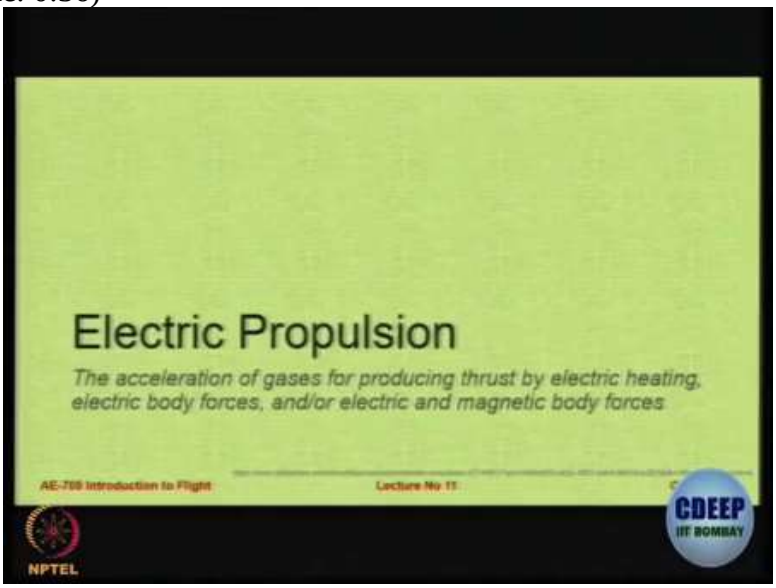
Introduction to Flight
Professor Rajkumar S. Pant
Department of Aerospace Engineering
Indian Institute of Technology, Bombay
Lecture 07.4: Introduction to Electrical Propulsion and Ion Propulsion

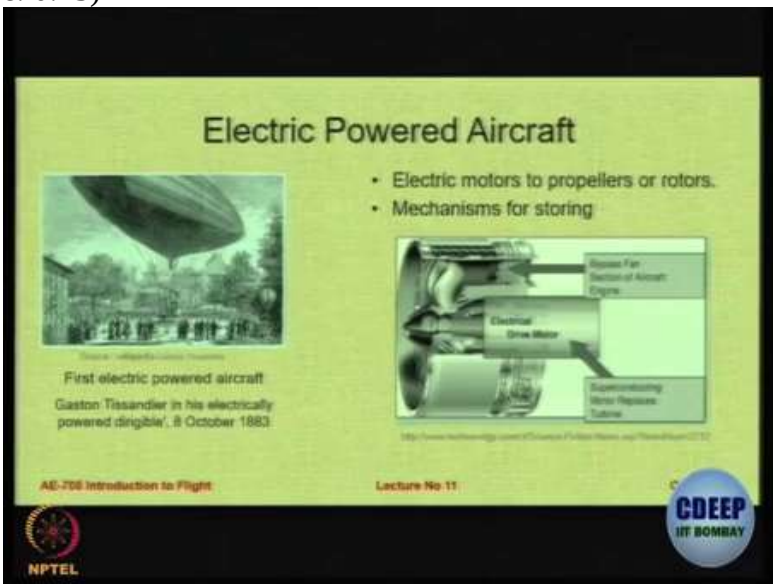
Ok, so we now move to the future, we move to current developments, R&D and future. In the next 12 minutes or so or 15 minutes or so, I am going to talk about electrical propulsion. And then in the last slot I will talk about ionic propulsion.

(Refer Slide Time: 0:36)



So what is electrical propulsion? Using electricity either stored in the batteries or in any other means by magnetic forces to generate the thrust that you need, ok?

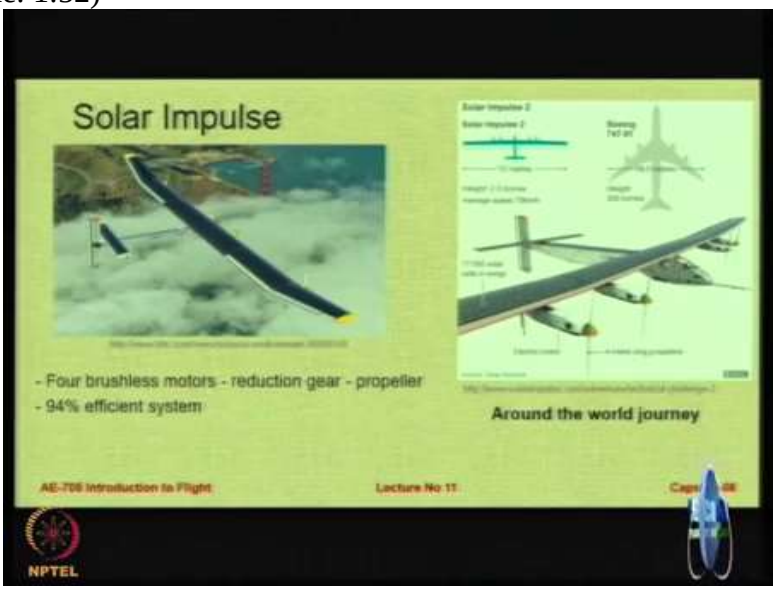
(Refer Slide Time: 0:45)



So what you do is very simple. All of us know that there are several remotely controlled planes which are flying today with electrical powered aircraft, ok? So there is nothing new. The only thing is do we have the ability to do it with for manned aircraft, ok? So the issues are you need to have a mechanism for storing the electrical power in the forms of batteries or some other devices. And you need electrical motors to produce the thrust that is needed, ok?

But interestingly it is not new. Many many years ago in 1883 itself actually we had an electrically powered aircraft. It was a small airship by Tissandier. So electrical powered aircraft are not new. Many years ago in October (1983) 1883 itself we had an airship which was powered by electrical propulsion, ok?

(Refer Slide Time: 1:52)



But our interest is to look at aircraft which are available today. And I have already discussed with you about this aircraft when we look at the aerofoil, ok? If you recall, we looked at solar impulse and we realized that this is an aircraft which is completely covered with solar cells, right from the fuselage, on the wing, on the tail. And the aerofoils were such they were they were having a flattish upper surface to allow easy mounting of the solar cell, ok? And recently the aircraft has completed on the, around the world journey not non-stop, but around the world with various stops. It also travelled India.

(Refer Slide Time: 2:30)

Let us have a look at some other R&D aircraft which are currently, this is a very interesting example of an all electric airplane called as the Magnus E Fusion. This is a technology which is basically being developed by Siemens of Germany.

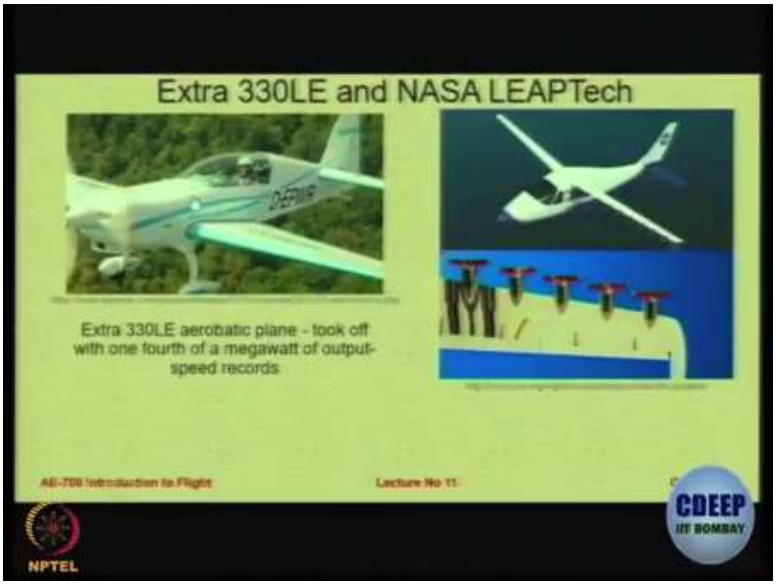
Video: Yeah Magnus E fusion is a wonderful aircraft this was actually the second flight of the aircraft that fabi and me onboard by myself together so this is really a moment another important milestone in electric aviation. Siemens has developed the fabric electric drive train, motors, pilot electronics and the control systems actually the batteries were developed by Siemens Hungary. Specifically for aircraft application having a very bulbous very reluctant batteries.

The Siemens partner was the best choice for working with us since they have the experience and knowledgeable engineering team while processing reliable solutions.

The Magnus E fusion serves Siemens for the further development of the aviation battery system. Magnus E fusion have capability of aerobatics so it can serve as a upside recovery trainer.

Professor: So this aircraft has been developed by a company called Magnus in and the drivetrain and the storage has come from Siemens, ok? There are many more examples of aircraft which are either under development or under design using electrical propulsion. For example, this is a good example of a distributed propulsion system, ok?

(Refer Slide Time: 4:52)



And here is an example of an aircraft called Extra 330. This video is in German and there is English translation available on the bottom. So this is a different aircraft, this one is called as the Extra, ok? But you can see it took off with one-fourth of a megawatt power output, ok? And just 50 kilograms gave you 260 kilowatts of power. So that is an amazing power to weight ratio. Now, let us look at distributed electric propulsion. This is also an interesting video which talks about the future about how things are going to come.

(Refer Slide Time: 9:37)

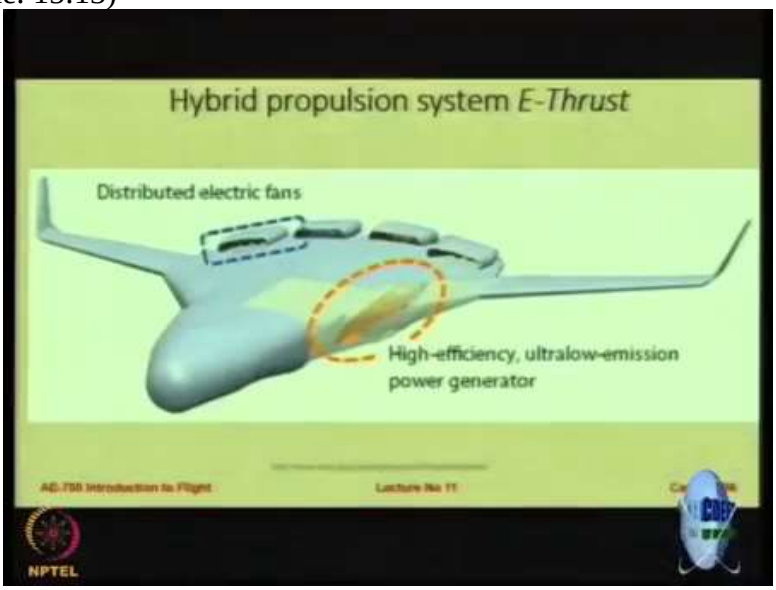
Video: for typical aircraft we see one propeller on the nose of the aircraft where two missiles on the wings of the aircraft so just a very few and very well inaugurated close up of entire aircraft system. We are looking at how hybrid distributed system electric propulsion can change the way of aircraft or design. Electric motors controls and just mean incredible breakthrough

in just last ten years. We look at the force horse power pounds of electric motors in control which is discourages the turbine engines and for same electric motors that is 95 percent efficient while if you look at turbine its about 45 percent efficient. So the idea come around a long time discovering the propulsion because of its characteristics and the turbine technology we simply put that in a practical feasible ways, electric propulsion gives us this freedom to put the electric engines anywhere without mechanical complexity. It opens the freedom that an aircraft designer can use this propulsion technologies and take sthe very low energy consumption very low, In fact the aircraft design now can uses five times less energy and the best general aviation aircraft market today. For this project we have fantastic industry partners, they can take higher risks.

Professor: Ok, now there is also a proposal that we can have passenger airplanes in which people like you and me can fly which are powered only by electrical motors. But it is the combination, it is not just electrical motors. So let us have a look at what are the kind of suggestions which are being given:

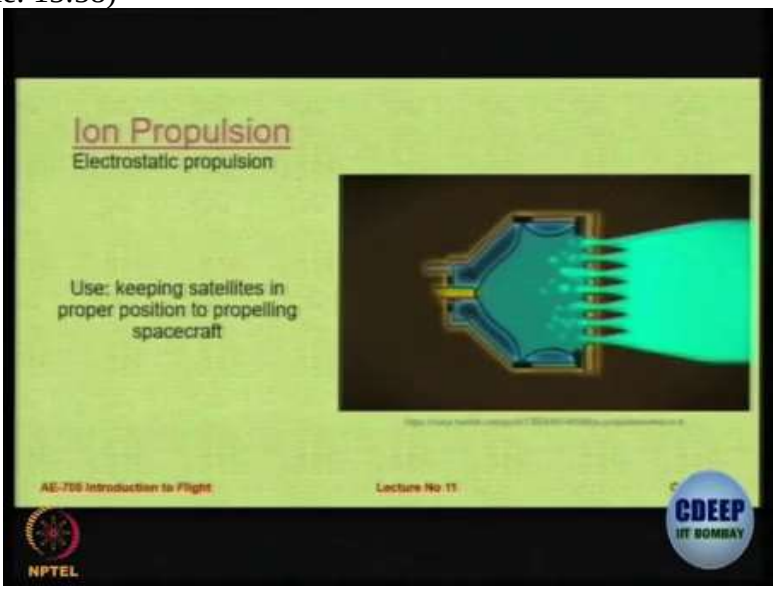
[Video Presentation]

(Refer Slide Time: 15:13)



Professor: Ok, so in the interest of time I would like to go ahead and talk about now the hybrid propulsion system. Or propulsion systems which are going, we saw something of that in the previous video also. But I think this video elaborates more on the concept of hybrid propulsion system. This is the project between two companies Rolls-Royce and EADS Innovation Works. It is a very similar concept actually; we have already seen this.

(Refer Slide Time: 15:58)

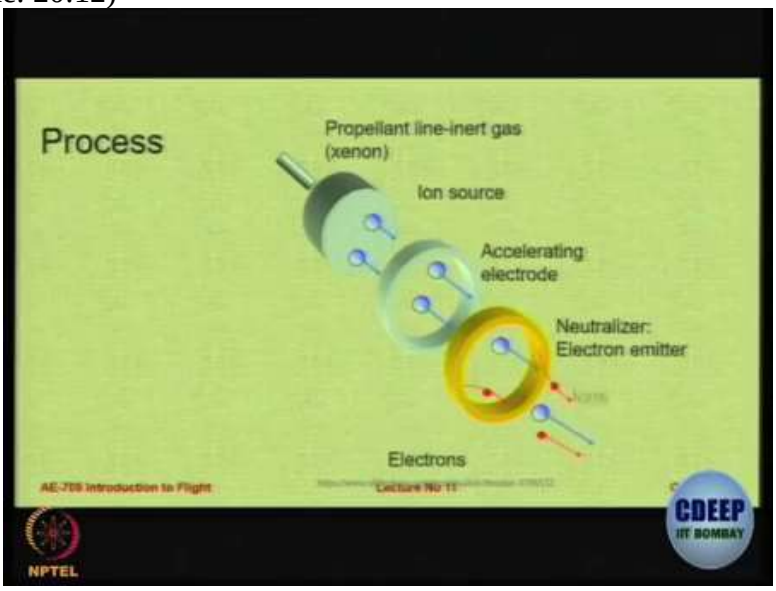


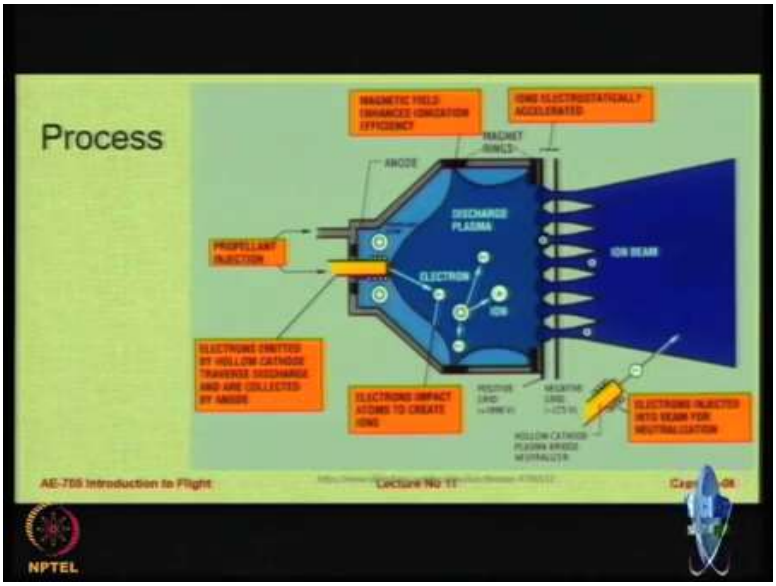
Ok, moving on to the future. There is something called as ionic propulsion which has a tremendous potential to really transform the way in which we actually create thrust, ok? So let us have a look at what is this:

[Video Presentation]

So this is not for powering civil transport aircraft or for transporting general aviation. This is meant for transporting or powering the probes for space exploration because the amount of thrust that they can generate is very small. However that is sufficient for us to generate the thrust needed in space, ok. So it can be used to increase the life of the spacecraft by providing a small amount of thrust for much longer duration of time and helping in the position.

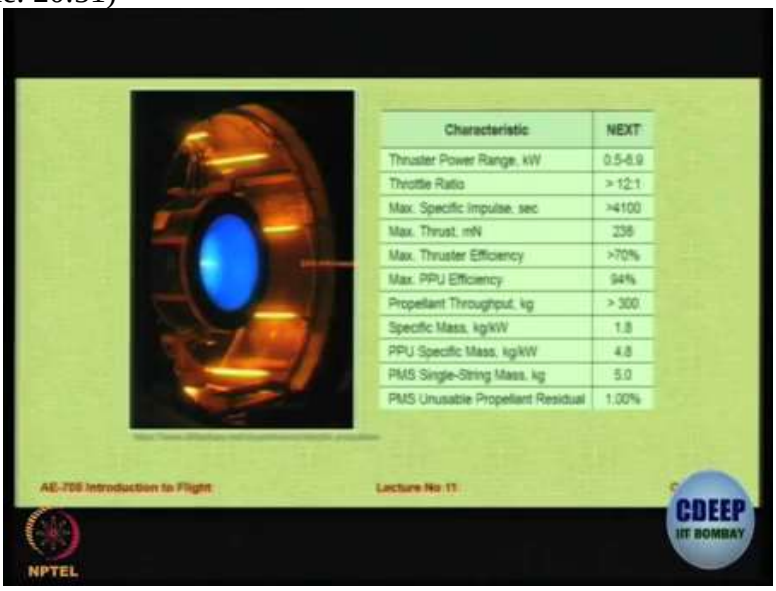
(Refer Slide Time: 20:12)





So the process is very simple. You have a propellant something like xenon which is thrown in source of ions. And then you have an accelerating electrode in which they are accelerated, you bombard the xenon with the ions from the cathode and then you give it a positive charge then it is attracted and then you emit. And finally you create a mechanism by which you can go back on the rear and reduce the charge to normal levels, ok.

(Refer Slide Time: 20:51)



So these are the characteristics. So the specific impulse is very high although the numerical value of thrust maybe quite some small value. Thank you.