Lighter-than-Air Systems
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Lecture -08
Why use Aerostats?

Question is why should we have aerostat? Why should we study this technology? Why should we make aerostats?

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So there are certain comparisons which people make. Now please notice I am not saying that the aerostat on the left is equivalent to the aircraft on the right. I am not going to make that claim the aircraft on the right is far more capable than the aircraft on the left but you know it is just F16 versus one small aerostat just to show you that. There are aircraft, there are aerostats. So let us see.

Aerostats are considered to be very highly cost effective because for surveillance requirements over a month, let us say the amount of money you will spend in operating an aircraft to do that work will be much more than what you do with an aerostat. They are portable and can be relocated so can aircraft they can also be relocated they can fly wherever you want, but they need airports, they need facility on the ground, they need runways which aerostats do not.

And then because aerostats are lower to the ground they are going to give you much clearer and sharper detail as compared to pictures or videos taken from an aircraft. Because they are closer if you are the height of the obstacle, the height of the object to be surveyed if it is more you get larger coverage area but you will then you the flip side is you lose on detail. So what we have seen is aerostats versus satellite, I think I should show you before that.

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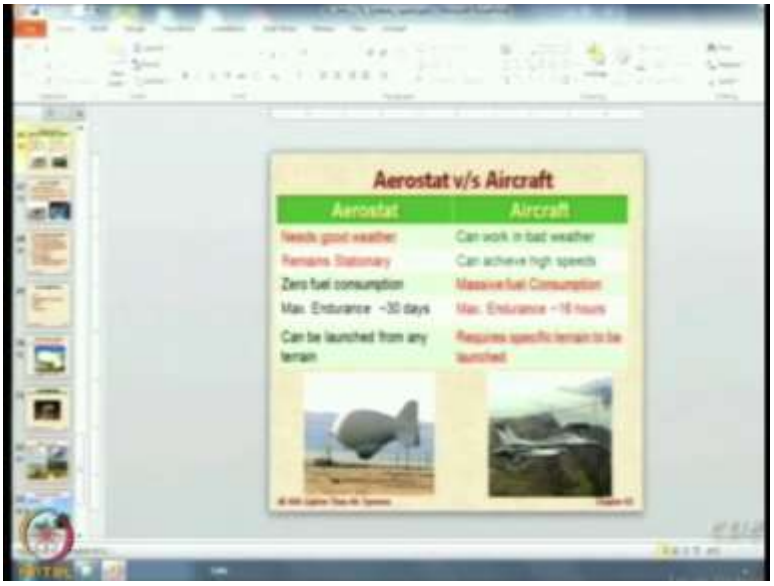

These are some of the applications of the aerostats, maybe we can just look at this. If we look at aerostat versus aircraft. Now Aerostats there are two red marks which are its drawbacks first of all they only work in good weather, they need the weather to be good and they remain stationary not as exciting and as dynamic as an F16 or an aircraft but the Fuel consumption is zero and they can give you endurance for a month and they can be launched from any terrain.

On the other hand aircraft can be used in even bad weather conditions to an extent and also you can achieve very high speeds supersonic, hypersonic. But the other three things are not in favor. So because of this, there is a role for aircraft there is a role for aerostats there is a role for satellites. The best thing to do is to use all of them together in conjunction with each other.

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Let us see the applications of aerostats again. These applications are ones which have already been done, so surveillance and communication you can use it for surveillance at the border, surveillance to give huge coverage. the Indian air force. For example, has installed aerostats for aerial surveillance, they are typically installed around 50 to 100 kilometers inside our territory and they can give a visual coverage of around 350 kilometers.

So they are safely located inside our territory, they can be protected by our own aircraft but they can still give you very good visual information about activities across. Similarly aerostats have been extensively used for surveillance over the sea and for military applications and by mounting the communication equipment on the aerostat you can use it as a transponder for wireless communication for high speed last mile data links in areas where there is no connectivity.

Or if there is a disaster at a place and there is no coverage there you want to give temporarily. Some coverage to help in the rescue operations you can set up a small communication station and then relocate it very quickly to some other place by using tethered aerostats. We have done some work in this area I will showcase the work done by our students and researchers in a separate lecture towards the end of the course.

Then you can use it for local area surveillance. One very interesting application which we will elaborate more when we look at historical perspectives is to go for protection of the aerodromes.

For that one can use what is called as a balloon barrage system. This system was developed by the allied forces in the Second World War in which they mounted these or sorry in the First World War they mounted these aerostats on the border of an aerodrome.

And the steel wires of the tether would entangle with any enemy aircraft coming in to bomb these fields. So by putting a family of aerostats around you can protect it from the enemy aircraft

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Let us look at some very modern applications of aerostat once again. I would like to reiterate the aspect which I mentioned and I will keep repeating it that your own imagination, your own creativity can play a very big role in finding new applications for aerostat. This is also one very interesting and creative application which is now developed into a product called as the JLEN system. So let us have a look at the JLENS. It is a promotional video by a company but approved for public release.

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As you can notice there is a growing threat to our vital sea lanes and strategic waterways multiple fast-moving asymmetrical threats such as anti-ship cruise missiles, unmanned aircraft and swarming boats which can be armed with missiles suicide bombers or small arms. Today's warfighter needs more time and more distance to detect, decide and engage the threat. The threat is immediate, the solution already exists.

A revolutionary long-range surveillance capability providing continuous detection and fire control data on army, navy, air force joint and coalition networks. JLENS extends the battle space allowing war fighters to simultaneously detect and engage threats in three hundred and sixty degrees including ground targets, sea skimming anti-ship cruise missiles, unmanned aircraft and surface moving targets like swarming boats from up to five hundred and 50 kilometers away.

JLENS provides more time. Conventional radar can detect an anti-ship cruise missile only seconds away. JLENS can detect that same threat when it's launched and because JLENS has fire controlled radar commanders can protect themselves from that threat at the maximum kinematic range of their defensive weapons. JLENS is always on, it provides three hundred and sixty degrees of continuous surveillance twenty four seven, thirty days at a time.

Allowing commanders to develop and analyze patterns of life over time and make better evaluations. JLENS is proven capable, cost effective and ready an existing system for a growing threat, a smart approach to safeguarding commercial and military interest in strategic waterways. JLENS more time and distance to detect to decide to engage.

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So Raytheon is a company which has developed this system as you observed, there were two aerostats one of them has got a fire control radar and a ranging system the other is used only for observation. So as soon as the observation aerostat observes something that is fishy. It will communicate the information to the other aerostat which will then immediately communicate with the fire control system.

There is a fire control radar so it will communicate with the fire or launching system which can very quickly engage with the adversary. Otherwise by the time the adversary is detected it is too late. So this kind of a couple so that is why it is the netted system, it has got two sensors which are netted together. So this is one example of how aerostats have been used recently.

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Another example is for collecting the meteorological data, so for that small aerostats like this can be sent up or can be stationed at a particular place for a long time you can collect data regarding the weather, atmospheric properties and many other parameters which are difficult to calculate. For example, if someone wants to do a study about pollution happening because of a chimney in one particular area.

You can actually use the tethered aerostat at various heights, sample the air and calculate the presence of harmful compounds. So aerostats allow aerospace engineers to collaborate with other disciplines and enhance the capability of their sensors or their systems. And they allow it to be done in a very cost effective manner. You do not have to be a pilot because it does not fly, it does not need any piloting skills and it is safe, because it is tethered to the ground.

If there is a serious problem if the winds are very high or there is a disturbance you can just bring it down and it is possible to install on an aerostat and airship. Many safety systems which will take care of emergency situations we will showcase to you some systems that our students and researchers have developed as part of their work. And also I will showcase one example in which we successfully use that system during our own testing when things went bad. One can also find some other applications of aerostats.

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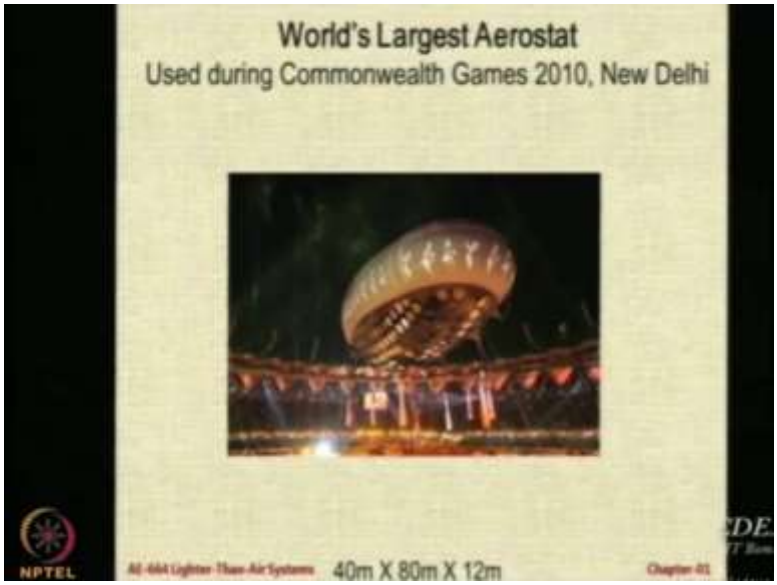

This is the common wealth aerostat which was nothing but an aerial screen on which information was projected for entertainment purposes. So this is also although you can call it non-technical application, but it is an application and it is also in the same family of inflatable systems.

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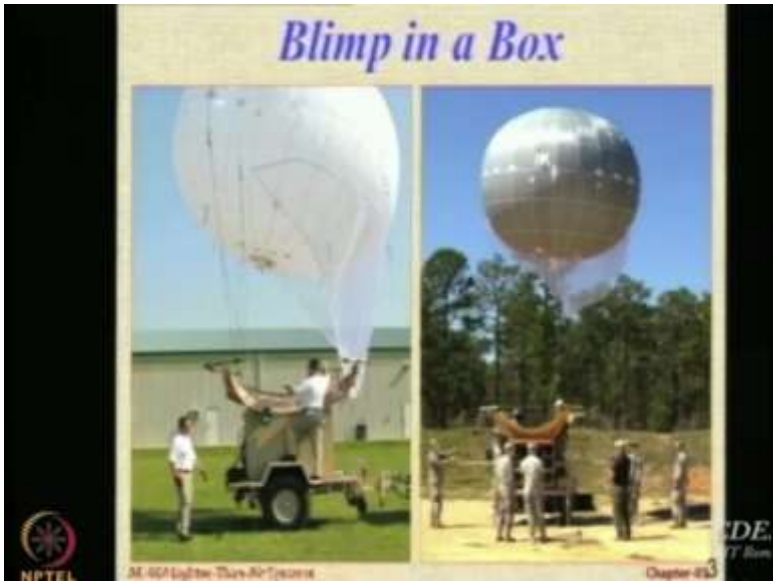

Now to increase the portability of aerostats simplicity in their design and to ensure that they can be used more for remote applications. People have come up with designs which are making them highly portable. So this is one called as Blimp in a box, it is a trade name of a company which uses either for defense applications as you see on your right or applications for civilian on your left.

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And then a similar application is also being used by a company, with which I very closely work. Now, this is a startup company by two M Tech Aero students from a university in Brazil called as ITA Institute Technological Aeronautical. So these guys have started a small company which uses this simple oblate steroid aerostat with sail. So let us just have a look at what they do, this is also a promotional video.

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There is no audio in this, just music. I will tell you how, what things are happening here. So this is an example of how it can be deployed from a field, so there is a small customized winch which has been patented by this company for a small aerostat. At the moment they are buying this aerostat envelope and tether from a company in US, but eventually they have a plan to make it indigenously.

This is aerial view of the campus of that institute where this company is located, so this is their wind tunnel hangar, they have a big wind tunnel here, these are the departments. And next door is the airport you can see a small aircraft coming into land and at the end of this is the hangar and production facilities of a company called Embraer Aerospace, which is the Brazilian aerospace manufacturer.

So this institute is co-located with Embraer and also with the military base, you can notice how infrared cameras can be mounted on this balloon to identify people, this is a shot from the aerostat

ground. For protection of dams or other areas where you expect trouble, this is the winch that they have designed, you can see, it is a triangular tripod kind of a winch. This is a close view of how the winch automatically aligns when the wind direction changes.

Some demonstration about the tracking capability of the cameras now these cameras have been purchased from companies in Israel. But when you integrate them they have a correction mechanism. So that the vibrations of the airstrike can be automatically corrected. Now there is a question people ask about what happens if somebody shoots bullets on this balloon, it will bear, it will create a catastrophe.

I will show you a small testing result of a firing bullet where you go. These are being fired through the balloon. There will be a slow motion video which will show you that the bullet enters and leaves. Of course there are two holes created but this is a low pressure balloon, so it does not explode. The gas inside is helium that does not catch fire and it takes time for this gas to slowly leak out by the time you can take emergency measures and bring the system down.

So during the world cup football there was in brazil nearby these highways if there are any mis happening, where you can see people are Standing at the top, now in case of fishing so in the IR camera but this picture without all cameras a transponder mounted below the aerostat for mobile communications.

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All right now let us look at what I would call as a dream aerostat system, something that is what one day I wish to develop with the help of researchers and that is the rapid elevated aerostat platform.