UAV Design-Part II
Dr. Subrahmanyam Saderla
Department of Aerospace Engineering
Indian Institute of Technology-Kanpur

Lecture-16
Flight Demonstration of same Wing and Tail Configuration

(Video Starts: 00:13) Dear friends, welcome back, so we are here for a demonstration of wing and tail combination. as I As we As we derived in our lecture, we noticed that when we have similar wing and tail identical wings wing and tail separated by a distance assuming a minimum downwash you know interference at the tail. We figured out the neutral point to be at the midpoint of the distance between aerodynamics center of wing and aerodynamics center of tail, that is what we have derived.

So, we are now going to prove that whether our derivation is true or not. So, first of all let me show you the configuration. So, we have 2 identical rectangular wings, if you can see here, so they are about 2.4 meter span, ok and a chord of. So, you can see in the side view, so with a chord of 0.23 meters to the aspect ratio is close to 12 you know. So, and then this entire setup weighs about 1.8 kgs, right now.

So, I just want to show you the aerodynamic centers of wing and tail, ok. So, we have our friends here, Kirubakaran and yeah Kiruba come here, Santosh and Pravijith. So, Sampath and Pravijith yeah. So, he is Kiruba and Sampath who has made this model with the help of Pravijith yes and yeah Santosh also helped them, thank you for that. And I will be taking their help to catch this model.

Once we throw it I am not sure whether this model is going to sustain the you know first landing or not, if it sustains then we will also demonstrate in unstable mode say when the Cg is behind the neutral point ok. So, say this is my 0.23 approximately you know this bit curved, right. So, 0.23 metres is a chord due to curvature it is bit more here. Now, we have figured out the aerodynamic center of the wing of the first wing let us say is at this particular joint you know you can see this particular joint.

So, this is the aerodynamic center of this wing and then the aerodynamic center of this tail is somewhere here, you know. It is marked here aerodynamics center of tail. So, here this is the aerodynamics center of tail, right. So, I am now trying to locate the neutral point which is midway between these 2, ok. So, can you help me to hold it from there, yes of course, there will be some inaccuracy, that is the reason why I will take Cg a bit more ahead of the neutral point as well as bit behind the neutral point, this may not be so accurate because of this measurement errors.

So, place it on top of this, yes, this is approximately 176. So, half of this 176, 176 is the separation between ac of wing and ac of tail, so half of 176 how much? 88, yeah. So, 88 is where this neutral point is located, we have a marking here which is close to 88 centimeters with respect to the yeah aerodynamic center of wing. So, that is a midway between these 2 points. So, now I will try to you know throw this out, ok, yeah.

So, let us check what is the current Cg of this model, so I am getting inside this model, ok. So, this is slightly behind the neutral point right now, I would like to add some more weight, so that it becomes ahead of it will go ahead of this aerodynamic center or the neutral point for this entire configuration. Do you have a weight with you, yeah there will be a lot of interference because of this you know strings. But still we will try to fly this model, ok.

So, bring it back, so now what will be let me check the Cg again. So this is definitely ahead of the neutral point right now, ok, so this is somewhere here I am able to balance this somewhere here. So, ahead of the neutral point, so now according to our derivation, now the Cg is ahead of the neutral point, it has to fly in a stable mode. Let us see whether it is able to or not, right, Kiruba you may come front bit front.

So, if this model sustains the first landing then we can demonstrate in unstable mode as well. So, it is able to right, it is able to glide. So, I will try to throw it again, it is able to glide properly, right, so our derivation is correct, right now it is just maybe 2 centimeters ahead of the neutral point for this configuration. So, we will try one more time and then see, ok is the angle, ok. So, I will try now to demonstrate in the unstable mode.

So, for that I need to shift the Cg behind the neutral point, so what I do is, I will try to take out this weights, ok. So, and then and see where is the current Cg location, ok, it is behind. So, this is where I am able to balance right now, so this is the place where I am able to balance a model, so which is the current Cg location. So, this is where the neutral point is the my index finger is pointing at the neutral point.

And my thumb is almost close to the current Cg without added weights, so which is behind the neutral point. Now Kiruba I think yeah I will try to throw this, so now the Cg is behind the neutral point way behind see that. So, since because of it is inertia you cannot see that flipping but still it is not able to glide properly, we can see that again. We will try to throw it again, maybe when we drop it from a higher altitude you will be able to appreciate, see, yeah, so it is not happening.

The Cg is behind the neutral point, you can see it is not able to you know fly in a stable mode, ok. So, it is important for us to make sure that the Cg is ahead of the neutral point. And we also figured out that the neutral point for identical wings lies at the midpoint of the separation of aerodynamic centers of the 2 wings, right. So, now I am on top of this ATC I am trying to throw this. So, we are now again flying it in a stable mode, the Cg is ahead of the aerodynamics neutral point here, yeah ok, done, thank you. **(Video Ends: 08:32)**