Indian Institute of Technology IIT Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

Course Title
Introduction to Experiments in Flights

Lecture-17
Introduction to Parameter Estimation

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Good afternoon friends, so far we have completed three experiments in fact briefing for three experiments and they are trying to show you how the experiments are conducted and how to analyze the data using my best father here. I wish that you find some time and come to flight level and typically do this course. Before we end this module we have added something extra and that is we need to fill the parameter estimation from flight data. It is also a part of an experiment what do we what I will do menu is a parameter estimation using flight data.

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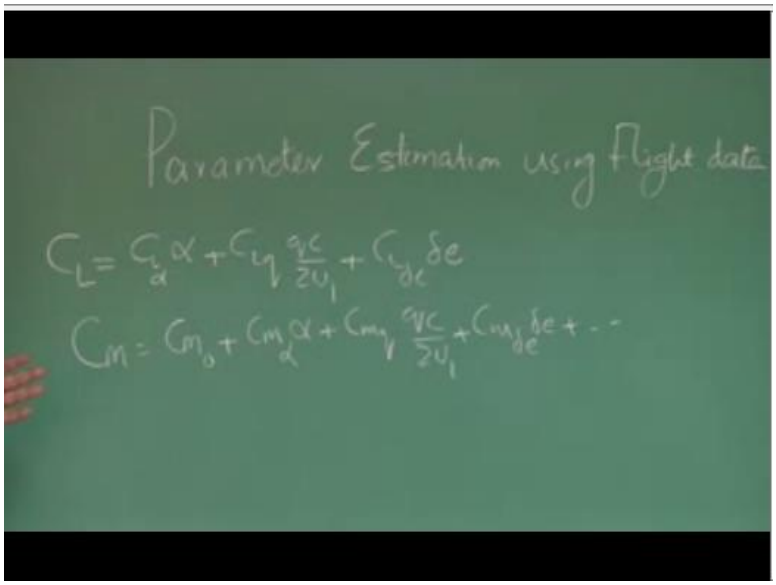

What do we say parameter here remember when I express C_L as $C_{L\alpha}$ + C_{Lq} $qc/2u_1$ + $C_{L\delta e}$ δe similarly for $Cm=Cm_o$ +$Cm_\alpha\alpha$ +Cm_q $qc/2u_1$ +$Cm_{\delta e}\delta e$ +.. like many other terms depending upon how complex the segment over how about the aero dynamics associated. Here we are assuming the aerodynamics is leaving out you can express Cm and C_L using the aerodynamic parameter which are aero dynamic parameters $C_{L\alpha}$,C_{Lq} ,$C_{L\delta e}$,Cm,Cmα,Cmq these are non-dimensional returning parameters.

The question is can I estimate the parameters to flight this gift that is what I would be explaining you that we have to be the philosophy behind it and my sis father is participating and he will I example how they have done and I will deal with them but they do it but I get one hand please understand we have the real experience. So I requested their department when I say I want to estimate CL $C_{L\alpha}$ $CL_{\delta q}$ there will be many approach.

You see one is in our mind to this and have a very difficult here and I give it a little input to the airplane that is I am moving like this moving the elevator up and then again take it back.

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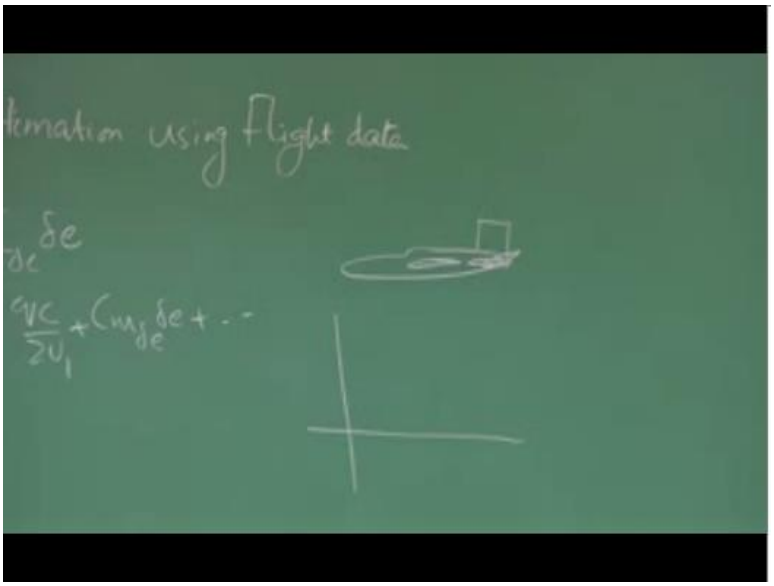

So it is like I have to excite the airplane in particular mode of interest what is the mode here whether I write C_L and Cm . And I am talking about Cm is pitching moment so I want to excite the airplane in this mode longitudinal node how do I execute that I excite it by the elevator mode. That is what we did and I can give you different types of elevator I can give it anywhere something like this I guess simple impulse.

I guess immediately that I can give a pulse rate input would hold it and bring it back I am only holding the elevator were the bring back once again getting back I can do it like this holy and with deflections energy I can use multiple impulse depending about this is for type of anything definitely ever invented.

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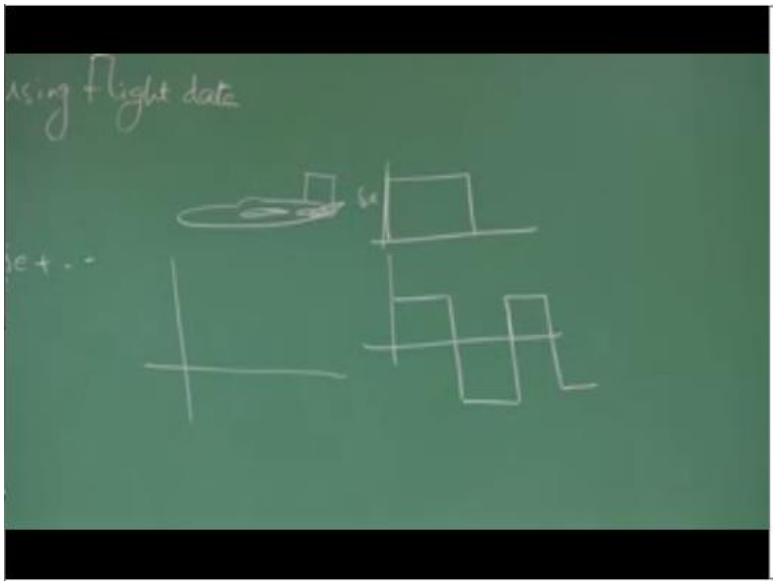

They are all during the day a negotiated by capturing the dynamics can isolate this parameter into a personal intimate and what is the method what is the mathematical method for that and whatever instability in estimation. That is what we will be doing in few lectures ,let us say we have given particular type of input and we are measuring angular background for this week goes like this a measure increase rates you measuring a lit accumulation to something like this measure what is the pitch angle.

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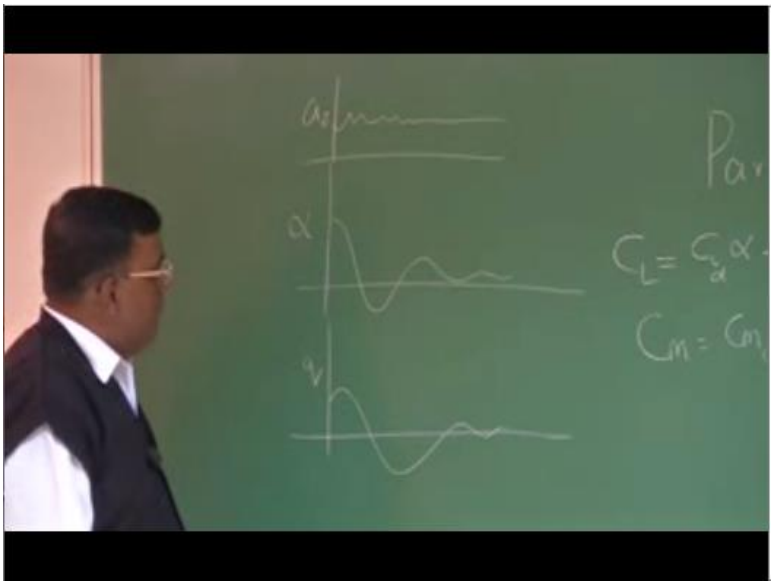

I can make sure every respect but angle and you know all those instruments which are used to find a measure it is as per cube θ extra the cost identify with measuring and the types to measure. Any of this information to get this error any fire that is what we talked about our destination will be slightly but before you sleep in it if somebody asked you how to measure angular stabbed to death.

You get to let all the visual angle of attack you pistol ended already to see and if this can move among a few that you can move up end up not liking what is happened to this move. If this is the oriented tail and the boom honestly I put it like this if this angle of attack language what happened because it is statically stable it will turn it love it this whole system returning to me and here as you can he actually linked with Rosalie potentiometer.

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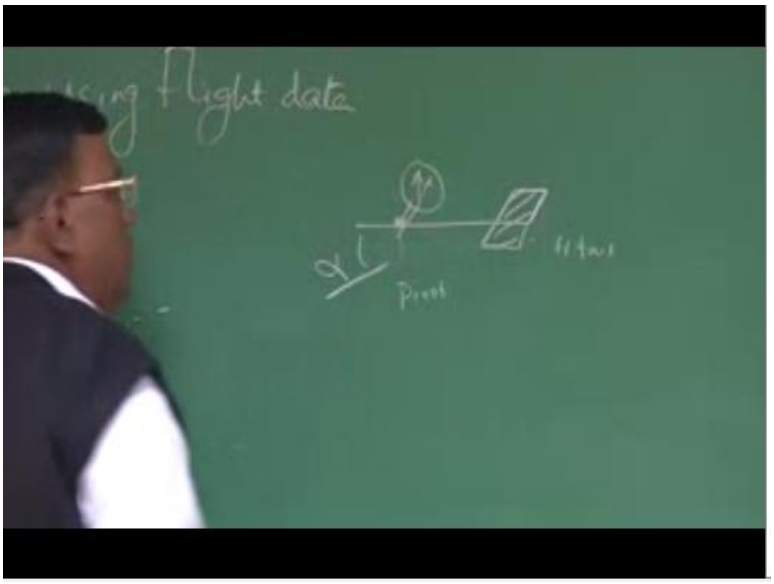

So the transfer gate and share pretends he develops the voltage and you can ignore that all day to get a collision platform and initially you to the calibration this much what they will defer the patient so I can pollinate the angular back the voltage teams. That is how we measure than that and if we think of spirits with us systems of gyros and measure measuring unit and θ you know we will get to my integrity yellow signal.

What is this picture reliable and then too late point of good news what is this regular, regular one element maybe when you put. And how to understand what should I do all this first thing should not forget what is the natural should not held up yes play you are pitching rubber to the most the most short videos because the big enough.

You try to give input actually that the excited not airplane around. So that they let us give it up to the short beard is really excited the you have to decide the frequency of even that input and you will give input in such a manner that it excites almost they airplane in it now is no more if you are trying to estimate this better okay. For example if we are given a elevator and holding it for too long put it up and the airplane will lift up their place.

And you are only clear it up then it became ready right there you go like they are ready lowland to go through the inspector so one more get excited if you get a flight data which looks like this which is typically used by almost a kilometer remaining constant. So there will be some changes then naturally you cannot accept estimate Cm_{α} from those data.

We go there is so much excitement only going like this what you want for Cm also excite the x and y axis which is not happening predominantly. So I need to select the elevator input appropriately depending upon which parameters I am going to actually one of the challenges. The secondary challenge is do it leds mathematical model.

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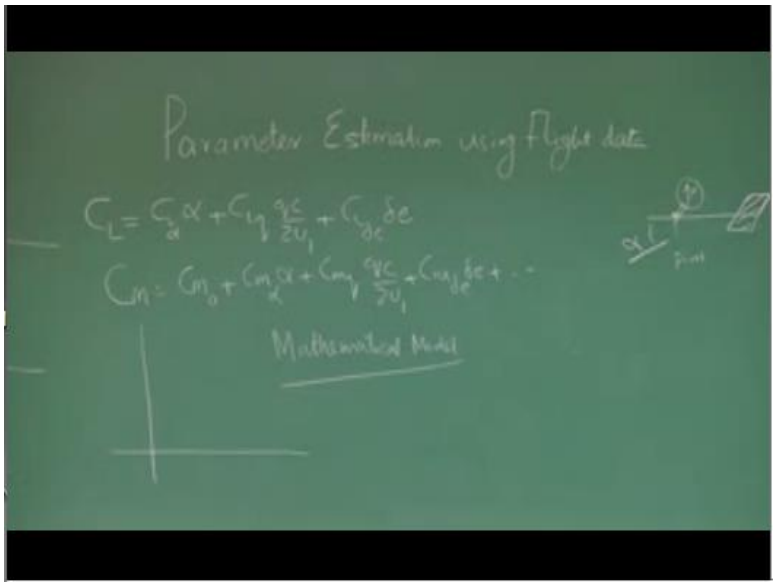

What sort of mathematical model you are using to evaluate the parameter to estimate for another. Let us assumed this entire component for the airplane what do we do we have mathematical model for the aircraft to δe and we calculate what will be for α or what do you mean by αq .From this mathematical model that means essentially on me longitudinal equation of motion you know that we have done it in a aircraft stability control.

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We are actually solving values for these parameters. And you will get some αq you will get some this simulation good. And now actually now what is in the slightest thing you give this data input to the elevator the happening when you are flying and you measure what is the α measure and what is the acceralation measure and what is the qm. Then if your model but first he feel bad relations get parameters were first then this and this would match nationally years but what you know that no matter what even model it was perfect and all the measurements of it.

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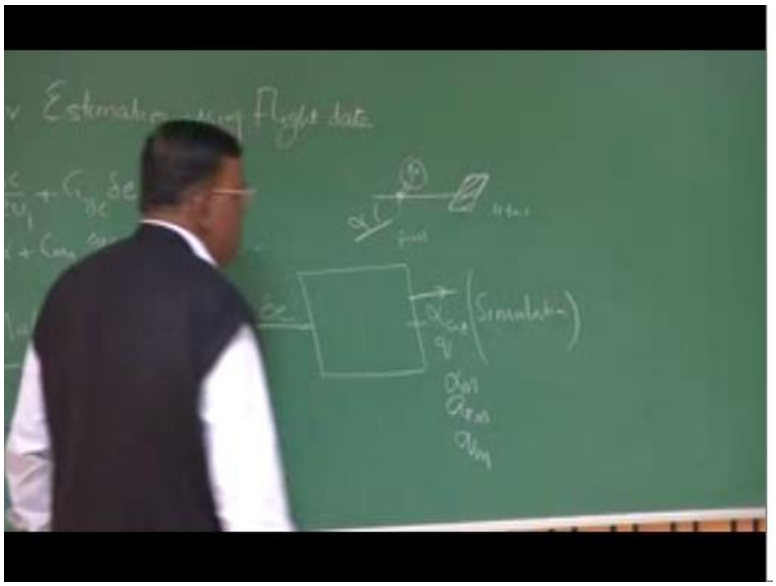

So you follow the process part of estimation what will you say I find Error the α measure and α simulated to + q measure and q simulated + a_z measure simulated square right. This error would try to ask a question what are the values of this parameter what are the values of this parameters which will ensure the error is meaningless.

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So what is a production here production is what we are a dynamic model what exactly is perfect right so we are saying as a windows I did you I will not doubt this morning is one structure when a question in bound estimation what we are absolutely positive correct. What are those where is the combination of this parameter which we may buy this error and those parameters are estimated parameters for the air plane to fly.

That is that you see will be giving demonstrations using a leaf square method right then we will try to give some idea about how to use the neural parameter to estimate the network place. This section would know what is happening purposefully so that you know what is happening beyond whatever we have thought I know ever will not go well let us do it yourself yes but if you are interested in being some sort of a researcher or post graduation.

With some research in this area of logistics of an estimation initial motivation that you are thinking. Make you think how to follow conventional path as well as unconventional neural network literally permit myself a tremendous. My research will take over for me and you will be going forward it gives an examples and we want to collectively already hear this from the power. Thank you very much.

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