Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning(NPTEL)

Course Title Introduction to Experiments in Flight

Lecture -08 Introduction to Flight Data Recorder

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Hello friends in your previous lectures and experiment you might have seen how to calibrate control surface, how to measure centre of gravity and what were the relationship between deflection of control surface and voltage. So now today we will be seeing an experiment how to collect data from FDR as it is a very common name FDR means flight data recorder and aircraft you might have seen while analyzing how the aircraft was behaving and it have data for different deflections as well as measurement of your angle of attacks, acute angle.

Also whatever the pitch rate rule that your rate and what was the value of thirst everything is accumulated or combined in flight data recorder.

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The diagram for flight data recorder is same in our case we are using an NI module for which we have this is a NI module number is 9205 and for this it has a 32 channel a log input module this is the 32 module and log input module from which it accumulates data from sensors, this is accumulated from sensor.

Now as you know this will cause a power supply and your data output will be on a PC/ laptop any output device which you want. And this whole part is known as your flight data recorder the output will be displayed on your laptop or simply you can call this as black box. Now earlier experiments we showed what was the deflection of control surface with respect to voltages.

Now flight data recorder we have to do in flight data recorder we have to do the analysis of whole aircraft, so it has to has much more data is compared to a simple experiment which you did for calibration of control surface.

As data which we get from flight day recorder a flight data recorder alpha, beta that is angle of attract, side slip angle, slip angle your PQR that is roll rate, pitch rate, yaw rate a_x , a_y , a_z that is acceleration in xyz axis.

Plus you have measurement of pressure your absolute and deferential pressure your battery voltage in our flight data recorder we are having different we are calculating or we are recording different data's which are as follows your angle of attack you slide slip angle, roll pitch and your rate, your acceleration in different access what we where deflection of control surfaces which we have already seen previous experiments.

What are the total pressure and differential pressure this can be using this can be determined using P thought what are the values of your roll pitch and your angle as you might have studies in your entotic course you can determine the relation between your roll pitch and your angle using Euler equation, these where the data's we are determining in our flight data recorder, apart from these there are several more data's if you go for UAV operations.

Such as your GPS data which involves your lat, longitude what will be the height and magnitude meter readings your even battery voltage because in UAV operations battery voltage are very important and for determining. We will be discussing all this answer in detail in coming topics we will be seeing in our experiments how to derive the flight data how to derive various parameters using your flight data and we will also showing a small programs how to get readings from various sensors for instance these values can be derived from IMU really showing a small code we will be even sharing you that small code.

So that you can also access that how to determine your readings of distance of data and while performing experiment we will be more about these sensors what are the rules of this what is accuracy how to select a particular sensor that part will be explaining in your experiments.

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During the lecture we discussed about flight data recorder and what for the instruments are sensors we used to accumulate data from our aircraft as you can see in this video this is the flight data recorder we are using to accumulate data while performing experiments now we during the lecture we saw the block diagram of flight data recorder now I am explaining you what are the parts which we explained during the lectures.

During lectures we said all sensor data's are accumulated into or connected through your NI drq so this is your NI drag we said we are using 16 channels we are using 16 channels in NI daq so these are the 16 channels where the data's are collected and these data's are corresponding to different sensors.

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As you can see this your IMU.

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Now IMU stands for initial measurement unit and it is a basically a connection of your accelerometer gyro and magnetometer now as far as accuracy is concerned your IMU the acceleration or it can measure yes up to 4G = and - 4G with an accuracy of less than 0.5 G as far as concerning regarding your role and pitch angles it can go from -180 to 180 degree in case of role where as pitching it can go from – 90 to 90 with an accuracy of less than 0.1 degrees.

And as far as heading is concerns same it can from -180 to 180 degree and same your resolution is less than 0.1 this is as far concern related to your IMU and you can see there is a pressure sensor.

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And you can see in this area there are two powers 1 and 2 this is this is corresponding to your absolute pressure and differential pressure. Now this tube probes will be connected to probes of the aircraft and corresponding to that you will be getting an absolute pressure which is used in during using this sensor and a differential pressure which will be used this sensor will be use in both absolute and differential pressure will be explaining in coming lectures.

What are the use of this absolute and differential pressure to calculate your parameters of aircraft or different use say input data you can says for instance like height and velocities will be seeing that in coming lectures and as you can see all this flight data recorder instruments require a power supply that is why you can see we have given as you can see for this whole data accumulation is sensor requires a power supply that is why we have given a 12 volt battery as a power supply source and a different sensor will be having different power it in for instance.

Suppose my angle will be requiring a 5 volt to 10 volt for instance I am saying then this voltage will be regulated by some BCO some potential divider you can say means voltage will be regulators. So that this is your instrument does not get damage, now once this whole sensors are accumulated into your NI deck then we saw in the block diagram that from NI deck you can see

the output of that particular sensors using some interface or some software so we will be using a simple value code see what will be the outputs of your sensor and the result will be shown in your LV code.

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Now once the data has been accumulated using your NI deck you can see output of particular sensors and parameters using particular sensors using a lave program which we are using, now this is the interface we are using to collect data from your five data recorder it has different windows corresponding to different output which you want to see for instance you have a readings for acceleration in different direction xyz, your deflection of control surface that is elevator and along as well as your pitch your enroll rates as well and also you have value of static pressure and what is altitude.

Now this is a simple interface where you can select which particular and I deck you are using and the refresh rate or you can say for this flight data recorder is 60 Hz as you can see while I tilde my flight data recorder the values corresponding to particular senses you can see that pitch you and rate there you can see modification as well as you can see variation in acceleration so well performing experiment is flight data recorder is kept in your air craft and you pressures probes are connected to your flight data recorder and once a particular manure or of flight normal clue flight is flown or corresponding to that you can change manure title and corresponding to that you can save data.

Or instance if your air craft is performing claim one just you have to entire many more title s claim and click set and then data corresponding to claim will be saved. Now after require number of data suppose you want to perform at the manure so instance you want to go for cruse then typing the title cruse and just click anywhere else now this data is corresponding to cruse will be saved.

So this is the simple software corresponding to your sensor on your flight data recorder will be discussing more about how this sensor works and what are the refresh it and accuracy of difference sensor we wish hearing you small codes for different sensors so that also you can be familiar with this sensor and it will be helpful for you realizing how to accrue data using your man senses.



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Now why this hidings are required because suppose while you are trying to build an auto pilot and you want to have particular restriction on particular turn rate clime rate and do you have limitation such as your survey cannot survey cannot beyond a certain limit or certain degrees you want to have or you want to design such a sizing should be enough so that your restriction can be matrix. So that is why while performing in manual mode you have to collect these data and based on this data you can directly your auto pilot to give this much percentage of gain when performing that manures.

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The lectures we have seen what is the flight data recorder what are the different parameters which we are measure to flight data recorder we saw a block diagram how flight data recorder work consist of how sensor are integrated to can I deck and how it was inter face using a labue code so once everything is planted or everything is put ion to its place or FDR is put in to your flight and as we have seen the lectures how FDR is operated or how level program was after closing that application you will get a file.

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In which small data you collected, difference senses and for different manuals, so here the test file, will open it using the notepad application, with this the test data for answer. As I told you, it can based on different data's, these are mentioned here and if both particular order the data, the following data will be captured, hence this column represent the angle elevator and respective columns will be, what will be the respective columns? These are the calibrated, whereas we have already seen experiment, how to calibrate the control surface, what do you mean by reference point and how to calculate slope and the intercept.

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Now we assumed while according data found, like we have to just mention which particular module you are performing and data will be started from that particular point. Here you can see, as flame goes first performing a diving, these are the different data's which were collected, at a sample rate of or scan rate of 1000 hertz.

Now these values, here you can see in the diving state, so it will not have any wide direction. So acceleration wasn't, in this data with, till no timing will perform, now for this scanning based data, you can see for different values, once you were in cruise slide, normally the title will change and these are the data's for cruise slide.

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And for the, these are the data corresponding to line network, now when the students go for experiment performance for performing experiment, you get these data from FDR, or you can collect it manually also but these are can ac required, because collecting manual data will involve instrumentation error, will involve human error plus they will have a different perception to different readings plus using this data you can advice, as you told can give lectures also, what are the limitations you want to have if you want to learn auto pilot?

What value of this manual you can access that might aircraft is particular restrictions or instance, in can perform toll rate or perform a banking engulf with certain degree, so that particular value will be represented in FDR and based on that you can design the control system that how much to I give to a particular a control logic so depending on that saturation point so based on these data's we can see you can analysis how your aircraft is per forming.

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Now for a instance so every different title you might have seen in a previous lectures we had a experiment to calculate what will be the track polar of a particular aircraft so it involve in clues and as well as in climb state so from clues you go for the data's which you got for your these are the data's and a the tax the tax may give you rectangle and different data's and clues. And by climbing you have to go for data so in order to calculate rate of climb also so you have to see what are the data's for the rate of climb.

Apart from this what are the mass and manifold pressure and everything that place the manufacture given using that data's you can calculate what your track co efficient or the particular plane or climb maximum rate of climb so that is why these data's are very much important or aerodynamic. Aerodynamic point of view of an aircraft in coming lectures we will see how to estimate the parameters of the aircrafts thank you.

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