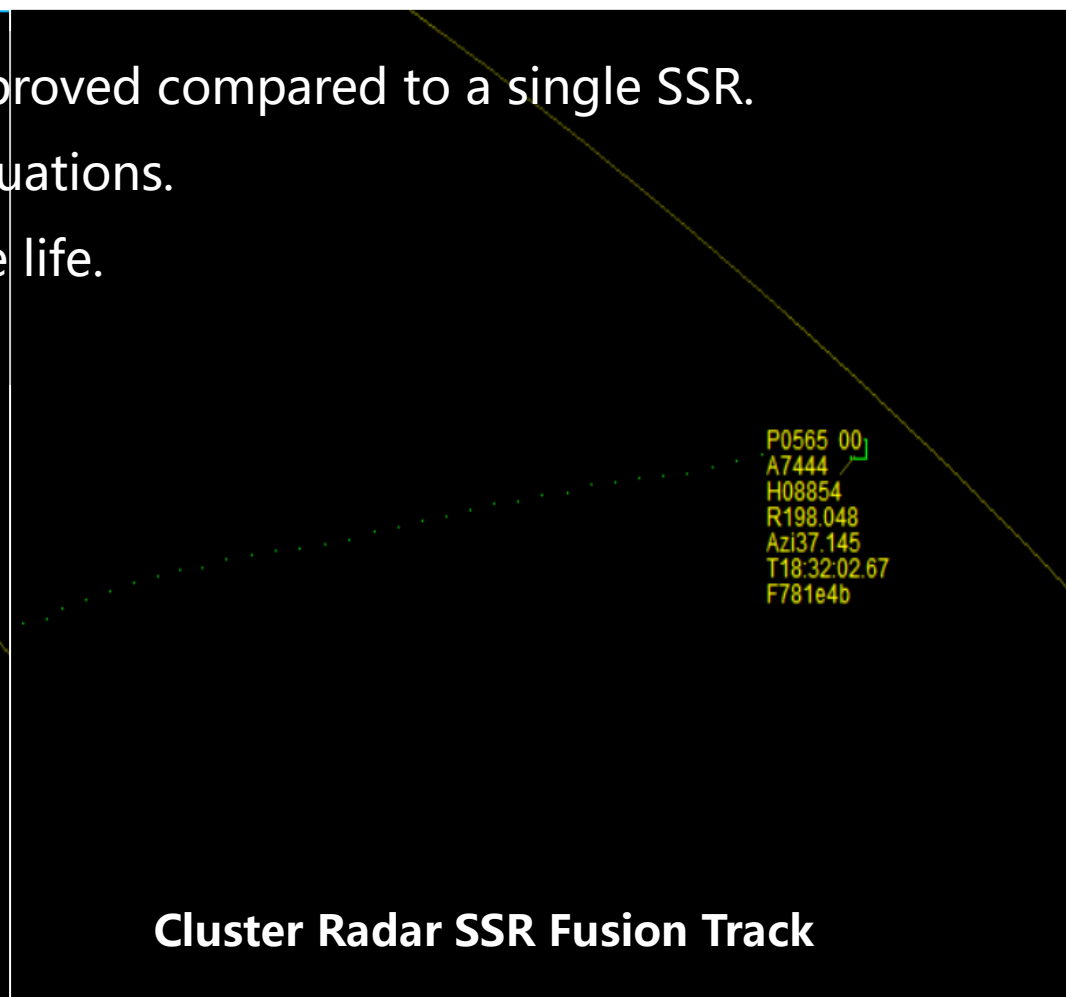
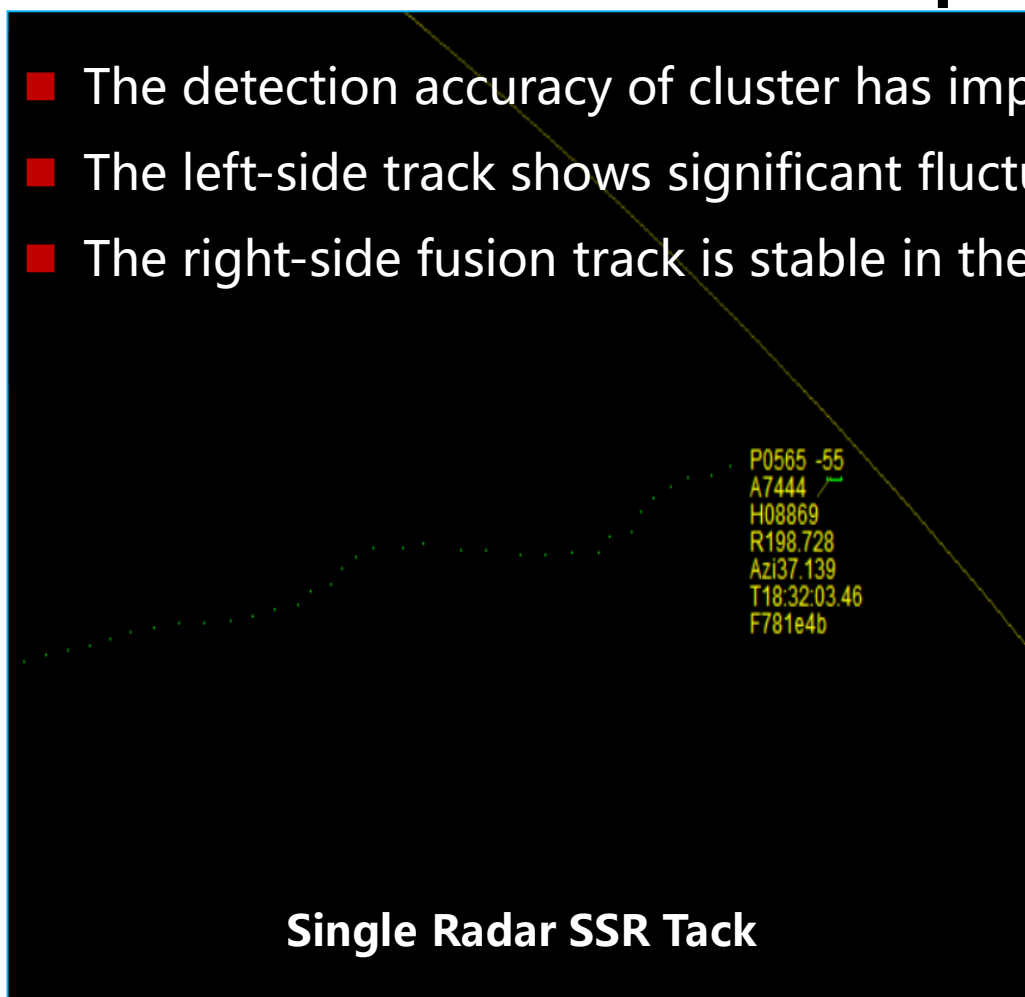
- The target surveillance in the cone of one SSR can fill by other SSR in cluster.



Latest Progress | Surveillance Co-ordination Service

Surveillance Performance Improvement

- The detection accuracy of cluster has improved compared to a single SSR.
- The left-side track shows significant fluctuations.
- The right-side fusion track is stable in the life.



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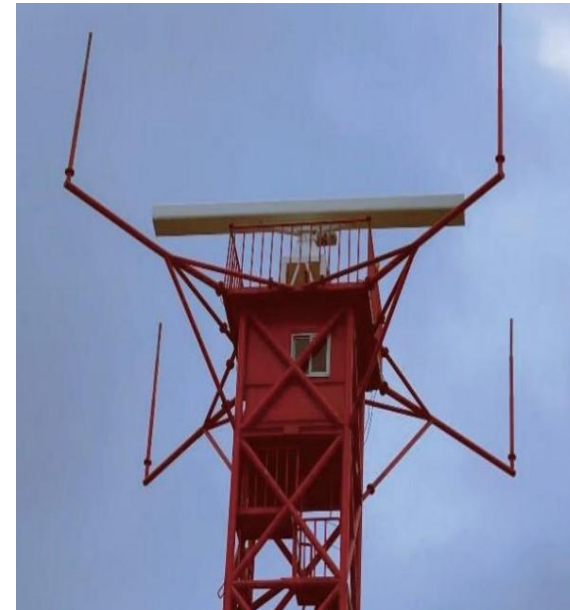
Latest Progress in SSR Technology

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Other Solutions

DLD-300A Surface Movement Radar

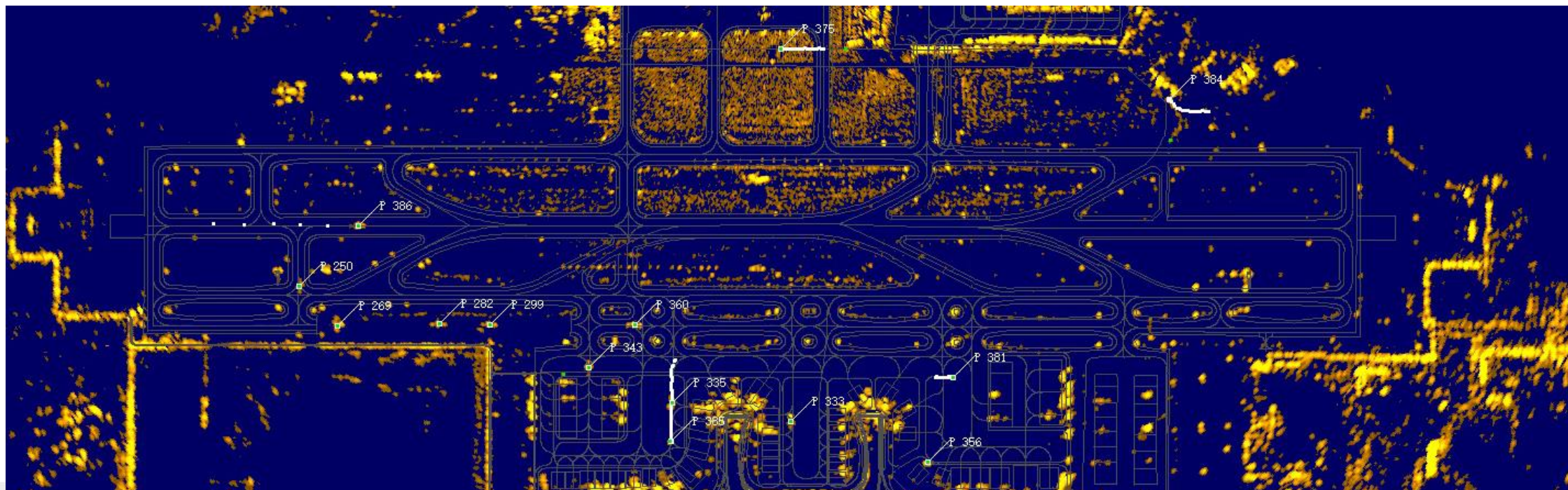
- The DLD-300A Surface Movement Radar adopts an **X-band full-solid-state pulse compression system** with frequency diversity function, which is capable of real-time tracking and detecting the moving targets on the ground and at low altitude within 6km range, providing information such as distance, bearing, speed, and heading of the targets.
- The radar **obtained a license from the CAAC in 2022** and has been successfully applied at Nanning and Wuxi in China.



DLD-300A Surface Movement Radar

Main features:

1. Full-solid-state pulse compression system with low power and high reliability
2. High-resolution waveguide slot antenna and two-dimensional mechanical scanning
3. **Low sidelobe pulse compression algorithm based on linear amplification technology**
4. **Super clutter target detection technology**
5. Noise suppression, interference suppression, clutter suppression, etc.



"Spider Web" Airport Clearance Protection System Solution

NRIET provides an integrated overall solution for anti-UAV and bird detection. With low-altitude surveillance radar as the core, it integrates electro-optical, spectrum detection and other equipment to effectively detect and identify UAVs and bird targets. It can reduce the probability of UAV intrusions and bird strike incidents and ensure airport airspace safety in real time.



Practical issue: UAVs and bird strikes rank as the top accident precursor category at civil aviation airports in China

Detection Targets



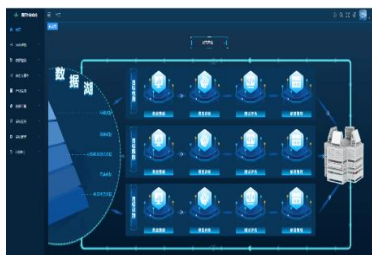
"Spider Web" Airport Clearance Protection System Solution

For airport clearance protection scenarios, NRIET has built a complete closed-loop product system from advanced sensors to efficient kill chains, achieving integrated bird detection and anti-UAV capabilities.

Command and Decision-



Low-Altitude Safety Management and Control Platform



Low-Altitude Cloud-Edge-Terminal Digital and Intelligent Base Platform

Detection and Identification



Low-Altitude Surveillance Radar



Spectrum Detection Equipment



Electro-Optical Detection Equipment

Countermeasure and Disposal



Electromagnetic Net Capture Gun



Electromagnetic Net UAV Capture Device



combat drone fighter



Bird Repellent Cannon

THANKS