DESIGNING HELICOPTER CONTROLLER
USING SOFWARE

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DATE : MAY 2008

"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation & Automation)"

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Date : MAY 2008

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This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree of
Bachelor In Electrical Engineering
(Control, Instrumentation & Automation)

Fakulti Kejuruteraan Elektrik
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"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature : .....……

Name : NORSARIZAN BT MAT YOUB

Date : MAY 2008

For my beloved father, Mat Youb Bin Hamzah ;

Mum, Sabariah Bt Abd. Hamid ;

Brothers and sisters

ACKNOWLEDGEMENTS

First of all, I would like to express my thankfulness and gratitude to Allah S.W.T who has given me all the strength that I needed to complete this final year project and also prepare this report.

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Thank you.

ABSTRACT

This project are describes a software environment for simulating and visualizing high-performance helicopter systems. The environment also accommodates data exchange with MATLAB. This can use MATLAB software on personal computer directly to the helicopter compare to the use remote control. The ability to control the helicopter using by computer as well as remotely. The project has been divided into four main parts; hardware (transmitter), helicopter model, remote control and software (MATLAB). The computer is interfaced to a transmitter on the helicopter by a parallel connection. The remote control uses an external power supply. This helicopter in consist of 4 channel transmitter. It can simulate most flying attitudes of modem helicopter, such as hanging in the air, up and down and moving forwards and backward. A helicopter visualization model that is created and implemented in MATLAB and simulink. This model will be used to visualize a scaled model helicopter in order to assess the helicopter's attitude during different fly modes.

ABSTRAK

Projek ini adalah menggambarkan satu persekitaran perisian menggambarkan sistem helikopter prestasi tinggi.Ini boleh menggunakan perisian MATLAB di komputer peribadi secara langsung untuk mengawal helikopter berbanding penggunaan kawalan jauh.Projek ini telah dibahagikan kepada empat bahagian utama; perkakasan (pemancar), model helikopter PC , kawalan jauh dan perisian (MATLAB). Komputer adalah ruang hubung kait untuk sebuah alat pemancar di helikopter oleh satu sambungan selari. Penggunaan kawalan jauh menggunakan bekalan kuasa luar. Helikopter ini dalam mengandungi 4 saluran pemancar. Boleh ia menyerupai kebanyakan penerbangan helikopter modem, seperti bertahan di udara, naik turun dan ke hadapan dan mundur.Satu pembayangan model helikopter yang dijadikan dan dilaksanakan dalam MATLAB dan Simulink. Model ini akan digunakan untuk menggambarkan model helikopter yang teratur untuk menilai cara berbeza semasa helikopter terbang.

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CHAPTER I

INTRODUCTION

1.1 Definition

In the world of Radio Controlled Vehicles, RC stands for radio controlled but can also mean remote controlled. RC vehicles are scale model helicopters, cars, trucks, and other vehicles that are controlled by a hand-held controller that sends radio signals to the vehicle. Remote controlled is often meant to mean toy vehicles that have a line between the controller and vehicle but often the term remote controlled is used to mean an radio controlled RC.

RC vehicles communicate through radio signals. A controller is a hand-held device that sends radio signals to the radio receiver in the RC vehicle to tell it what to do. The controller is also called a transmitter because it transmits signals that control the movement and speed of the helicopter. The controller is also described based on the number of actions or channels it controls.

1.2 Project Overview

The project has been divided into four main parts; hardware (transmitter), helicopter model, remote control and software (MATLAB). The computer is interfaced to a transmitter on the helicopter by a parallel connection. This helicopter in consist of 4 channel transmitter. It can simulate most flying attitudes of modem helicopter, such as hanging in the air, up and down and moving forwards and backward. This can use MATLAB software on personal computer directly to the helicopter compare to the use remote control. The ability to control the helicopter using by computer as well as remotely.

1.3 Problem statements

- High costs for maintenance
- Control the helicopter for limited distance.
- Not suitable for commercial applications.
- Difficult to protect the electrical equipment installed in the helicopter.

1.4 Objectives of the project

- To design helicopter controller using MATLAB.
- To reduce cost in designing controller.
- To produce mini helicopter controller with high performance.
- To achieve MATLAB software.

1.5 Scope of the project

The concept of remote control helicopter is an up-to-date high-tech product. It consists of three major sections. First, the helicopter mechanical structure including main rotor. Second, the electronic control equipment including battery, electronic mixed controller, and gyroscope. Lastly, the remote control unit including remote transmitter, receiver, and servo. It can simulate most flying attitudes of modem helicopter, such as hanging in the air, hanging in the air, up and down and moving forwards and backwards. Equipped with precision electronic gyroscope to stabilized flying posture and provide emulation flying effect.

The ability to control the helicopter using by computer as well as remotely. This can use MATLAB software on personal computer directly to the helicopter compare to the use remote control. A simple user interface runs on the target PC and displays information on the status of the target application while it runs. It also displays signal traces. A simple command-line interface to execute commands for control and parameter tuning directly from the target PC.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter will discuss about source or article that related to the project. There have many sources or researches done before and from there, details about this project are known and can understand briefly about the software.

2.2 Helicopter

Helicopter lift is obtained by means of one or more power driven horizontal propellers which called Main Rotor. When the main rotor of helicopter turns it produces lift and reaction torque. Reaction torque tends to make helicopter spin. On most helicopters, a small rotor near the tail which called tail rotor compensates for this torque. On twin rotor helicopter the rotors rotate in opposite directions, their reactions cancel each other.

2.2.1 Main rotor

The main rotor produces the lifting force. Each blade produces an equal share of the lifting force so that the weight of a helicopter is divided evenly between the rotor blades. If the helicopter also accelerates up, the rotor also has to provide for the force needed for acceleration. Furthermore it has to provide the force to overcome air resistance towards the helicopter due to upward motion.

Figure 2.1: Main rotor

2.2.2 Tail rotor

The spin of the main rotor will make a force on the rest of the helicopter that brings it to spinning in the opposite direction if something does not counteract this spinning. This is called torque reaction. The tail rotor compensates for this torque thus holding the helicopter straight. On twin-rotors helicopter or the four rotor helicopters, the rotors spin in opposite directions, canceling out this reaction. The tail rotor in normally linked to the main rotor via a system of drive shafts and gearboxes , that means if the main rotor makes one turn , the tail rotor is also turn a definite number of times. Most helicopters have the tail rotor turn 3 or 6 times for each turn of the main rotor.

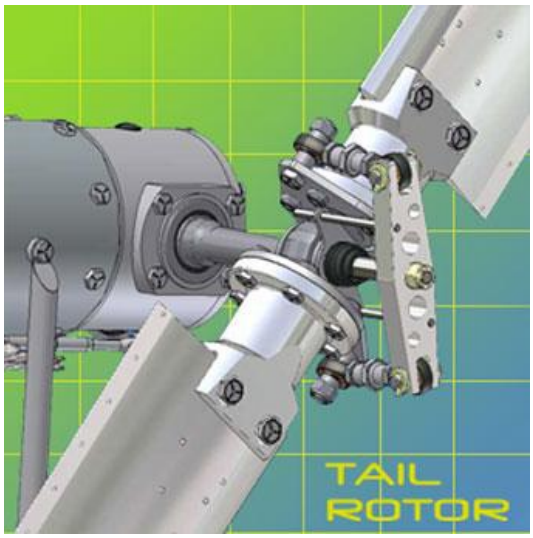

Figure 2.2: Tail rotor

2.2.3 Lifting dissymmetry

All rotors are always experiencing Dissymmetry of Lift in forward flight. As the helicopter gain air speed, the advancing blade develops greater lift because of the increased airspeed and the retreating blade will produce less lift, causing the helicopter to roll. This has to be compensated for in some way. The compensation is mostly effectuated passively by blade flapping. Increased airspeed and lift on the advancing blade will cause the blade to flap up and decreasing the angle of attack. The decreased lift on the retreating blade will cause the blade to flap down and increasing the angle of attack. This combination equalizes the lift over the two halves of the rotor disc.

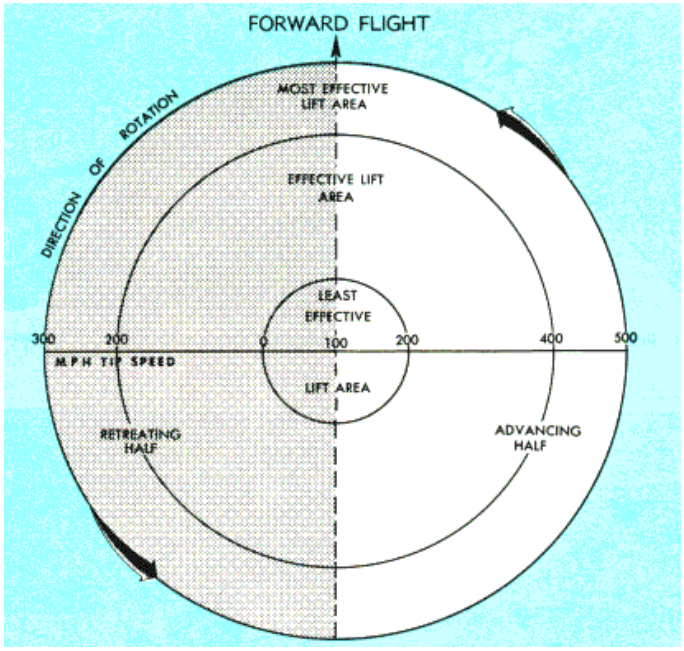

Figure 2.3 : Lifting dissymmetry

2.2.4 Regulating the force of the main or tail rotor.

This is usually done on a real helicopter by regulating the angle of the rotor blades without changing the speed of the rotors, thus giving the rotors more or less power. At the same time the force of the motor must be regulated up or down by adding or decreasing the gas given. In a helicopter, the force may be regulated by changing the speed of the rotors because the mechanical system used here is simpler.

2.2.5 Regulating the flying direction for the helicopter

A helicopter can hover still in the air, fly forwards or backwards. This is done by tilting the helicopter main rotor so that a component of the force from the rotor points in the wanted flying direction. The vertical force component of course still is used to make the helicopter hover. The force used by the motor must also be regulated so that it delivers enough force both for the horizontal component and the vertical component.

2.2.6 The mechanical regulation of the rotor blade angles and tilting

This is done by the following mechanism in a real helicopter.

i. Swash Plate Assembly:

The swash plate assembly consists of two primary elements through which the rotor mast passes, one of which is a disc, linked to the cyclic pitch control. This disc can of tilt in any direction but does not rotate as the rotor rotates. This non-rotating disc is attached by a bearing surface to a second disc, often referred to as the which turns with rotor and linked to the rotor blade pitch horns.

ii. The Collective Control:

When pilot raises the collective control or pull collective control up , the collective control will raises the entire swash plate assembly as a unit . This has effect to the blades by changing the angle of all blades simultaneously. This causes to increase angle of attack and give more lift.

iii. The Cyclic Control:

The pilot has a so-called cyclic control stick at his disposal. The cyclic control will push one side of the swash plate assembly up or down, so that the rotor will be angled in the desired direction. This causes the helicopter to move left or right, forward or backward.

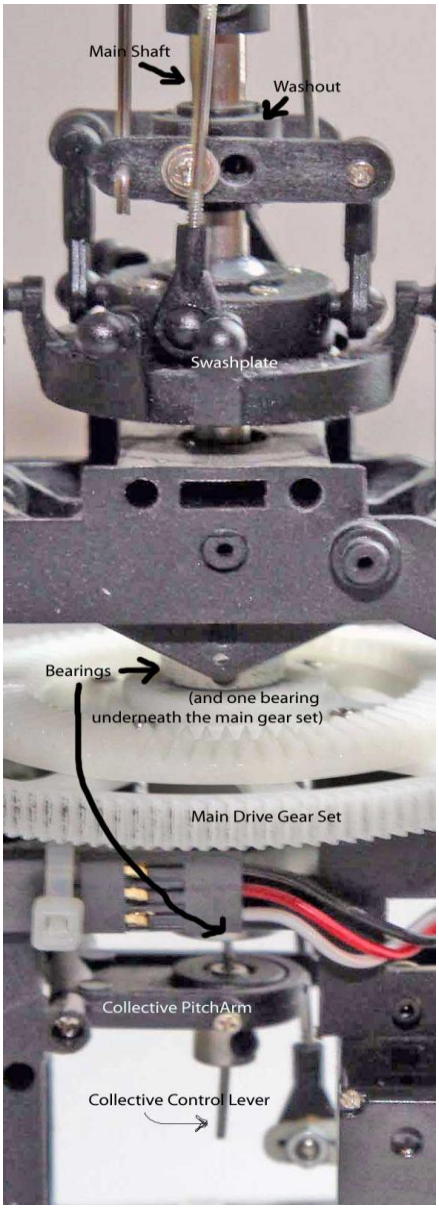

Figure 2.4 : Swash Plate Assembly

2.3 MATLAB

MATLAB short for MATrix LABoratory is a special-purpose computer program optimized to perform engineering and scientific calculations. It started life as a program designed to perform matrix mathematics, but over the years it has grown into a flexible computing systems capable of solving essentially any technical problem.

The MATLAB program implements the MATLAB programming language, and provides an extensive library of predefined functions that make technical programming tasks easier and more efficient. This is introduces the MATLAB language and shows how to use it to solve typical technical problems.

MATLAB is a huge program, with an incredibly rich variety of functions. Even the basic version of MATLAB without any toolkits is much richer than other technical programming language.

2.3.1 Overview of MATLAB

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy to use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include

i. Math and computation
ii. Algorithm development
iii. Data acquisition
iv. Modeling, simulation, and prototyping
v. Data analysis, exploration, and visualization
vi. Scientific and engineering graphics
vii. Application development, including graphical user interface building