Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning(NPTEL)

Course Title Bioenergy

Lecture -15 Static: Lateral-Directional Stability Test Contd...

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So I will take two types of value one is steady side slip what is the meaning of steady side slip we know what is the meaning of side slip where this is the central mat that slip okay and if you have the ending side slip then modulus side slip angle and then we talk about in that slip side slip angle zero from verifying going with.

So I am actually moving like this well actually be what okay in this all duration size will be passed in do recommends with side slip angle to this angle with the relatively come from the right side of the values frame. So this is the concrete cycle right. So what we will do is there is actually the manual way and we are trying the machine radically tells that we after correction and if I get across the beta across that right.

That is the steady side slip value okay. The second thing we also know to reduce we look of steady coordinate turn, what is the steady coordinate turn I will write like this, I will write that way write value using the values. So every time whether because allowing with the we have to get that towards beta so beta is 0 this is what we did. So we are talking about steady coordinate turn high band greater than.

We are doing the these value we have beta=0, this beta =0 which we had the center of gravity of the happening the supported gravity here steady coordinate turn beta is 0 at CD we are running above the CD like this right, here is beta = 0. Now if you put a sensor so angular with that been

somewhere here than adequate β exactly because that is called whatever terminate is there divided by \emptyset that is inter final what is the β .

But we are talking about steady coordinate in term β is remain in the center of the gravity what are the instrument we put at the low scream of the victim of the average then it will below record zero you have to give a correction okay. So this to menu was we will execute at the value parameter with that in turns of let us see how value on the time using the flight and data.

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First we did the steady side slip here.

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 β is not equal to 0 where moving with the constant β that is reflecting constant okay and if you require your switched up iteration that Fy both on the y direction with mg sin $\emptyset + \frac{1}{2}$ leads to Fs lead to Cy β + Cyp / 2 β + Cy r into rv. 2v that Cy dr into this what is Cy here what is Cy please do refer by all this.

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See what is the x axis this I the y axis z is into the board right both is the active as the y direction weight as that goes in the y direction is Fy and if I non eventual effete upload these squares I guess Cy okay what I am going for airplane this I the general equation with Fy we see that Ø will turn.

Because if I am backing that way then mg sin \emptyset over will be along the y direction that of and the other possible low less when I am talking about steady side slip so I am ensuring that next force is 0 okay I will ensure through where are every at net force is 0 if I write 0 for mg sin \emptyset at the end of the problem accordingly going to $\frac{1}{2} \rho u^2 s[CU I \theta with \eta]$ will there be contribution for these term.

This term come when there is a roll way you guys have doing this studies actually what is the value of T, 0 right so obvious what is the value of R, R is the your rate it is early going like this what is the value of R, 0 I draw with and there is a roller defection that R, so that C1 with R which is delta R you may ask that why do not you delta A.

There will be some small value of UI delta A where this small but we are neglecting because not that significant in y delta R, okay where this gets fulfill digit you know what I do, I divide left hand side and right side by half ρV^2 where is 0 equal to MG by $\frac{1}{2}\rho$ with square else satisfy where PY beta into beta with residue I delta R into delta, okay. Can you add some more information how to improve this term, how to recognize more implicit.

What is mg/1/2 ρ^2 is, is this CL therefore I can write from here I can write $0 = \text{CL Sin } \emptyset + \text{Cy}_{\beta} \beta$ + Cy $\delta r \cdot \delta$ any objection, after verify. Let us split along with your with every part, focus with reflection if I can do, if I bring a small bag right I do not use security like I can go straight actually let uss say bring 10 degrees back I am giving you steady actual you, then I can do the approximation $\psi \emptyset = \emptyset$, right. So this actually you can be.

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So for small \emptyset as a word I came back again let me denote you as CL \emptyset you have CUI beta into beta you have Cy then R into del beta now tell me in the free restrict the right hand side how is this you can measure to the distance meter, as a measure CL yes, did I know there is $2w/\rho$ requires I do not wept I get sweet for best indicator then I corrected okay this is going with you so CU I know, no comments Ø so that is by indicator I get beta get know and you know what I move.

Which comes from the at not then what gets and delta also we know that low potential meter bit reflection will measure it in a laptop, okay answer how many of flight those hands up, so you have seen that delta are coming fight coming flight one. Of course this is the message for those who are doing the certificate course if you send the request to NPTEL copy to me if you all do the experiments here we can make arrangements for you to NPTEL right, I will explore on that possibility.

So I know what the, I have taken the fourth diffusion from the standard fixed of model right, I have done cross summation I have got this simplified equation and the experiment and I know that I can measure on this mark parameter of variable. Now let us say one question, when I talked about Rudder, what is the role of Rudder to give force or to give moment primary rule, primary small area but large moment of way okay.

That is why if I Cy δ if you compare Cn δ that is why when you compare Cy δ , Ci δ this is a strong derivative okay, how work this is related to weak derivation relatively, that you can understand because of that this mean to give more moment that is lot large long moment on this derivative. If I again do this slide approximation then what I get, I get $0=CL\phi+Cy\beta.\beta$ and these are I am negatives, negative and the digit of it.

This is approximation then what I give from here if I see this either $Cy\beta$ =-CL ϕ/β no objection here, now this equation I can gave this what we get the through that if I execute ϕ by newer I know the values of CL I can measure ϕ , I can measure β then actually I am estimating the value of CL β for the whole error, which is approximation right, whatever the quotient is we use that aero plane with other level very high rather area I under effective place this sense the Cy δ became very, very large.

Which I this is regenerative this is strong derivative other than approximation we look on precisely and measure what is ϕ what is β find that ratio multiply with CL the value numerical

value will be $Cy\beta$ so you are getting that estimate this is very important when you do the mitral quantification in the vertical data so it is a minor change is detected.

So how we do reduce as a manual you get how much β has change otherwise you go for a all the fright is estimated you get re cursive, where the ting as usual experiment of this you should know what is the ϕ of Cy β coming from usual definition, what is the cycle we are getting from this and you get ϕ positive β is positive then c is positive then sin is negative.

Then we have just going this now let us see for the whether β is negative or not basically try force when the β comes from the vertical ways it is when we are getting normal I hope it is like this it will be a β arrive with you. So everything have has plain is they are really size with you so the air is coming from here so it will be the force connect from here but as for the convention this is x and this is y so this direction is positive or getting.

Negative so this is negative using how beautifully this experiment will goes you have to go for the about the answer data will share with everybody and try to get the value of Cy β so get me that everyone share that one, let us move some more detail extraction from through this model you know that three and we have Cn Pn β this is β + Cn p +pb / ub + Cn δ r x rb / 2u + Cn δ x δ r right.

Usually we are trying to moving process and it is standing assuming thing have been here right using the partial derivative which are called our dynamic derivatives non in derivative with the parameters, now if I am doing this study side skip now let us see if it is a study that means studies have been going this way what is the value of Cn these are the bombing moment you are getting in two term when we going like this.

So any one hold is there so what is that it become 0 so Cn β β is the whether it is going study side skip whatever this ar this any P there is moment is like this is there any p is there is p in that you do not like this it is moving like this is there any ting. So this I am going is there any arm do not know this is 0 to Cn this is Cn β r includes δ r and till we are expenses here using small cn δ and δ a this is moment because of analog deflection maybe very small one what is this Cn δ δ a how do they will be along moment with themselves right.

I have repeated the analog here down and it will up so which will depend down up there is as it move like this which one is having more lift this much which wing has more induced at other one will do here see here because of the big die that is Cn δ if you understand there is much race come back to actual Cn δ in to all those Cn δ r and Cn δ which is typically we called network Cn okay it is good to prove the ratio and then we can assume that at all limited.

Do you understand, there is much this compared to actual Cn δ . δ r, Cn δ r is the δ , it is good for revolution and then, now let us have this vertical effect as you convert it, that is why this one is also taken as low, so if I use this evaluation I will get $\beta/\delta r = -Cn\beta/Cndr$, but this Cn δ r/Cn β , so this is the required equation, right, again recalculate, this lesser than or not and by simplifying a standard calculation, under the assumption that the aircraft is executing heavy tides, so this executing heavy tide slip, t0 and r0 also it is refrained and what your β will be dropped there.



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And we go to the option, we got the equation that $Cn\beta$ that δ is δr , we just simply the either β or δ , where $Cn\beta/Cndr$, so what is the sign of $Cn\delta$, anyway it is negative, whatever the $Cn\beta$, what is the statically stable element, positive is equal to positive, where $\beta/\delta r$ is positive, that β is 0, I want to do the calculation, if I want the positive β , I have to give a positive β right? What is positive data, you got the left, using how this, how will you extract this, do you understand, this is very important, what is input in this method, be careful on it okay? This is it, okay, if there is a θ what is here by you use.

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If there is a zeta what this areoplane will do see this is studying the stable in rational case for a positive β I will give a positive value only. So this standard in puzzle that is Cn β is a β this one is only the positive. You want to hold that as the β is all straight we have to write like this β Cn β in β and then what will remaining so we are bringing what kind of moment. Negative movement how will we get that movement wherever formula is Cn δ into δ this time what you are getting Cn δ into δ do you get this.

Where you low Cn δ is what i8 am going to get so let us look here as the aero plane sees the data aero plane being naturally static symbol it means that it is positive symbol which is Cn β into β

but if your holding for a β constant this moment has to be put into because you should go like this but because this the rational stable as there is a big angle I turn it will become β 0 you have to hold this β that me3ans I have to apply counter movement equal to this conclusion since this is first one be the negative one and the same δ into δ sign is negative okay so I have to give δ with which side positive well I will give in positive.

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So that is how I studied the radar is there and it towards left so what do I see the positive β I must give the δ positive correct and that is exactly what we do here ratio β by δ is also positive. So whatever eventual motion you have developed the flight is finding it is constant making sense is there any doubt in this anybody who have doubt okay. Now question is how well I do this general use of some of the use of y suppose you have changed the particular case so there are cases. Mind changes as Cn δ is strong anyway and Cn β is strong in negative the ratio is important right.

So the rational is if attribute to Cn δ will change similarly match so right I can measure β I can measure δ by doing a different studies I fell better with $\beta 2^{\circ}$, $\beta 3^{\circ}$, $\beta 4^{\circ} \beta 5^{\circ}$. And then I am

going to add the same δ value I can find out the values Cn β did you get it. Approximate radiation whether this change has to a large radiation of blood in water.

And if it is not fine you carry on this otherwise you will get rules for whatever you get so do you understand rules is as simple as rules how beautiful this kind view to develop the skill to extract information with oOnt he physics with on the educational motion we are going to understand. Let us give a that was the purpose of this and impressed all of you to the concerned data and do this side.

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