Deployable Quadrifilar Helical Antenna for space applications

Using Nickel Titanium

Master thesis

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Here you can write something about which tools and software you have used for typesetting the document, running simulations and creating figures. If you do not know what to write, either leave this page blank or have a look at the colophon in some of your books.

AALBORG UNIVERSITY
STUDENT REPORT

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Here is the abstract

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Her er resuméet

Contents

Todo list

Preface

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Aalborg University, November 6, 2018

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Chapter 1

Introduction

Automatic dependent surveillance-broadcast (ADS-B) is used of air planes to transmit their identity and location obtained by GPS. In this project an antenna for satellite communication will be developed.

add more

Chapter 2

ADS-B signals

Automatic dependent surveillance-broadcast (ADS-B) is a system in which aircraft continually transmit their identity and GPS-derived navigational information. ADS-B networks for air traffic monitoring have already been implemented in areas around the world, but ground stations cannot be installed in mid-ocean and are difficult to maintain in the Arctic, leaving a coverage gap for oceanic and high latitude airspace [Francis, 2011]. Therefore a solution can be to monitor the signals with a low orbit satellite using an antenna matched to the frequencies of the ADS-B.There are currently three types of ADS-B transmissions, including the 1090 MHz extended squitter (ES), the 978 MHz universal access transceiver (UAT), and the VHF data link (VDL) mode 4 operating between 108 and 137 MHz.
An ADS-B message is 112 bits long and the transmission takes 120us. The mudulation is pulsed RF and the package consist of 5 parts. The first part is Downlink Format which tells that this is an ADS-B signal, second part is Additional Identifier which has different meaning within each ADS-B subtype. The third is the ICAO which is the unique identifier of the aircraft. The fourth is the DATA which contains several informations including aircraft operation status, airborne position and velocities measured from different sensors. The fifth and last is the checksum [**?**]. It is observed that the ADS-B signal is a unencrypted signal which makes it easy to detect and therefore also vulnerable to attacks [**?**].

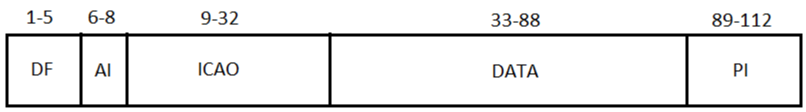


Figure 2.1: 112 bit long ADS-B message

1090MHz Mode S Extended Squitter

This is the most common frequency in ADS-B. It uses a single channel at 1090MHz and is used for communication from aircraft to ground only. The message is sent in intervals determined by the aircraft commonly every second.

978MHz Universal Acces Transceiver
This is a newer standard that communicates from aircraft to aircraft. It uses a single frequency at 978MHz.
108-137MHz VHF Data Link Mode 4
This is most commonly used at small airplanes. It is multi-channel where the frequency depends upon the local regulations. The channel spacing is 1MHz.

Chapter 3

linkbudget

Typically in satellite communication a LOS component exist. Therefore the only obstacle between the satellite and user is the atmosphere and therefore the loss can be modelled as free space, with a limited variation due to weather conditions. ADS-B signal is sent through a linear polarized monopol with power varying from 75 W to 500 W depending of the airplane and speed [Francis, 2011]. The height of a low orbit satellite is between 600 km to 800 km. To calculate the power loss Friis Transmission Equation is used. It is assumed that the SNIR is minimum 9dB [?]

$$\frac{P_r}{P_t} = (\frac{\lambda}{4\pi R})^2 G_t G_r |\vec{P}r \cdot \vec{P}t|^2 \tag{3.1}$$

$$\lambda = \frac{c}{f} \tag{3.2}$$

Where $c = 3e8$ is speed of light in vaccum and f is the frequency in Hz. $|\vec{P}r \cdot \vec{P}t|^2$ denotes polarization mishmash. When solving for $f = 137MHz$ $R = 800km$ $G_t = 0dB$ and a polarization loss at 0, the free-space loss becomes 133.2dB.

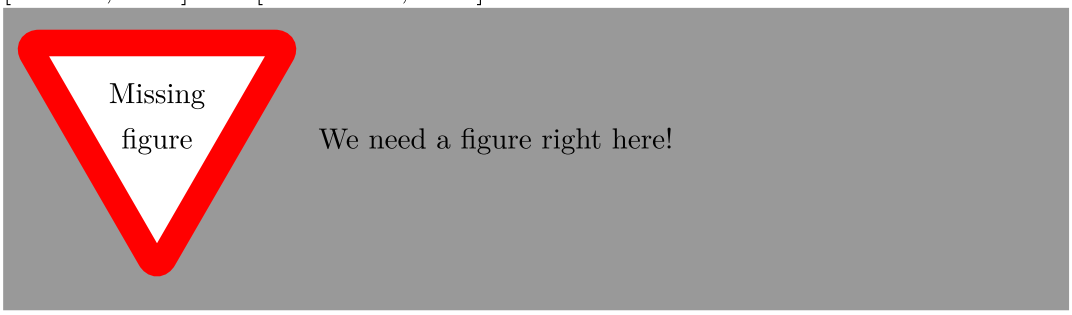
Item	*Link parameter*	*Value*	*Unit*	*Computation*
1	Frequency	1090	MHz	
2	Transmit power (75W)	18.8	dB	
3	Transmit antenna gain	3	dBi	
4	Athmospheric absorbtion (clean air)	0.1	dB	
5	Free-space loss	151.3	dB	
6	Polarisation loss	3	dB	
7	Received carrier power	-135.6	dB	2+3-4-5
8	Bandwith (4.6MHz)	66.6	dB Hz	
9	System noise temperature (373K)	25.7	dBK	
10	Boltzmann's constant	-228.6	dBW/Hz/K	
11	Noise power	-136.6	dBW	8+9+10
12	Carrier to noise ratio	7.0	db	7-11
13	C/(N+I)	9	db	Requirement
14	Receive antenna gain	2	db	13-12

Chapter 4

Chapter 2 name

Here is chapter 2. If you want to leearn more about LaTeX 2$_{\varepsilon}$, have a look at [?], [Oetiker, 2010] and [Mittelbach, 2005].

I think this word is mis-pelled



Chapter 5

Conclusion

In case you have questions, comments, suggestions or have found a bug, please do not hesitate to contact me. You can find my contact details below.

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Bibliography

Francis, e. a. (2011). The flying laboratory for the observation of ads-b signals. https://www.hindawi.com/journals/ijno/2011/973656/.

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Oetiker, T. (2010). The not so short a introduction to LaTeX2e. http://tobi.oetiker.ch/lshort/lshort.pdf.

Appendix A

Appendix A name

Here is the first appendix