Tracking of aircraft

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Abstract— **The main aim of this paper is to provide an overview on tracking of aircraft. This paper focus on tracking of aircraft using radar and new technology better than radar and this paper also throws light on ADS-B which is a new technology used for tracking of aircraft along with its advantages and applications.**

Index Terms—**ADS-B, PSC, SSC**

I. TRACKING RADAR SYSTEM

A Tracking radar system measures the coordinates of a target and provides data which may be used to determine the target path and to predict its future position. There are two types of tracking radar

- **Primary Surveillance Radar -** A Primary surveillance Radar is used to convey high-frequency signals towards the targets. The transmitted pulses are replicated by the target and then they are acknowledged by that radar. The energy reflected is developed to obtain the target information.
- **Secondary Surveillance Radar -** Secondary surveillance radar unites the work with the active answer signals. This type of radar uses a transponder on the airborne target/object.

II. HOW RADAR IS USED TO TRACK AIRCRAFT

Radar is normally concealed. It is used in Air traffic control to track planes both on the ground and in the air. It is also used to guide plane for smooth landings. It is used by the military to detect the rival and to guide weapons. The air traffic controller can track the echoes on the display to determine the direction of aircraft. This is called **primary radar**. Primary radar is rarely used any more in isolation as there are too many planes in the sky.

These days, **secondary radar** is also used, in which a coded pulse series is sent to the aircraft and a transponder on the plane generates a coded restore, consisting of a lot of information about the aircraft. This is also called as **identification friend.**

Secondary radar is mostly used in air traffic controllers to track commercial aircraft and only use real radar in the case where transponders are not fitted, are turned off or are broken if the aircraft transponder is switched off, it will be complicated to identify which one of the many primary radar echoes on the air traffic control display corresponds to the aircraft you are interested in.

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III. LIMITATIONS OF RADAR

For long distance procedures, the main obstruction with radar is that the quantity of power essential to send and receive the signal is dependent on the distance to the aircraft hoisted to the power of four. Therefore, if you want to double the range at which you can identify an aircraft, the amount of transmitted power must be raised by a factor of 16.

For long-range operations, the peak power required to send out the radar pulses become very large.

Typical radars that are used to track planes out to a range of 100 kilometers or more transmit peak powers in the megawatts. However, the pulse transmitted is short, normally one micro second or so, and they only occur for a few hundred times per second. So the average power is quite low.

Another limitation for long-range radar is caused by attenuation through the atmosphere i.e., in clear air, but the attenuation is worse in the rain. This is inversely related to the wavelength of the signal, so long range radars operates at very low frequency.

IV. NEW TECHNOLOGY BETTER THAN RADAR TRACKING

The technology that is better than Automatic Dependent Surveillance-Broadcast (ADS-B) technology is better than radar tracking and it guarantees more detailed tracking of planes than radar, even over water when planes are outside the scope of traditional radar.

As aircraft from more than a dozen countries continues to hunt for Malaysia airlines flight 370.Technology previously being rolled out in the U.S., Canada and elsewhere could prevent a recurrence of a "lost" jet airliner. The Federal Aviation Authority announced that it will be mandatory for all facilities to use ADS-B by 2020. Many newer planes already have it and organized more than 600 ADS-B enabled ground stations nationwide. But it takes time to retrofit existing gear, to build infrastructure and ADS-B is still wending its way through the certification — a process some ADS-B supporters hope that it will now be speeded up.

Company of Skip Nelson (CEO of Anchorage-based ADS-B Technologies) developed a technology named ALAS or the ADS-B Link Augmentation System. With ALAS, the ADS-B signal is basically copied and forwarded to a satellite system so that an airliner would be visible over water, mountainous terrain, or other places where there are no ADS-B ground antennas. ADS-B permits controllers to monitor an aircraft from the time it takes off to the time it lands using GPS satellite tracking rather than ground-based radar. In the future ADS-B equipped jets they would be signaling the data to a set of ground stations and to other planes throughout their journeys.

According to Barbee Ponder, general counsel and VP of regulatory affairs for Global star; global star could provide coverage worldwide with additional ground stations, each of which can cover a million square miles ADS-B Technologies

utilizes Global star for its work. As Kevin Fitchard has written, Global star and Iridium are pushing their respective satellite networks for use as consumer hotspots and now for air traffic control.

V. HOW ADS-B WORKS?

ADS-B is a system in which electronic apparatus involves an aircraft automatically that broadcasts the specific location of the aircraft via a digital data link. The data can be used by other aircraft and air traffic control to show the aircraft's position and altitude on the display screens without the need for radar.

The system engages an aircraft with ADS-B determining its position using GPS. A suitable transmitter is used to broadcast that position at rapid intervals along with identity, altitude, velocity and other data. Dedicated ADS-B grounds stations obtain the broadcasts and relays the information to air traffic control for specific tracking of the aircraft.

ADS-B data is broadcast every half-second on a 1090MHz, digital data link.

ADS-B emitter will periodically broadcast the required information obtained from the onboard navigation systems. This information is received by other operational aircraft and it is viewed it on cockpit display of traffic information (CDTI). The CDTI is a display that shows traffic in relation to your heading. It is also known as a mal-functional display that encompasses weather and navigation information.

ADS-B will be able to provide controllers on the ground with valuable information that they might not be able to see on modern secondary radar. If all aircraft were equipped, separation coverage would be granted everywhere not just in certain areas.

The ability of a ground station to receive a signal depends on altitude, distance from the site and obstructing terrain. The maximum range of each ground station can exceed 250 nautical miles. In airspace immediately surrounding each ground station, surveillance coverage extends to near the surface.

A. Comparison between PSR, SSR and ADS-B

Type	Independent?	Cooperative?
Primary surveillance radar(PSR)	Yes: surveillance data derived by radar	No: does not depend on aircraft equipment
Secondary surveillance radar(SSR)	Yes: aircraft range and azimuth derived by radar	Yes: requires aircraft to have working with transponder
Automatic dependant surveillance-Broadcast(ADS-B)	No: surveillance data provided by aircraft	Yes: requires aircraft to have working with ADS-B function

B. ADVANTAGES

ADS-B is used to provide traffic information to the pilot about surrounding aircraft. This information includes altitude, heading, speed, and distance to aircraft.

It also provides information for pilots, including weather.

It consists of better surveillance of the aircraft.

It provides more detailed plane tracking.

It has a huge fuel cost savings.

C. DISADVANTAGES

In order to work ADS-B properly in the air for collision avoidance, all the aircraft needs to be equipped.

There should be a system to obtain the aircraft's position from.

References

[1] New better-than-radar technology will boost aircraft tracking [online]. Available: https://gigaom.com/2014/04/08/new-better-than-radar-technology-will-boost-aircraft-tracking/

[2] FAA Officially Launches Radar's Replacement [online]. Available:www.flyingmag.com/gear/avionics/faa-officially-launches-radars-replacement

[3] How ADS-B works [online]. Available:www.airservicesaustralia.com/projects/ads-b/how-ads-b-works/