Lighter-Than-Air Systems
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Lecture – 19
Indoor Blimp Projects By Students

Now apart from this, there are many airships which have been made by students like you. Some from outside IIT Bombay; some from inside IIT Bombay and I thought it is a good idea to quickly have a look at this student project.

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So, the first project was done in 2004 by a group of students who were given KVPY summer internship in IIT Bombay under my supervision. There were these 4 students and these 4 students what they did is they went to the White Pond gate. They purchased a can of Coca Cola okay. They enjoyed the coke and then they cut it and made it into a gondola okay. No, the gondola is basically a plastic body.

Sorry the gondola is basically a plastic container Surf Excel container. And the two shrouds for the motors are coke bottles, the large coke bottle and they made a swivelable system okay.

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So, you can see this this whole system of two motors can actually be swiveled by remote control. And then they did a small demonstration of this flight in front of our department. It is the place which is now completely cemented with car parking that was an open space at that time, you can see more grass there. So, this is what they did. Lets us see.

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Then subsequently they were invited by other institutes.

So, there is an institute called for IUCAA in Pune. So every year they have a National Science day on 20 th February. So, these students were invited by IUCAA to go and demonstrate their airship. So this is IUCAA campus, some kind of a small foyer there in which you see Rahul Sangole is the name of the student who is trying to maneuver this small oblique swivel envelope.

We can see that they can swivel the motors to create, yeah this is vertical thrust now.

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So, they can swivel the motors to give directional force and they can also swivel it vertically to give vertical thrust to that. So, these four students made this.

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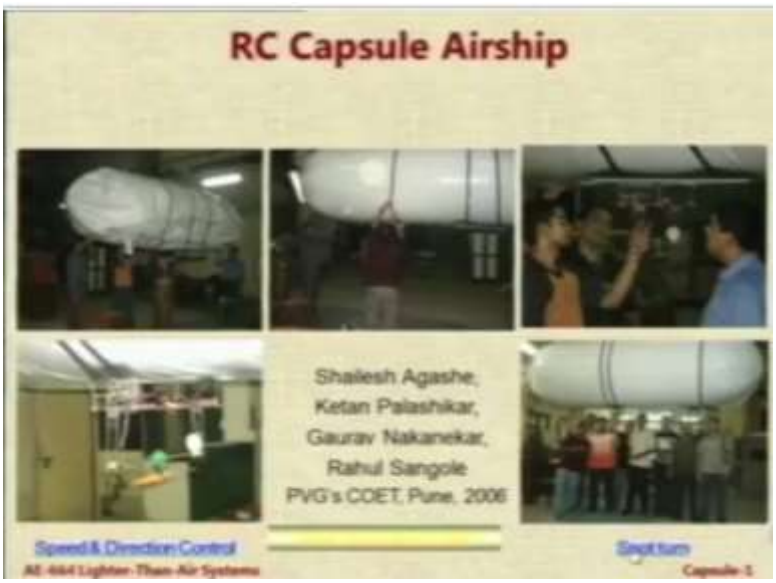

And then some of them came back again next year for their B. Tech project and for the B. Tech project they made this Capsule airship. Basically nothing special about it except that the shape is like a capsule. Now, because it is an indoor airship, therefore there is no need to put any aerodynamic surfaces, they would be anyway ineffective at low speeds. So, by the time you deflect the surfaces then $\frac{1}{2}\rho V^2$ is so less than the force and then it is very small.

So, you can completely control the trajectory of an indoor airship by electrical motors. So, if you use a spherical envelope, you will get the least surface area for a given volume, but spherical envelope also has very large drag and also it has got much larger, I mean diameter is equal to the length l by d = 1. So, these smart people said why not go for a combination of a cylinder with two spherical caps or capsule.

It gives you sufficient length so that the motor mounted behind can give you side force which a sphere cannot plus it gives you very good volume to surface area ratio okay that should be high because you would like to have high volume for given surface area because surface area means weight, self weight and volume means lift or buoyant force. So they came up with this design and then they also went all over the place to look for material.

And then they found a company which makes packaged food. You must have seen nowadays we have these ready made foods, right. The famous brands are MTR. So they say take this packet and put it in boiling water or put it in the microwave food is ready and all that. They are packed in a special silver foil. And these guys discovered that that silver foil is low weight, it can hold helium very well and it is also able to take loads plus it can be heat sealed.

Now what more do you want? You can join it properly, it can hold the gas. So they bought one big roll of that particular food packaging material and the guys were wondering what are they doing with food packaging material, but they were able to get it. There is a slight problem with this system also. It is a little bit difficult to inflate because wrinkles are very hard in this, but they managed to fabricate an airship with this.

Let us see the demo and for the students of my department I want you to guess what is the location of this demonstration.

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So guess where is it being tested? Okay, so you have a swivelable motor and then you also have on the back a yaw motor which gives the direct side force. It is a reversible yaw motor. Could you guess where it is being tested? Structures Lab, correct.

Now there are big partitions there, so our flying area is reduced slightly. But the good thing is Structures Lab is that it has got a huge double storey space. And students reach togerther work mostly in the night, this was 2 in the night, 2 a.m. So, they said if you give us permission for Structures Lab in the night time, we will be using it for our testing. So, the entire project was tested in Structures Lab at night.

You might say it is a very slow flying vehicle, what is the big deal, but okay, speed it is not very important here. Important point is imagine there is an exhibition going on Pragatti Maidan in New Delhi. A big exhibition going on. There was huge hall and you have this capsule Cipla brings you some new medicine just flying in the air. You do not need to fly fast, you want people to notice you. You want people to read what is written on that.

So it is fantastic. Very good. One can make good amount of money with this simple internal or indoor airship. So that is what was the mandate for them. It is very maneuverable. It can do even spot turns. For example you can see it can turn on the spot if needed, so powerful is the yaw meter. Spot turn is the forward push okay.

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And we want a very simple control system, which can go for reversal of controls.

Now, one way is that you go for a reversible speed controller, ESC, so those of you who have worked on remote control systems, they are expensive, they are also unreliable. So, what these guys did is at that time they did not get a chance to buy.

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So, they did this very special construction of the switch for yaw motor direction controls. This is a servo motor, which is connected to the white shaft.

There are in all 6 contacts, 4 our of them are fixed and 2 of them connected to the right shaft are movable contacts. The fixed contacts are connected in a cross fashion which is seen with the blue wires and the red wires. You can see that the blue wires are crossed and the red wires are also crossed. This is a speed controller. These two wires are connected to the movabale contacts which go as inputs to the motor.

The speed controller is connected in the alternate fashion to the fixed contacts.

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Now Rahul Sangole now he works for GE, he works for Cummins in US. I think Shailesh Agashe works for GE. He is making washing machines now. Gaurav Nakanekar continued to do masters in IIT Bombay in mechanical department. So these people have done a good piece of job.

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Now let us look at some other students okay. Now, this is the Blimp which was developed by students of Texas A and M University. I visited the university for 2 months in June and July of 2011. So my mandate was to kickstart LTA activities in Texas A and M because interestingly

how it came about is very inspiring. So a professor from the university, who is an Indian origin professor, Professor Giri Majhi.

He comes to India regularly. He came recently also. So I remember in 2009 he came to IIT, Bombay. He gave a talk and then he comes to me and says, you know I have a slight problem, I want to keep my suitcases somewhere because I have to vacate the guesthouse and I have an evening flight. And I want to meet you also. So he came to my lab to keep suitcases. At that time, there were some kids making a small blimp, they were testing the controls.

He was fascinated. He said who are these guys? I said these are undergraduate students, they have a design lab and they are making a small blimp. So he says you mean to say these people are going to make an aircraft. I said yeah they will fly it very soon, you want to see a flight? He said yes. So they went and they flew it for him. He was amazed. He said, I want the same thing in Texas A and M. I have money, but I do not have people who can do this.

Can you come to Texas A and M. I said why not? So during one summer when I had a chance I went there and this is what we did. So we made a small blimp in Texas A and M and let me show you a demo of the flight.

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So you will notice that there is a lecture hall. So we gave a lecture on LTA systems, all these blah, blah, applications, etc. We flew this blimp inside because it is a big hall and then we did a small demonstration flight outside okay.

Just to save some time. This person in the front is a faculty member. So this student called Jacob was a Ph. D. student at that time and this is Jacob's mother. She came just to see what Jacob is up to during summer. So mothers everywhere are looking at what their kids are doing, even though they are doing Ph. D. okay and just to save some time. Let us see Jacob is doing some setting up okay.

So you can see this particular blimp has got two swivlable motors on a gondola. And these lights that you see are only for fun, no technical application, just to create some excitement in the night okay. This is a very small blimp. And there is also a really interesting story about this blimp. So when we design this whole thing, we came to a point now where do you make it? Because Texas A and M does not have a machine to fabricate the blimp.

So I called up various blimp makers in the US and I said, I come from India. I am here for 4 weeks, 5 weeks. I have designed the blimp, can you fabricate it for me? They said yeah you give us the design, we will get it fabricated, but it will take 3 weeks, but I said why 3 weeks? In IIT, we do it in a couple of days this can be made. They said no, we have a problem. When the design is made by you and given to us, we have to send it to India because the fabricating agency is in Hyderabad.

So they will make the blimp envelope and mail it back to us. So it will take a week to go, a week to make, a week to come back. And then they said 1 week for delivery. I said hang on. I do not have 4 weeks. So then I said I am coming to California for sightseeing can I come and pick it up from your factory? They said yeah that we can do. So I went to California for sightseeing and while coming back I got this in the aircraft with me. So this is a situation.

I mean blimps in the US are being made in India, of course TAMU blimps like this. But there are also fabric suppliers in India who are supplying fabric to US companies. We recently had a meeting with a supplier who is based in Villa Parle and during discussion they said yeah we supply this material to so many blimp companies in the world.

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So the technology is available in the country. It is very easy for us to use it. It will be much cheaper for us to do this okay.

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Our own department we have this festival. There is next one happening in the month of March. Every year we have this festival and for the last few years we have been flying blimps in that. So we made one special blimp using a new material that was given to us by the manufacturer for 2003.

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And again this was a part of a B. Tech project by Syum, Syum BTP and it was matching because the fare takes place in February-March and the BTPs are ending in April. So by February or so, his blimp was ready. You can see this is a simple experiment to determine the net gross lift where you tie the balloon to the weighing machine and it tells you what is the weight which is coming because of the buoyancy, so it is 1000 grams of net lift.

The challenge now is to make everything else within 1000 grams, the controller, the battery, the gondola, the fins, and the 3 motors. They all have to fit within 1000 grams that is a technical challenge when designing LTA systems okay.

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So we made these things. First we did some testing from thermocol, tthermocol gondola and then we did some flying okay.

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So you can see the indoor testing is happening in the Structures Lab. Same place which we visited recently for the capsule airship. Now we will visit that place for having a look at this black airship. Now this is a very simplistic gondola.

Just a thermocol box cut into few pieces to accommodate the various systems because we were heavily very critical. The challenge here was to do one complete circuit around that central pillar of the Structures Lab without hitting the wall. So you can see there is yaw motor and there is a forward motor and we just missed the wall. So the systems are a bit sluggish when they are indoors because wind does not help them out. However, we can still manage by careful design.

Now, let me show you for those of you who are not there. This is a small demo as part of the Zephyr festival So that is V K Saraswat who was that time the DRDO chief. He was the chief guest of this program and in the Gymkhana foyer we have flown this particular airship. This is Syum with the controls, highly maneuverable because of the yaw motor. It can do almost a spot turn and in the small space of VMCC foyer we are able to fly.

Sometimes we also go outside the foyer and come back inside. One more thing I want you to see, maybe is not there in this video, if it comes I will show you. Very important to note how forgiving these systems are see. The vertical tail is bent and now you see the airship goes.