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MODELING DRONE AXIS, BY ROUTH-HURWITZ GETTING FT (TRANSFER FUNCTION) IN MATLAB

Engineering

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ABSTRACT

The drones are cuadricopteros that remain stable in the air by means of four engines, two that go clockwise and two counter-clockwise, however a single engine has no stability, with this project is looking for a single axis to remain stable. For this reason, was manufactured the fourth part of a drone (single axis), which was modeled in the software called SolidWorks, used to draw pieces in third dimension, this design was printed on a 3D printer, with material (filament PLA), once made the Design, started with the movement tests of the shaft, using an accelerometer, which sent angle data that was presented in the arm of the drone to Excel, this was also possible after having loaded a program of the ARDUINO software, ending that Process, in the Matlab software, opened a new document and there with the use of the function "ident" to find the exact transfer function, this with the help of the method Routh-Hurwitz that helps us to know the movement on the axis, after having obtained the Mathematical equation.

KEYWORDS

prototype, quadricopters, Routh-Hurwitz method, simulation.

INTRODUCTION

A drone is an unmanned flying object capable of being handled distance or draw its own route using GPS. One of the earliest recorded uses was by the Austrians in July 1849 after about two hundred unmanned aerostatic balloons were mounted in the city of Venice. The mechanics functions of a quadricopter drone consist of 4 equidistant propellers, two of which rotate clockwise and the other two counterclockwise. The four propellers work at the same time to create a thrust force equal or greater than the weight of the drone in question, for that reason it raises. The quadricopter has four

types of movement: yawing (clockwise or anti-clockwise rotation relative to the vertical axis), tilt (to the right or left relative to the transverse axis), pitch (forward or backward tilt relative to the transverse axis) and altitude (vertical lift or descent).The standard toy drone usually does not reach the kilogram, ranging from 50 grams to 500 grams. When this passes the kilogram, we can already speak of a drone used by companies for various jobs, and of these we can find staff of 25kg or more, depending on the type of work you want to perform. The speed can vary between 2 m / s for smaller drones at 27.28 m / s (100 km / h) and later on mid-range drones.

SURVEY OF LITERATURE

At present, the use of advance control systems is increasing day by day in every field; aeronautics is one out of them. From generations, it was a desire of human to develop intelligent systems which can obey them. Unmanned aerial vehicles are one such development of aeronautical, instrumentation and control system technologies. UAVs have a wide range of civil and military applications and are of different sizes according to applications. Remote sensing, Commercial aerial surveillance, Archaeology, Forest fire detection, Armed attacks, research, Oil, Commercial and Motion Picture Filmmaking, Search and rescue operations, Maritime patrol and Aerial target practice in training of human pilots are the few out of many applications where UAVs have proved to be an alternative and fill the gap where the risk of human piloted aircraft is not acceptable or impractical. (Jain, 2014)

The Routh – Hurwitz theorem is used to analyze the stability of dynamic systems.

Basically, the theorem provides a criterion able to determine in which semiplane (left or right) of the complex plane are located the roots of the denominator of the transfer function of a system; and consequently, to know whether that system is stable or not. If after applying the criterion gives us as a result that all the poles are in the left hemiplane, the system is stable, and if there is a minimum of a pole in the right semiplane, the system is unstable.

The criterion refers to the closed-loop transfer function of the system. To apply the criterion to a system described by its open-loop transfer function.

METHOD

Block diagram in function to the obtaining process of the drone axis modeling, by Routh-Hurwitz getting FT (transfer function) in Matlab.

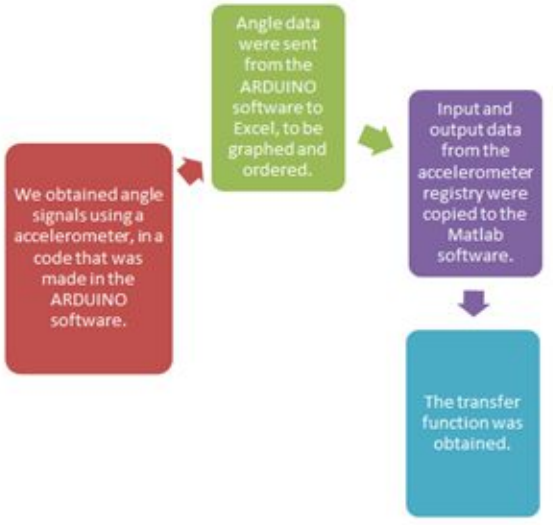

Figure 1: Process of the project.

Adapt the code to convert voltage signals into angle signals, we look for a code that gives us voltage signals.It was necessary to modify the

previous code and investigate a new code to obtain the angle signals.

To send data to a record to obtain the behavior was achieved through the verification of the arduino program that is in the appropriate COM.

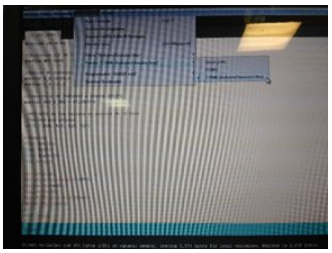

Figure 2: *COM selection.*

The same COM was placed in the Excel registration program, using the icon that has the name "programmer", in the section that says "See Code" this was selected.

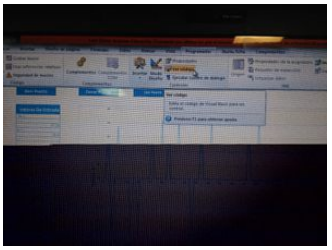

Figure 3: *ID port.*

A data sheet appears in which the "ID port" are modified by placing the COM that was placed in the arduino program, when this action is finished in the section "see code" the tab is minimized.

Figure 4: *Excel log.*

It returned to the Excel registry where three sections are located, selecting the section "Open Port" and selecting "Reading port" and that is where you start to read data and graph the behavior of the angles in which the accelerometer is located.

Figure 5: *Obtaining data in Excel.*

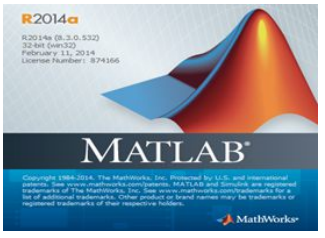

Figure 6: *Matlab Software logo.*

When the Matlab system we declare the input and output variables that are x-axis and y-axis, we enter the system identifier "ident", once we obtained the box, import select Import data, which opened another window to enter the Variables X and Y will also place the start time that is 0 and the sampling interval that is 0.05 thousandths, we import them and the system was loaded, then we instructed him to do the modeling process, opened another window and started with the easiest , with a system and a pole without delay, then select estimate and so we indicated what was the system transfer function, we did the calculations and now we saw the output model, and Matlab I believe the function that had 84 percent success , according to the real signal, as it is not a very acceptable value as we are working with values greater than 75% what we did was recalculating the process, now with a system of first order but with a delay, was estimated and improved the system , the output model was selected and gave an accuracy of more than 84% so we obtained the transfer function in a system of first order with downtime.

From there we take the system to the workspace, we assign a variable for example H = TF (P1D) we gave enter and now if we fully obtained the transfer function.

We also tested the modeling process by putting different variables in the poles with or without delay, so also in model views, was continually reviewing the output model to verify that is the method Routh-Hurwitz.

RESULTS.

After having obtained data from ARDUINO to Excel were taken into account the input data that is the x-axis and the output that are the y-axis, were entered into the Matlab software using the command "ident".

The results were as follows:

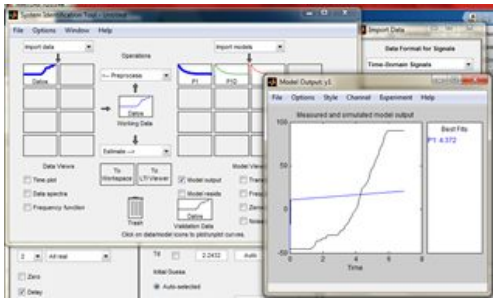

Figure 7: The data is delayed and a single pole is displayed

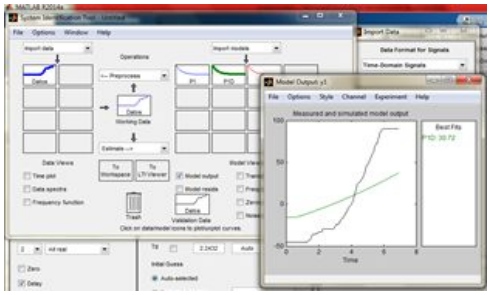

Figure 8: A lagging pole.

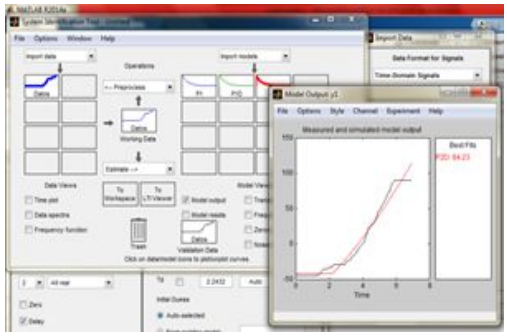

Figure 9: Two poles late.

```
>> ident
>> H=tf(P2D)

H =

  From input "u1" to output "y1":
                          1784
  exp(-2.24*s) * ---------------------
                 0.01 s^2 + 1e04 s + 1

Name: P2D
Continuous-time transfer function.
```

Figure 10: transfer function

We did the different in comparison to simulate the mathematical output model, considering if there was delay, as well as what was the number of Poles, so it turned out that improved the graph, since the purpose of our project was to find a mathematical model Using the model Routh-Hurwitz and the result was gratifying.

CONCLUSIONS.

In this small work we show the monitoring of half-axis drone, the work is for the operation and interpretation of the movement that makes a single propeller of a quadricopter.

In the prototype we chose to use less dense materials that facilitate the elevation of the half-axis quadricopters, a mathematical equation that shows us the angle in which the propeller is found, in some of the research done we find no equation or Mathematical formula showing the angle and velocity required by a single quadricopters engine. The output voltage to the motor is converted to a formula of radians degrees that interprets the Arduino.

This project is open to any other student or researched that proposes other improvements for the control of a single helix.

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