Lucerne University of Applied Science & Architecture

ARIS - Data Fusion for a Sounding Rocket

Bachelor Thesis

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Declaration

Hereby, I declare that I have composed the presented paper independently on my own and without any other resources than the ones indicated. All thoughts taken directly or indirectly from sources are properly denoted as such. This paper has neither been previously submitted to another authority nor has it been published yet.

Horw, March 11, 2018

Abstract

This is the Abstract

Contents

Chapter 1

Introduction

Simon (2006)

1.1 Bla

About Sensor Fusion and ARIS

1.2 Research

Write about the Papers/book you used: Kalman-filter Optimal state estimation The Master Thesis

1.3 Problem

State the problem, what will be difficult ? For what is it ? where should it be improved

Problems found so far:

- How to calculate Height out of Pressure/Temp/Humidity Fabian version: $44330 * (1 - (\frac{pressure}{101325})^{\frac{1}{5.255}})$
- How to parameterize the different sensors (Measuring, Test Flight, Data Sheet) ?
- How to fuse together Data from Sensors that have different Taus, especially those who are slower than the Loop-Time ?
- How to integrate AirBreaks/Drag Force of Air/ Trust of Motor a input value?
- What are the different noise factors and when do they occur ?
- The up-flight is rather short: about 25 seconds, so the Fusion should have a small settling time
- The Micro-Chip on which it is used is no the fastest : 168 MHz clock
- The Ram on the Chip is not endless: Maximal space for the Sensor fusion is about 10kB
- The Sensor Fusion should be as modular as possible so that it also can be used in the next competition
- The Sensor Fusion has to be as sturdy as possible so that it will not fail if a problem occurs
- The Fusion should make a state Estimation as precise as possible.
- There are a lot of different variables: 3 Positions, 1 Speed, 3 Accelerations, 3 Lagen, Time, Pressure, Tempteterature, Humidity, Up-/Downforce.
- Especially the Input Value u which is the force onto the rocket is difficult to define (Drag, Trust = acceloration depends on wheigt which changes over time).
- The different Sensor have different weaknesses:
  - Accelerometer: Offset, drift, weak to vibrations
  - Gyro: Weak to Vibrations
  - Barometer: Many uncertenties, unpercise
  - GPS: Slow (max 5Hz)

1.4 Requirements

These are the requirements which were drown out of the problems list.

Requirement	**Rating**	**Aim**	**Importance**
Precision	Error between estimation and ground truth	$<$ 5% after settling time	High
Reliability	Functioning State Estimation with # failed sensors	functions with 2-3 failed sensors	Medium
System Load	# Calculation steps per loop	$<$ 1000	Critical
Non Linearity	# non linearity's in the algorithm	0	Desirable
Settling time	Time from ignition to optimal estimation	$<$ 5 s	Critical
Modularity	Effort needed to integrate a new sensor	$<$ 10 h work	Desirable

Table 1.1: Requirements table

1.5 Desired Solution

Describe in quick terms what you are aiming for.

Chapter 2

Approach

hoho

Chapter 3

Tests

Here come the tests

Chapter 4

Conclusion

4.1 Thanks

Thanks to the Aris Team espacially Thomas and Fabian Also Thanks to Lukas and Jossely

Bibliography

Simon, D. (2006). *Optimal state estimation : Kalman, H∞, and nonlinear approaches.*

Appendices

This is the Appendix