UNIVERSITI TEKNIKAL MALAYSIA MELAKA

OMNIDIRECTIONAL 1090 MHZ ANTENNA FOR AUTOMATIC DEPENDANT SURVEILLANCE BROADCAST (ADS-B)

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronic Engineering Technology (Telecommunications) with Honours.

by

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Tajuk: OMNIDIRECTIONAL 1090 MHz ANTENNA FOR AUTOMATIC DEPENDANT SURVEILLANCE BROADCAST (ADS-B)

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ABSTRAK

Automatic Dependent Surveillance-Broadcast (ads-b) adalah kaedah teknologi terbaru dalam pengawasan ruang udara. Ia juga satu teknik alternatif menyampaikan data kedudukan pesawat pesawat udara terus menghantar identiti mereka dan maklumat navigasi. isyarat atau amaran tersebut diterima oleh stesen bumi dan disampaikan kepada Air Traffic Services di mana ia digunakan untuk meningkatkan data radar. Ia juga boleh diterima oleh pesawat lain dan lalu lintas berhampiran. Kerana secara purata, lapangan terbang Malaysia kini mengendalikan sekitar 30,000 penumpang yang berlepas sehari, semasa menerima kira-kira 50,000 setiap hari untuk ketibaan. Ia berfungsi lebih daripada 60 syarikat penerbangan yang beroperasi di lapangan terbang. Data ADS-B dikumpulkan dari laman web yang diketahui untuk melihat ke dalam pergerakan pesawat terbang di atas ruang udara Semenanjung Malaysia dengan memplot trajektori laluan penerbangan berdasarkan maklumat ID penerbangan, latitud dan longitud dan altitud. Kita menunjukkan bahawa ini Sample kemasukan id penerbangan untuk "Boeing" yang AK6285 / AXM6285 dari airasia, dengan latitud: 43.5033, longitud: -79.1297 dan ketinggian: 7833.36. Kita menunjukkan bahawa dari trajektori penerbangan dan laluan penerbangan semua data yang dikumpul, ketumpatan dan aliran lalu lintas udara dari sistem ADS-B bagi Semenanjung Malaysia boleh dilihat.

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ABSTRACT

Automatic Dependent Surveillance-Broadcast (ads-b) is the newest technological vault in airspace surveillance. It also an alternate technique of presenting aircraft position data which aircraft continually transmit their identity and navigational information. Such signals or alert are received by ground station and relayed to Air Traffic Services where they are used to increase radar data. It can also be received by other aircraft and the nearby traffic. As on average, Malaysian airport currently handles around 30,000 departing passengers a day, while receiving around 50,000 daily for arrivals. It serves more than 60 airlines operating at the airport. The ADS-B data was gathered from the known website in order to look into the movements of aircraft flying over Peninsular Malaysia's airspace by plotting the trajectories of flight path based on its flight ID, latitude, and longitude and altitude information. We show that this Sample entries of flight id for “Boeing” which is AK6285/AXM6285 from airasia, with latitude: 43.5033, longitude: -79.1297 and altitude: 7833.36. We show that from the flight trajectories and flight path of all collected data, the density and flow of air traffic from the ADS-B system for Peninsular Malaysia can be visualized.

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DEDICATION

I would like to dedicated and special thanks to
My beloved father and mother,
To my beloved family, my respected lecturer and fellow friends
And for the rest, might Allah blessed you
Thanks for all the guided and support

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
1	-	Length
m	-	Mass
N	-	Rotational velocity
P	-	Pressure
Q	-	Volumetric flow-rate
r	-	Radius
T	-	Torque
Re	-	Reynold number
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

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CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter give an overview of the project regarding background of the project, omnidirectional 1090 MHz antenna for automatic dependent surveillance broadcast (ADS-B), the basic design of omnidirectional patch antenna, problem statement of the project, objectives to achieve, scope of the project and the thesis organization.

1.1 Background of Project

Over The Omnidirectional 1090 MHz Antenna for ADS-B is the project to characterize the omnidirectional antenna with the fixed frequency value of 1090 MHz with the effective receiving gain for ADS-B which act as portable receiver. Specifically, the omnidirectional antenna able to perform the clear wireless transmission that radiates or intercepts the radio-frequency (RF) electromagnetic field very well in the horizontal direction in flat position. Therefore, the ADS-B, in particular, is the surveillance technology in which the involving aircraft capable to determine the specific position by using the navigation provided by satellite and broadcast about it occasionally. The information gathered is able to be received by air traffic from the ground based station as the good replacement for the secondary surveillance radar. To perform the suitable simulation of this project, i choose the computer simulation software such as CST and FEKO. Those simulation software mean to be used to design and portrayed the antenna for the optimum return loss and gain. In order to perform the clear simulation, the antenna mean to be tested on the vector network analyzer for the direct comparison of the actual result against the simulation. The simulation mean to improve antenna gain. The antenna gain shall be increased the radius or range of the reception for the ADS-B signal to be received.

The system involves an aircraft with ADS-B determining its position using GPS. A suitable transmitter then broadcasts that position at rapid intervals, along with identity, altitude, velocity and

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other data. Dedicated ADS-B grounds stations receive the broadcasts and relay the information to air traffic control for precise tracking of the aircraft.

Automatic – Requires no pilot input or external interrogation.
Dependant – Depends on accurate position and velocity data from the aircraft's navigation system (ex. GPS).
Surveillance – Provides aircraft position, altitude, velocity, and other surveillance data to facilities that require the information.
Broadcast – Information is continually broadcast for monitoring by appropriately equipped ground stations or aircraft.
ADS-B data is broadcast every half-second on a 1090MHz, digital data link.

Broadcasts may include:
Flight Identification (flight number call sign or call sign)

- ICAO 24-bit Aircraft Address (globally unique airframe code)
- Position (latitude/longitude)
- Position integrity/accuracy (GPS horizontal protection limit)
- Barometric and Geometric Altitudes
- Vertical Rate (rate of climb/descent)
- Track Angle and Ground Speed (velocity)
- Emergency indication (when emergency code selected)
- Special position identification (when IDENT selected)

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.

1.2 Problem Statement

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Automatic dependent surveillance broadcast (ADS-B) was a completely new paradigm for air-traffic control not only in Malaysia but all over the world. Every participant retrieves their own position and velocity by using an on board GPS receiver, provide a varies frequencies or band allocation and bandwidth. The ADS-B coverage reception standards have been proposed: Universal Access Transceiver (UAT) and 1090 MHz Extended Squitter (1090ES). UAT has been created specifically for the use with aviation services such as ADS-B, utilizing the 978MHz frequency with a bandwidth of 1Mbps. Since UAT requires fitting new hardware, as opposed to 1090ES, it is currently only used for general aviation in EUROCONTROL and FAA-mandated airspaces. Commercial aircraft, on the other hand, employ SSR Mode S with Extended S quitter, a combination of ADS-B and traditional Mode S known as 1090ES. To minimize these limitations, the enhancement of an external Omnidirectional antenna shall be designed using the RF microwave software application such as CST simulation tools. It is predicted to have improved signal to noise ratio, VSWR and better antenna gain.

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1.3 Objectives

This project purpose to make the measurement of the antenna which suitable to the current wireless technology in Malaysia. Therefore, various objectives are stated to attain the goal of the project. The main objective for this project :

i) To study the high gain directional using Omnidirectional 1090 MHz antenna and to study the antenna capability.

ii) To design Omnidirectional antenna that is capable to get the information from high frequency such as Automatic dependent surveillance-broadcast (ADS-B) system (1090Mhz).

iii) To measure and analyze the performance, sensitivity of the receiver.

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1.4 Scope of Project

This study is proposed to develop and improvise an antenna that covers the frequency of ADS-B operation. The designed Omdirectional antenna is capable to operate at ADS-B frequency. The standard frequency of ADS-B are 1090 MHz respectively. Antenna development and analysis is using the CST simulation software. This simulation tools will be used to assess the performance of the newly design antenna in terms of return loss, radiation pattern, bandwidth, gain, efficiency and VSWR. After that, the designed antenna is fabricated by using enamel copper wire, coaxial cable and SDR software defined radio USB dongle . Lastly the fabricated antenna will be tested with real applications which is RTL 1090 software.

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