

# Hybrid Electric Aircraft

Jainil Shah

Student, Dept. of Diploma Electrical engineering, Parul Institute of Engineering and Technology(Diploma Studies), Gujarat, India

\*\*\*

**Abstract** - Since a long time, the aviation industry has adhered to different kind of jet fuels like kerosene or naphtha kerosene for propulsion. But due to the increased awareness regarding global warming, it led to a fresh interest in green technologies. Among this some interest has been devoted to hybrid electric aircraft where propulsion system consist of electric and hydrocarbon fuel propulsion i.e. the motor and conventional jet engine. Despite the fact that several research organization worked on to improve the conventional design to make it more environment friendly, they hardly reached their desired outcome. In approach of reaching the willing fuel saving and less pollution, hybrid electric aircraft came into existence.

**Key Words:** Hybrid, specific energy, motor, electric, aircraft.

## 1. INTRODUCTION

Recently, the trend towards green aircraft has piled up a lot. Due to the tremendous amount of fuel consumption and pollution from conventional jet engine aircraft has led the aviation industry to think about switching onto hybrid electric aircraft. The hybrid electric aircraft has the blend of both electric propulsion and the conventional jet propulsion. Although hybrid aircraft isn't the exact remedy for the disastrous effect of conventional aircraft but it has the potential of reducing the effect through it's disruptive technology.



Fig -1: Airbus/Rolls Royce/Siemens hybrid electric aircraft

## 1.1 Degree of Hybridization

Aircraft can be categorized according to degree of hybridization of power.

$$\text{Hybridization power} = \frac{\text{motor power}}{\text{total power}}$$

Conventional aircraft use no electric propulsion so degree of hybridization is 0 in it. All electric aircraft works solely on electric propulsion so the degree of hybridization is 1. Hybrid electric aircraft uses both the techniques so the degree of hybridization lies between 0 to 1 in case of it.

## 2. Types of Hybrid Electric Aircraft

There are commonly two types of hybrid electric aircraft. They are series hybrid and parallel hybrid electric aircraft.

### 2.1 Series Hybrid Electric Aircraft

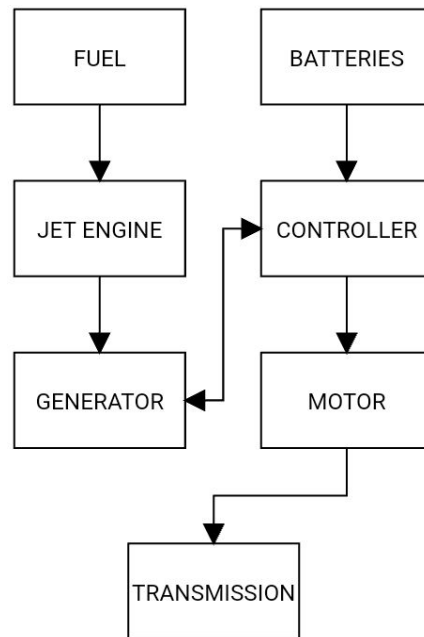


Fig -2: Series hybrid aircraft

In series hybrid, the generator coupled with the jet engine generates electricity which is stored in battery packs through a controller, the motive power is gained through the motor which yields necessary signals by the controller in essence with the battery pack.

### 2.2 Parallel Hybrid Electric Aircraft

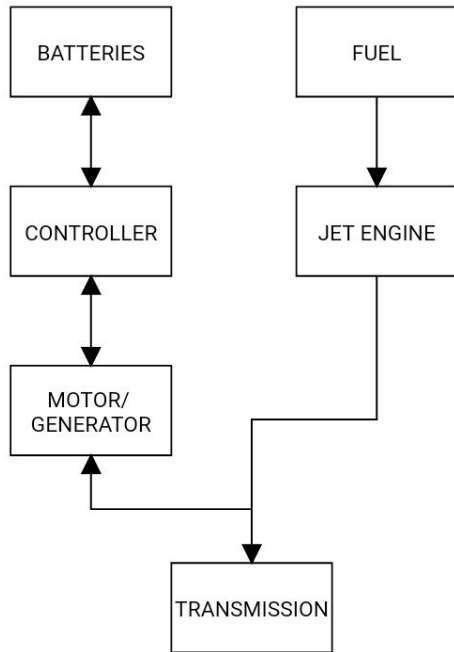


Fig -3: Parallel hybrid aircraft

In parallel hybrid aircraft, no generator is used for electricity requirement. Instead of that there are two sections, one consist of conventional system like the jet engine and the second section consist of electrical propulsion system including batteries, controller, motor etc. Both this system are coupled through a complex transmission system.

### 3. Considerable Advantages of Electric Hybrid Aircraft

1. As of economical charts it's a fact that electricity is much cheaper than jet fuels.
2. Less fuel consumption.
3. Reduction in pollution in case of hybrid electric and probably zero pollution in case of all electric aircraft.
4. Depletion in noise because of electric motors.

5. Easy start up in conversion with jet engines which requires initial rotational force for starting.

6. Regenerative braking can be implemented which are way more efficient than conventional braking system which uses disc brakes and waste a lot of power turning it into heat.

### 4. Challenge Faced in Hybrid Electric Aircraft

The most effective challenge faced is the low specific energy of the batteries. Specific energy is the amount of energy stored in a source with respect to it's mass.

Batteries have 50 times lower specific energy compared to that of liquid fuels. The specific energy of liquid fuel is 11900 Whr/kg and that of lithium ion batteries is 200Whr/kg.

### 5. Conclusion

Hybrid electric aircraft can surely change the aviation industry through it's disruptive and groundbreaking technology/ advantages. Although hybrid electric aircraft isn't the best solution for approaching an environment friendly system but still it has the potential to make a tremendous reduction in pollution.

### REFERENCES

- [1] [https://www.researchgate.net/publication/327085495\\_Electric\\_hybrid\\_and\\_turboelectric\\_fixed-wing\\_aircraft\\_A\\_review\\_of\\_concepts\\_models\\_and\\_design\\_approaches](https://www.researchgate.net/publication/327085495_Electric_hybrid_and_turboelectric_fixed-wing_aircraft_A_review_of_concepts_models_and_design_approaches)
- [2] <https://www.emerald.com/insight/content/doi/10.1108/AEAT-03-2019-0046/full/html>.
- [3] [https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019\\_pg124-130.pdf](https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg124-130.pdf)
- [4] [https://www.aiaa.org/docs/default-source/uploadedfiles/publications/standards/hybrid-electric\\_properties\\_attributes.pdf?sfvrsn=c8eb8f11\\_0](https://www.aiaa.org/docs/default-source/uploadedfiles/publications/standards/hybrid-electric_properties_attributes.pdf?sfvrsn=c8eb8f11_0)
- [5] [https://en.wikipedia.org/wiki/Hybrid\\_electric\\_aircraft](https://en.wikipedia.org/wiki/Hybrid_electric_aircraft)

### AUTHOR



Technophile, Fond of Engineering,