Lighter-Than-Air Systems
Prof. Rajkumar S. Pant
Department of Aerospace Engineering
Indian Institute of Technology - Bombay

Lecture – 17
Remotely Controlled Airships

Now, what happened is that when we were talking about airships to people, when we were trying to pitch airships to people, a thought suddenly came to our mind that all our knowledge is secondhand. We have no personal experience. So, the credibility of a person is always at question when you make statements without having any personal experience. Now as an academician in IIT, Bombay, I really cannot think of making man carrying airships 1500 kg payload or even 100 kg payload.

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What we can do here is to do design fabrication and flying off remotely controlled airships that is what we started with. And I will show you a small trailer of some of our airship flights that will give you an idea.

(Video Starts: 01:03)

This was the first airship wihich was demonstrated in Texas in 2002, this month January 2002 we flew it in Gymkhana ground and you can see the kind of control we were able to achieve.

Next year we were invited by the Indian government to the Indian science Congress which took palce again in this year January, first week of January and we flew this Airship in Bangalore. But what you are seeing are the full scale dress rehearsal in Pune. Then we were contracted by

the DRDO laboratory called as Snow and Avalanche Study Establishment or SASE which wanted us to show airships can be used for avalanche monitoring, snow cover studies.

So for that this airship was designed and it was demonstrated as part of an international seminar on Snow Avalanches in April 2009 .This airship is the one which is flying in our VMCC foyer designed by a dual degree student as part of his GDP couple of years ago. And this is an autonomous airship about which I will talk much more detail very soon okay. Then we also made this small airship for demonstration purposes.

We go to many institutes and we showcase this technology to excite the students so that they can also think of making these systems. And so far, I have a very clean record that wherever I have gone and given a presentation like this, immediately the students say we want to make something and they start a project, they try to get funding from here and there, and many of them have succeeded also and I will showcase to a few of them.

This is a field deployment of a wing and this particular device was tested couple of years ago in the Gymkhana grounds. In case there is an error and in case there is a loss weather loss of tension, we have a free flying balloon and we are near the airport. So this system automatically brings it down to recover the payload safely. And this video is that of an aerostat that was installed at NIT Hamirpur last year in the month of April.

As a device which can be used by the college existancy for the ariel survelliance of their campus okay. So these are some of the projects that we have been doing.

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And in this presentation, we will look at some of these projects very closely.

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So here is the first one. The remotely controlled airship designed by the students of the 2002 passing batch. This was part of the aircraft design laboratory course, a course which is also going on right now AE 417. That year in AE 417 since I was completely occupied with airship and airship research, I requested the students why do not they work with me in developing an airship.

So there were two teams and then one team finally was able to give a very detailed and a correctly sized design. So that team along with some project engineers, they made this airship and as I said it was flown in Gymkhana ground. We had basically flights on 4 days. On all the days of tech fest we have flown this airship in 2002 plus we have done some several other trial flights subsequently. So this airship can lift just 1 kilogram of payload.

But the dimension is just under 5 meters in length. So just understand that 5 meters of dimension is needed to lift 1 kilogram of weight. And the envelope was actually fabricated by an agency in Vapi because at that point of time we did not have any facility in the department to fabricate or joint these envelopes. So it was sent to a company, our students went to a company in Vapi over 3 or 4 weekends and taking help from them they fabricated this particular envelope.

Similarly, I invited a friend of mine to come and fly this airship for us because none of us at that time knew how to fly an airship. And this person is a very experienced flyer. So therefore, we requested him to join our activities and he obliged and since then he has been working with

us on all our airship projects. Most of the projects that we have done, we have had the participation of this gentlemen.

So I have already shown you the video, but do you want to see it again? Okay, I will show you. This is a slightly noisy video. I am putting the noise off. Actually it is very noisy.

(Video Starts: 06:10)

The sound that you hear is because of the engine. Now, can you just connect this downstairs? There is one electrical point there just below. Now, it is so noisy because we had to remove the radiator of the engine for weight control.

We were very critical on weight and also we were not sure whether it will be cooled properly. So, we wanted to have air cooling by the propeller okay. Here you can see horizontal turn. Now you will notice that the nose of the airship has got some reddish kind of a bag which is hanging. So can someone guess what this reddish bag is for? What does it contain? Yes, this is for centre of gravity control. This particular term is called as ballasting okay.

So, we are using stones for ballasting. We picked up some small pebbles in Gymkhana ground and put them in this red colored bag and used it for balancing our airship because we need a very fine control on the center of gravity. Now, there is a maneuver called as a touch and go maneuver. It demonstrates the amount of control you have on a flying system in which you bring it to land as if it is going to land and then you take off.

So, in fixed aircraft the touch and go maneuver is an indication of the amount of control a pilot has on the system. And then there is one problem which always we face, engine cut. So basically, intentionally the engine was cut during the flight

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and as I have told you in the first lecture we fly airships actually heavier than air. So because it is really heavier than air, it comes down because of gravity.

And that is taken care by the power plant okay. This one is slightly large version. So there is a long nice documentary film which was made. So I will put that on. It will be self explanatory. I do not have to speak.

(Video Starts: 09:25)

So we rechristined LTA as Lets think airships. And this documentary film was made by a person who just passed out from IDC in IIT, Bombay.

So this was his first film. You see me in a very young stage. PADD or PADD that you see on the envelope behind me is an acronym for a program for airship design and development, a program that we have launched in IIT, Bombay aerospace engineering department about a year and a half ago. Airship is a lighter than air vehicle that means or more or less as light as air because of the envelope or the huge body which it has is filled with lighter than air gas, which is helium in most of the cases.

Right, now this is my ex-colleague Professor Gokde who is no more, he passed away in 2010. He was the consultant whom we had hired as part of our team and he worked with us for nearly a year and a large part of technical work in this project was actually done by Professor Gokde. And thereby it is so light that if there is a slight upward force, it will go up, and if the weight is slightly more it will come down. And because of this, there are a lot of advantages.

Got together and we conceived a small remotely controlled airship, which we fondly refer to as our microairship. This particular ship is about 15 feet or just under 5 meters length, the diameter is 1.65 meters from the envelope and it can lift a payload of approximately around 1 kilogram. What you see behind me is a modified version of the micro airship, which we call now as a mini airship. This mini airship today we have just checked out.

It can lift something about 3 kilograms of payload. An airship does not require a large runway. It consumes much lower fuel compared to aeroplane, but at low speed. The mandate for this vehicle is to be able to carry a video downlink so that we can demonstrate to people the capability of airship as a medium for surveillance and aerial observation duties along with having a huge size of the envelope, which we can use to promote or advertise a product.

This is the onboard camera. We are flying now in Bangalore Indian Science Congress. For commercialization where you can use in the add purpose or for surveillance purposes or for military purpose of acquiring different loads.

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Just to save time , we can go ahead.

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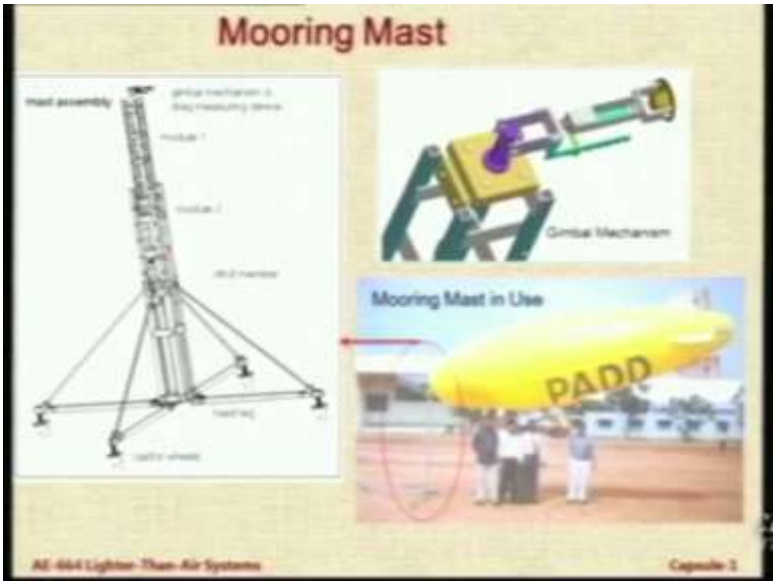

Now airships require a lot of support systems. One of them is a mooring mast so that when you are not flying the airship but working on it or doing some attachments, we need to attach it to the masts and keep it. So you can see there was a student who came from a college in Nagpur, who did his B. Tech project on the design of a mooring mast for the airship. And you will see a CAD model of the design as well as some kind of engineering drawing.

But when we actually asked the student to fabricate because he joined as a project engineer after he did his B. Tech project, he realized that all these fancy designs do not work in practice and it was too complicated. You can see it is such a complicated system. So ultimately, what

he made was just a single member in the center and that is what you can see in the picture below.

So he did make a mast, but it was much simpler than his own complicated design as part of. So that is why in theory we can do many things, but when you actually begin to realize you have to simplify things and simple things work much better. This was a very useful mast. This picture that you see on the bottom has been shot in Park College of Engineering in Coimbatore, which started an aerospace engineering department.

And they had one technical festival like Texas called Park by Manik Darshan. So we were invited to go and fly our airship there. So our entire team went from here to Park College for this flight.

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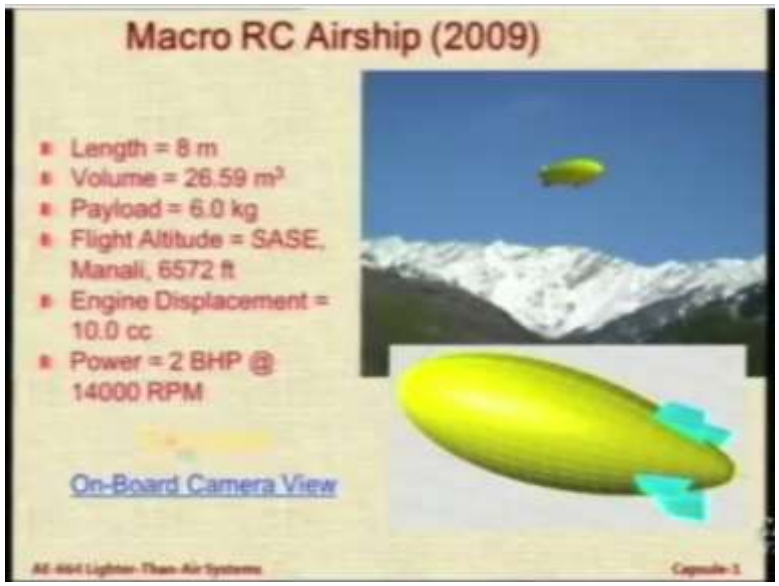

Okay. I also mentioned to you about the airship that was designed for snow and avalanche study establishment. Now, this was also a B. Tech project. Interestingly, the student working on this project was actually looking at an aerostat to start with. But then we got a request from the director of this laboratory saying that there is the International Science Congress, there is a international symposium on snow and avalanches and can you modify this design.

So, overnight the student converted from aerostat to airship very happily because aerostats are little bit boring, they are stationary. Technically, they are very great challenge, but they are not very exciting. Airships are very exciting because they move around, they fly, they come down,

they go. We were very happy and ultimately on YouTube he has put a video saying My B. Tech Project.

So have a look, just search for these words My B. Tech Project and you will find this particular video there put up by one of your seniors. So the challenge here was to design a system within a month including transportation of the system to Manali and then putting it together and flying it. So on 2 nd of March we got the final approval and on 4 th of April we had to do the demonstration. But on 4 th April, we did not get to fly because the hangar was occupied by helicopters for VVIPs.

We flew on 7 th of April. So from 7 th march to 7 th April is just 1 month or 1 month and 5 days. During this time we designed, fabricated, transported to Manali, we all went to Manali, put it together, tested it there. It has become a case study. And at many places, I have been invited to give an inspirational talk on, you know, from concept to reality in less than a month or something like that. So very interesting case study.

At some point of time, I can give you that case study in a story form. It is a story in pictures.
(Video Starts: 18:27)
But for you, what is important is to know some of the interesting features of this airship. So the altitude at which this is flying is quiet high for a airship that itself is no mean achievement. Now, we were not very sure whether electrical motors will work in this kind of environment when it is sometimes it may snow, sometimes it may be raining.

So we stuck to IC engine which are much more reliable and they have much better power to weight ratio. But our concern was the ability of an IC engine to develop enough power at this altitude. So some interesting studies were done to calculate the power available at the altitude. And interestingly, this was built in our laboratory. The envelope was built in our laboratory and taken to Manali okay.

So in the interest of time, I will try to show you some of the yeah this is a very beautiful segment of the picture which show the airship majestically undergoing a 360 degree turn while flying in the valley of Manali and during demonstration, there was on this airship we had fitted a very special camera called the IP camera. You know what is an IP camera? It is a camera that can talk to an IP address. So my laptop was the IP address.

This camera was recording images, still images at a particular frequency approximately 3 per second. These images were recorded on day they were encrypted, then there will be downlink. They were communicated downspace. My laptop was receiving them. Then there was an encryption decryption software and then there is a software which will show them in a sequence to show a pseudo video.

All this was done because it is DRDO, it is a defense application. There could be a situation when the airship goes into a territory where you do not want it to go. They do not even desire to go there. So nothing is stored on board. Everything is recorded in real time, transmitted and then decoded. So let us see what the onboard camera records. Now as you will see on top of the screen probably if you can read these are a series of JPEG images, which are numbered sequentially.

So we can now seeing 480, 481, 482, 483 dot jpg. So this whole flight is having 650 JPG images and I can accelerate them like this. So you can see it is fast forward. So it just shows you. This is the campus of SASE Manali by air. So using an open source software called a refine view, we are able to stitch them together into some kind of a pseudo video. My question to you is that there are several good video cameras are available with us and we have installed them and tested them before.

So why do you think there was a need to go for taking still images? Why could not we do video recording? In web they take less memory? Yes, for a given flight sequence, you are right, it takes less memory.

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But there is one more reason. What else could be the reason? One is it is easy to decrypt and downlink. But other than that, what could be the reason? Yes. That is also one reason.

There could be a limit on the data, so each image can be transmitted sequentially. So there could be a limit and there was a limit. There was a limit in this case. But our main reason was please remember this is meant for snow scientists. So what are they interested in? Not the beauty, they are interested in still images of specific areas, which they want to process in their software. If they want to do snowboard evaluation, they want you to fly today after 3 months, and they will compare the two videos.

So for comparison purposes, you have to grab an image from a video and now that reduces the image quality. So each of this is a high quality still image. So what we did is we looked at the customer's requirements and conceived a system suitable to the customer. Rather than telling the customer we have an airship, we have a camera, please use it. We said no, we will give you something now, this airship also flies in the rain.

It also flies in mild snow. It has been made completely waterproof okay. And I will show you some videos, it can also fly during night by using a very interesting system. But about that something else this is just a picture.

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Now looking at this airship, I want you to tell me two things. Whether it is climbing or descending or whether it is moving turning towards the left that is port side or towards the right or the starboard side? You have to look at the picture and then come to a conclusion and raise your hands so that I get to choose. There is already one person whose hand is up, but I will not give him a chance because he has already taken part in the discussion.

Anybody else would like to raise your hand?

"Professor – student conversation starts."

Is it, yes, Sandip climbing or descending? Why do you say it is climbing? Sir elevator is fixed up. Correct. Elevators are fixed up. So the air hitting the elevator will move elevator down, therefore nose will go up. What about turning flight or straight flight? Is it a port turn term or a starboard turn? It is a straight flight Sir.

Yeah, now you think this is a straight flight, but actually the angle of the photograph is such that the deflection of the vertical surfaces a bit towards the left as you see. If you see very carefully, you will find there is a slight deflection towards the left. So it is turning actually towards the left. Because the elevators go left, the move also goes left. So it is in the climb and a very shallow turn. Yes.

We cannot definitely say that it is in a turn because you can have picture present, You are right, but if the picture present if you have in this particular case, we normally approach, see in an aircraft you approach with the angle of attack during the landing because you would like to have high drag.

In airships we do not come at an angle of attack, we come at a horizontal config because we are not using dynamic lift at all. So if you see an angle of attack at airship, chances are it is climbing.

"Professor – student conversation ends: 25:27."