Victors Thesis - Title could be improved

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Abstract

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Notational Conventions

Abbreviations and Acronyms

Abbreviation	Meaning
LiU	Linköping University
LiTH	Linköpings tekniska högskola
DoF	Degrees of Freedom
CAD	Computer aided design
PWM	Pulse-width Modulation

Symbols and Mathematical Notation

Notation	Meaning
a	Small letter
C_D	Large letter
$\vec{n}$	Normal vector
p	Pressure
t	Time
α	Angle

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1 Introduction

1.1 Background

A sub-scale model of an aircraft can be used to test out various scenarios during flight that would be too expensive and dangerous to test out with the real aircraft. It is always a good idea to make a sub-scale model before building the real full scale aircraft. Although a well made sub-scale model is cheaper than a full scale aircraft it is still expensive to build anew if crashed, thus much thought and time is allocated to these models so they are as good as possible at the time they are built. Simulation models in computers can and should be utilized in parallel with the actual flight testing so that a reliable computerized model of the aircraft can be used instead of the sub-scale aircraft while testing new or advanced maneuvers. A goal for acceptable inaccuracy between the recorded flight data and the results from the computer simulation model has to be set by the designer.

1.2 Thesis Outline

Coc

From this part in the report existing subsystems in the model are addressed with a bold typeface.

1.3 Frame of Reference

2 Aircraft Model Overview

2.1 Blocks & Definitions

This part contains a summary of some of the commonly used blocks in the model along with the function and some specific properties not explained elsewhere.

2.2 General Model Outline

A visual representation of the model is shown below in figure **??**. This interpretation of the system contains the most important areas and how they depend on eachother for information. This will make it easier to inspect these areas in detail as we go along.

Since the model should be able to make use of live input from a pilot as well as actual flight data from a timeseries, the schematic is shaded along the logical path of using recorded flight data. The parts of certain interest that are explained further into the report are represented in the list as follows.

- Pilot Control
  - Flight Data
  - Live Flight
- Engine
- Aerodynamics
  - Flight Data
  - Live Flight
- Dynamics
  - 3DoF for Longitudinal Stability

  - 6DoF Complete Model

- Visualization
- Environment

The part using 3DoF while being important is in essense a tool used for the purpose of investigating longitudinal stability before connecting the 6DoF to also assess lateral stability. It is thus a included in the part explaining the 6DoF model and does not need to be explained separately.

3 Aircraft Model Interioir

3.1 Aircraft Flight Dynamics

The fourth and last major part in the top level of the model is the aircraft dynamics part. The subsystem called **Dynamics** takes the input in terms of forces and moments and outputs the so called *Plant Data* which is then used throughout the model and could be looked at as the current state of the model for the coming timestep. The data collected in *Plant Data* is explained later.

3.1.1 Inertial Reference Frame

3.1.2 Body Reference Frame

3.1.3 Equations of Motion

3.1.4 Longitudinal Stability

3.1.5 Lateral Stability

3.2 Aerodynamic & Engine Forces

The forces and moments section is devoted to the largest parts primaliry giving output in forces and moments. These are the **Engine** subsystem and the **Aerodynamics** subsystem, and they are described below in this order.

3.2.1 Engine System

The engine system is a subsystem accessible form the top level of the overall system, right next to the aerodynamics system, and is built to take the throttle command, the nozzle pitch command and the nozzle yaw command from the **Control** subsystem and to output forces and moments generated by the propulsion in effect.

3.2.2 Aerodynamics

A first aerodynamic model is built. It is however missing some parts so far.

3.3 Pilot Control & Actuators

3.3.1 Pilot & Control

The part of the system named **Control** is the part of the model where the pilot commands are either created or read, depending on if the model is run with live pilot control or is run with recorded data. The pilot control PWM signals (Pulse-Width Modulation) are the command signals representing specific SI values. Values of which they are translated into immediately in the same model block before they are directed into the **Actuators** subsystem.

3.3.2 Actuators & Servos

The part of the system named **Actuators** is the part of the model designed to take values from the **Pilot & Control** subsystem and run them through the appropriate output these commands in thrust and control surface deflection angles deflection

3.3.3 Sensors

4 Aircraft Model Exterior

4.1 Pilot

4.1.1 Logged Data

4.1.2 Live Piloting

4.2 Environment

4.3 Visuals

Bibliography

[1] D. R. Philpott R. H. Barnard. *Aircraft Flight: A Description of the Physical Principles of Aircraft Flight. Fourth edition.* Pearson education limited, 2010.