Superconducting Cables to Produce All Electric Aircraft

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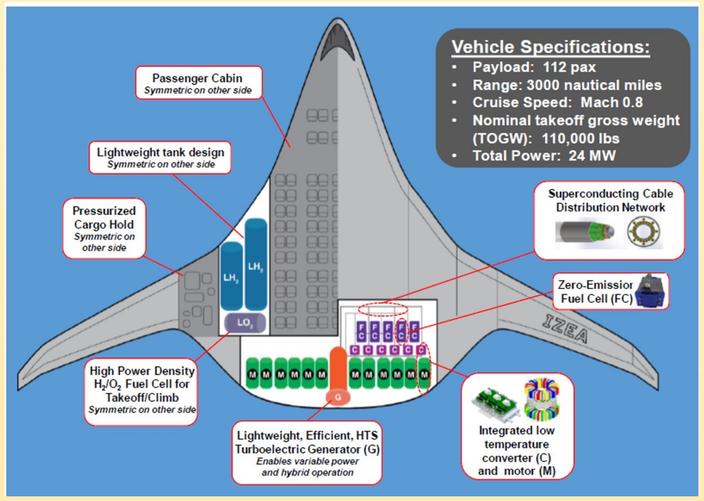
Background

- Aviation constitutes a major factor in emissions production and the production of greenhouse gases. There is a great initiative for zero emissions aviation, through the Integrated Zero Emission Aviation (IZEA) Project.
- Power system integration determines design of superconducting cable and termination designs.
- Major interest in ensuring the potential failure of one generator does not cause catastrophic failure in the aircraft.
- The power system required for the electric aircraft can be supported by superconducting motors, generators, and power cables dependent on the stage of flight.
- There is a varying power load depending on whether the flight is climbing, cruising, or descending and the power systems must be built to support each stage accurately and efficiently.
- The overall goal of this project is to create a hybrid wing fully electric aircraft that will be produced utilizing superconducting generators, motors, and power cables with redundancies to support potential failure in any equipment.



Methods

- Watched videos and conducted research on the schematics of an all-electric aircraft
- Read Peter Cheetham's published works so far and attended weekly IZEA student meetings for updates on different aircraft components.
- Become familiar with superconducting power cable networks and cryogenics required to reach desired temperature of the system.
- Ongoing – design a prototype aircraft to be built on a 4-foot by 6-foot table built to scale.

Results

- High Temperature Superconducting (HTS) cables will prove most beneficial for power transfer.
- Cables must follow volumetric and spatial requirements offered by aircraft.
- Thermal management and system level integration must be explored to keep HTS cables in desired temperature range.
- Total power rating of 18 MW for aircraft, with approximately 24 MW required for takeoff and 12 MW required for cruising.
- Cables fully encapsulated to ensure thermal conductivity.

References

- Cheetham, Peter, et. Al. "Superconducting DC power distribution networks for electric aircraft."
  - (Paper is not yet published but was written by faculty in the Florida State University Center for Advanced Power Systems in preparation for publication in AIAA Journals.)

Conclusions

- A prototype on a 4-foot by 6-foot table is being developed that will be 3D printed in three different sections to analyze the structure and where each of the cables and generators will lie.
- This is a five-year project that we are still currently in the first year of, so a lot of planning, preparation, and groundwork, is being done now for the aircraft to begin to take shape over the next year and be in production a few years down the line.
- This is a project that is taking place with no prior projects like it that have been successfully completed. The concept of an electric aircraft is a field of research that has taken great interest, where this project will shed light on the aviation field with the possibility to produce significantly less emissions and lower greenhouse gas production in the aviation industry.

Future Work

- As this is an ongoing project, much of it is still in development.
- The current stage of the project is in good standing with proper funding and a plan for the future of the project, with each of the experiments already done revolving around the aircraft documented in detail able to be understood and repeated by other IZEA partners so everyone has full understanding of the project and is on the same page.
- Even with the knowledge gained recently, there is still a lot of research and prototyping to conduct before many aircraft design decisions can be made regarding framework, where cables will be housed, generator and turbine placement, etc. .
- The concept of an electric aircraft is a field of research that has taken great interest, where this project will shed light on the aviation field with the possibility to produce significantly less emissions and lower greenhouse gas production in the aviation industry.