dedication (optional)

Summary

Write your summary here...

Preface

Write your preface here...

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Abbreviations

Symbol = definition

Chapter 1

Introduction

1.1 Background and motivation

Why is the project thesis relevant: Installing better GPS to enable better hight estimation

What have I done? Integrated new GPS with DUNE

What is next? Land the UAV. Test algorthm to Frlich, better state estimation

Unmanned aerial vehicles have in seen an increase usage in the civilian sector on land, where they can be used at a cheaper price then manned aircraft. However this has not jet been the case in the civil maritime sector, due to a harsher environment and smaller landing areas.

A UAV can increase performance in many maritime operation where today only other manned aircraft or satelites are the only solution. In the maritime sector they can be used in iceberg management, monitoring of oil spills, search and rescue and maritime traffic monitoring. To enable a safe UAV operation at sea there must be a system in place to ensure a safe landing.

There exist landing system that can guide the UAV towards a net, but they are expensive and restricted to a few UAVs. A pilot could always land the UAV, but it would be better if the UAV could hit the net by it self. In order to make the UAV able to performe a automatic landing the minimum requirement is that it know where it is at all time. Estimation of the altitude can give error over 1 meter, which is unacceptable for a automatic landing system

Unmanned aerial vehicles (UAVs) have long been used by the military, but is now becoming increasingly more popular in the civilian sector. UAVs is a cheaper alternative in some situation like . Today manned helicopters and aircraft in jobs like aerial photography, and large area inspections. That increase the cost of such operation, and have the limitation that aircraft and helicopter mostly needs an airport to operate from. UAVs do not have the same limitation. A fixed wing drone can be launched from a catapult, and can be design such that it do not need a runway to land.

UAVs are predicted to be more applied in the industry. In the maritime sector they can be used in iceberg management, monitoring of oil spills, search and rescue and maritime traffic monitoring.

UAV operations from ship is considered more challenging compared to land operation. Launching UAV from a maritime platform can be done with a catapult, witch is a common way to launch UAV even on land. However, landing the UAV poses several problems. A ship has usally limited space, and if it's not design as an aircraft carrier landing on the deck is not an option. Existing system today relay on a net placed somewhere on the ship that caches the UAV. The problem with this solution is that it requires a guiding system either on the ship or in the UAV to hit the net.

Talk some about GPS system. It is nesesary to enable the UAV to land

Today UAVs are mostly used on land, but the possibility to apply them in maritime sector is something that are being develop. Fixed wing UAVs has the advantages that they can cover huge areas, compared to unmanned helicopters. The drawback of fixed wing is the recovery phase. There exist landing system, but they are limited to a few UAVs, and expensive to install (need reference). UAVs can be used to track icebergs or applied in search and rescue.

What is the problem with flying from a ship

A automatic recovery system for UAV on a ship would over time remove the need of a pilot on-board the ship. (maybe in emergency) could ask about that.

How should this thesis help solve that problem

This project theises is about implement and test a nett landing system using RTK-GPS for position measurement.

1.2 Previous work

On the landing subsject: The UAV lab community; direct link to Frlich work.

Other master thesis, paper on visual aid landing system. Frlich did the same research, using reasearch from Spocli.

1.3 Goal of thesis

Install new GPS reciver with higher accuracy to enable automatic landing

1.4 Layout of thesis

```
\begin{eqnarray}\label{eq1}
F = m \times a
\end{eqnarray}
```

This will produce

$$F = m \times a \tag{1.1}$$

To refer to the equation

```
\eqref{eq1}
```

This will produce (1.1).

1.5 Figures

To create a figure

```
\begin{figure}[h!]
  \centering
    \includegraphics[width=0.5\textwidth]{fig/pikachu}
  \caption{Pikachu.}
\label{fig1}
\end{figure}
```

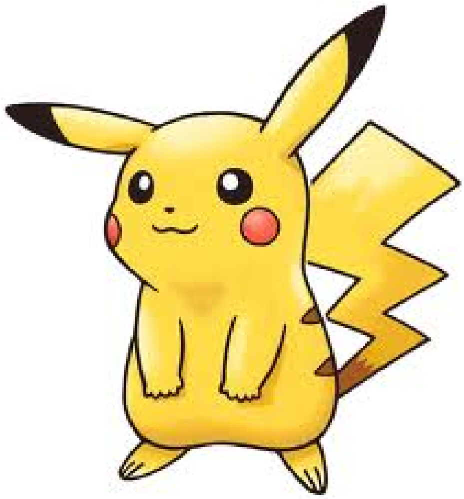

Figure 1.1: Pikachu.

To refer to the figure

```
\textbf{Fig. \ref{fig1}}
```

This will produce **Fig. 1.1**

1.6 References

To cite references

```
\cite{1,2,3}
```

or

```
\citep{1,2,3}
```

This will produce: Sarma and Chen (2008); Brouwer and Jansen (2004); Muskat (1937) or (Sarma and Chen, 2008; Brouwer and Jansen, 2004; Muskat, 1937), respectively.

1.7 Tables

To creat a table

```
\begin{table}[!h]
\begin{center}
    \begin{tabular}{ | l | l | l | l |}
    \hline
    \textbf{No.} & \textbf{Data 1} & \textbf{Data 2} \\ \hline
     1 & a1 & b1 \\ \hline
     2 & a2 & b2 \\ \hline
    \end{tabular}
\end{center}
\caption{Table 1.}
\label{Tab1}
\end{table}
```

No.	**Data 1**	**Data 2**
1	a1	b1
2	a2	b2

Table 1.1: Table 1.

This will produce
To refer to the table

```
\textbf{Table. \ref{Tab1}}
```

This will produce **Table. 1.1**.

Chapter 2

Background Theory

In this chapter outline path planing and position measurement.

2.1 Path planing

How to find a way, follow a path, geeing from A to B or simply hitting something. When a system is required to find a way, follow a path, moving from A to B or moving toward something it need to plan a path. The path can have different requirements such as limitation on deviation from path, speed requirement or time requirement. Also it might be that a straight line is not an option. This thiess will focus on the path following part of path planning. The path is given by several wayponits that represent a end of a straight line. En figur an WP hadde vrt fint her.

2.1.1 Straight lines

2.1.2 Interpolation

2.1.3 Dubins path

Include a figure that show dubins path. Might use plots from assignment 3 i Guidance and Control. Same in the two previous subsections.

2.2 GPS

Basic on how a GPS works. Also write about error sources and method to estimate position.

2.2.1 RTKGPS

Chapter 3

Real time kinematic GPS

This chapter outline the basic of the GPS signal. how RTKGPS works. It's assumed that the reader is familiar with how a single GPS receiver works. The first section give a brief summary on what differential GPS is, and how that principle is applied in RTK-GPS. The two following sections is directly used in RKT-GPS(maybe write some more). The last section give a quick overview over the error sources that effect the measurement.

A short description of GPS signals and error sources. How to find the Ambiguity resolution and why it's important. What is differential gps, and why use RTK-GPS.

3.1 GPS signals

Signal structure for the L1 signal. No need to write that much about the L1 signal. The signal structure form GPS is written:

$$L_1(t) = A_1 p(t) d(t) \cos(f_1 t) + A_1 c(t) d(t) \sin(f_1 t)$$
$$L_2(t) = A_2 p(t) d(t) \cos(f_2 t)$$

The carrier frequencies for the L_1 and L_2 signal are

$$f_1 = 1575.42 MHz$$
$$f_2 = 1227.60 MHz$$

A_1 and A_2 are the signal amplitude, and $c(t)$ and $p(t)$ are the Pseudo Random Noise, where $c(t)$ is sequences modulated into the L_1 signal and $p(t)$ into both the L_1 and L_2 signals. This thesis will mainly focus on the L_1 signal.

Could tell what c(t) and p(t) is, and what is known about them. Also the strength of A1 and A2. How the psudorange is not important for this thesis.

What is important:

Have done: Setting up the new GPS in the base station and in x8. Need to explain how rtklib work, and what is RTKGPS. Also need to talk about Ublox LEA M8T. It's here the talk about L1 becomes relevant. Maybe talk about the coordinate frame. Why use NED/ENU with base-station as fixed frame. The configuration of the GPS (elvation mask, kalman filter, search algortihm). Think I must remove the path theory chapter. Insert a theory chapter about coordinate frames. Maybe a chapter about Kalman filtering.

3.2 Differential GPS

Differential GPS consist of at least two receivers, where one is called a base station and the rest rovers. The two receivers are within range of a communication channel over which they are communicating. There are two basic ways to implement DGPS. There is the position-space method and the range-space method. Only the latter will be covered in this thesis.

Need to write about baseline restrictions. In the case of this thesis is a moving baseline relevant.

3.3 Interger Ambiguity Resolution

Interger Amiguity is used to calculate the carrier phase

$$\phi(t) = \phi_u(t) - \phi^s(t - \tau) + N \tag{3.1}$$

3.3.1 Search space minimization strategies

Liste different staretgies.

3.4 Error sources

Link the error source to where they originate

3.4.1 Clock error

There is drift in both the satellite clock and the receiver clock. The satellite clock drift is smaller, because the clock is an atomic clock. The receiver clock error can be relative large. The satellite clock error given in the satellite message.

3.4.2 Ionospheric and Trophospheric Delays

Effect of signals travelling through the atmosphere. Free electrons from ultraviolet rays ionize a portion of gas molecules. These influence electromagnetic wave propagation.

Ionospheric delay

Troposheric delay

Tropshospheric: clody weather, rain or sun. Local effect. Is removed with DGPS

3.4.3 Ephemeris Errors (maa leses om; se foiler?)

Error from satellites out of position. Cannot be corrected locally, but are maintained by someone.

3.4.4 Multipath

Main source of error in DGPS. Cannot be removed.

Chapter 4

System Components

This chapter contains a brief description of the system that has been used.

4.1 Software

4.1.1 Dune

A type of middleware

4.1.2 Netpus

4.1.3 Ardupilot

Ref to Grytes simulator.

4.1.4 RTKLIB

4.2 Physical system

4.2.1 x8 with all components

Chapter 5

Experimental testing

5.1 SIL testing

5.2 HIL testing

5.3 Physical testing

5.3.1 Fly test

5.3.2 GPS test

Chapter 6

Conclusion and Discussion

Bibliography

Brouwer, D. R., Jansen, J. D., 2004. Dynamic optimization of waterflooding with smart wells using optimal control theory. SPE Journal 9 (4), 391–402.

Muskat, M., 1937. Flow of Homogeneous Fluids. McGraw Hill.

Sarma, P., Chen, W. H., 2008. Applications of optimal control theory for efficient production optimization of realistic reservoirs. In: Proceedings of the International Petroleum Technology Conference. Kuala Lumpur, Malaysia.

Appendix

Write your appendix here...