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.

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AALBORG UNIVERSITY
STUDENT REPORT

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Deployable Quadrifilar Helical Antenna for space application

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Participant(s):
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Supervisor(s):
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Here is the abstract

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STUDENTERRAPPORT

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Her er resuméet

Contents

Todo list

Preface

Here is the preface. You should put your signatures at the end of the preface.

Aalborg University, October 10, 2018

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Chapter 1

Introduction

Here is the introduction. The next chapter is chapter 4.

1.1 Examples

You can also have examples in your document such as in example 1.1.

Example 1.1 (An Example of an Example)
Here is an example with some math

$$0 = \exp(i\pi) + 1 \ . \tag{1.1}$$

You can adjust the colour and the line width in the `macros.tex` file.

1.2 How Does Sections, Subsections, and Subsections Look?

Well, like this

1.2.1 This is a Subsection

and this

This is a Subsubsection

and this.

A Paragraph You can also use paragraph titles which look like this.

A Subparagraph Moreover, you can also use subparagraph titles which look like this. They have a small indentation as opposed to the paragraph titles.

Is it possible to add a subsubparagraph?

I think that a summary of this exciting chapter should be added.

Chapter 2

Usecase

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.Requirements for an satellite receiving antenna is listed below.

- Cover the frequency ranges from 108-137MHz and 978-1090MHz
- To be stowed in a 1U cubesat before and on launch
- Unfold when in orbit
- Circular polarized

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.

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

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

Where $c = 3e8$ is speed of light in vaccum and f is the frequency in Hz. $|\vec{Pr} \cdot \vec{Pt}|^2$ 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.

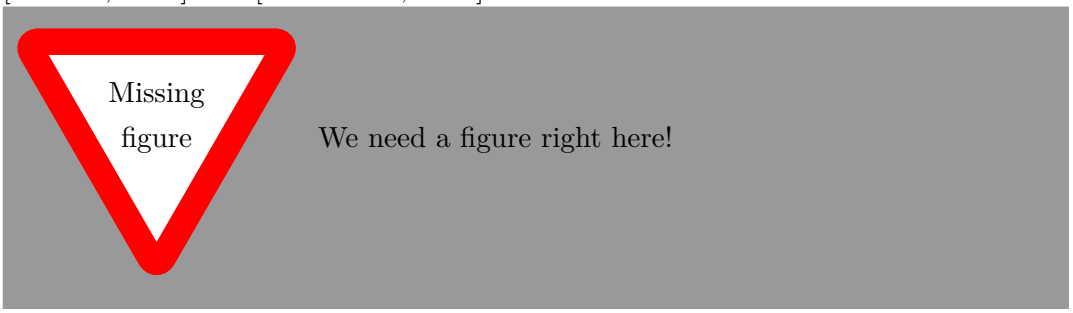
Item	*Link parameter*	*Value*	*Unit*	*Computation*
1	Frequency	1090	MHz	
2	Transmit power (75W)	18.8	dB	
3	Transmit antenna gain	0	dBi	
4	Athmospheric absorbtion (clean air)	0.1	dB	
5	Free-space loss	151.3	dB	
6	Polarisation loss	3	dB	
7	Received carrier power	-132.6	dB	2-4-5
8	Bandwith (4.6MHz)	66.6	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	4.0	db	7-11

Chapter 4

Chapter 2 name

Here is chapter 2. If you want to leearn more about LaTeX 2_ε, have a look at [**?**], [Oetiker, 2010] and [Mittelbach, 2005].

I think this word is misspelled



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/.

Mittelbach, F. (2005). *The LATEX companion*. Addison-Wesley, 2. ed. edition.

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