Preliminary Design of an SMR Airplane with BLI Propulsion

PIE 032

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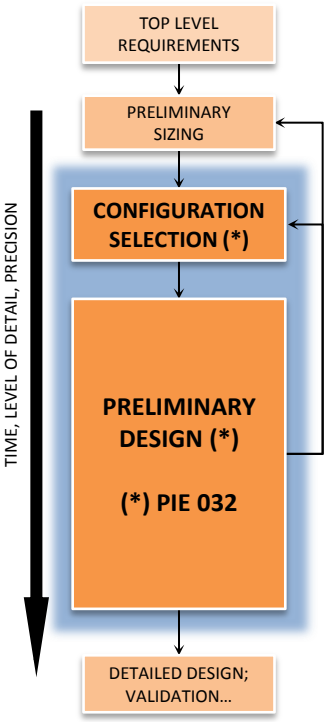
source: https://www.nasa.gov/aero/reduce-fuel-burn-with-a-dose-of-bli



Description & Objectives

Current global environmental (but also economical) circumstances impose a necessity to rethink civilian airplane technology, and consequently the related design paradigms and methods. One of the most prominent airplane subsystems facing a major change is the **propulsive system**. Aiming for more significant **integration of the propulsor into the airframe**, **Boundary Layer Ingestion (BLI)** concept is explored as a promising candidate to enable the civil aviation to move to an even more environmentally friendly and cost efficient future.

PIE 032 will continue the work carried out by PIE 004 (2017). To kick off, the group will pick up the previous PIE output: preliminary sizing of a **short-medium range (SMR) airplane** equipped with a BLI propulsive system (baseline airplane: **Boeing 737**). This means that the macroscopic parameters (e.g. mass characteristics, drag polar) to describe the aircraft designed to fly a prescribed mission will be available as the project input. Then, starting from these numbers, a **configuration selection** will be carried out for the targeted platform, followed by the **preliminary multidisciplinary design** of the selected configuration. That way, the preliminary sizing results will be developed further, this time taking into account the configuration (airframe outline, systems, etc.) as well.

The design will ultimately converge to a detailed set of **airplane geometry, systems and performance specifications**, which make the first deliverable of PIE 032. The second deliverable will be a summary of multidisciplinary analysis and design **methodology** developed by the group to reach the outlined targets.

Expected Results

- Aircraft configuration
- Detailed overview of airframe and propulsive system geometry
- Layout of the airplane interior and the systems (e.g. ECS, high lift devices, landing gear…)
- Propulsive system definition (cycles, components)
- Energy breakdown of the aircraft
- Aerodynamic properties
- Weight properties
- Synthesis of the methodology used for obtaining the above results

Expected Skills

Science/engineering:

- Multidisciplinary analysis & design
- Airplane propulsion
- Aerodynamics and basic flight mechanics
- Non-propulsive systems

Tools:

- Programming (Python)
- CAD (Catia)

Preliminary Design of a Small Airplane with Hybrid-Electric Propulsion

PIE 033

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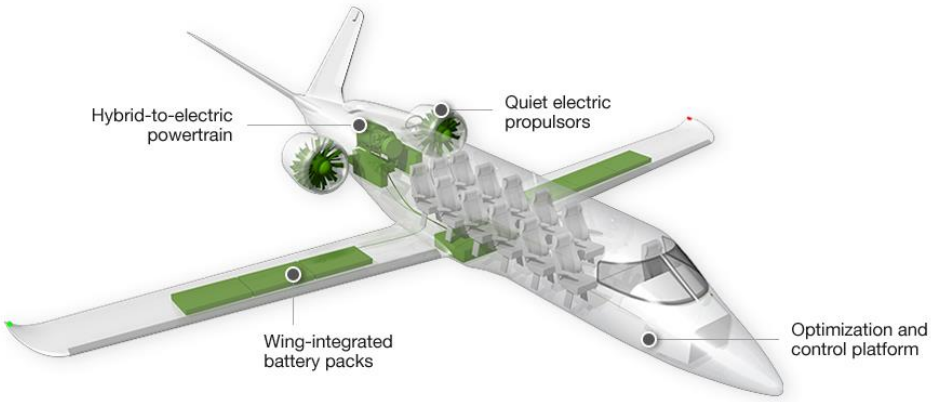
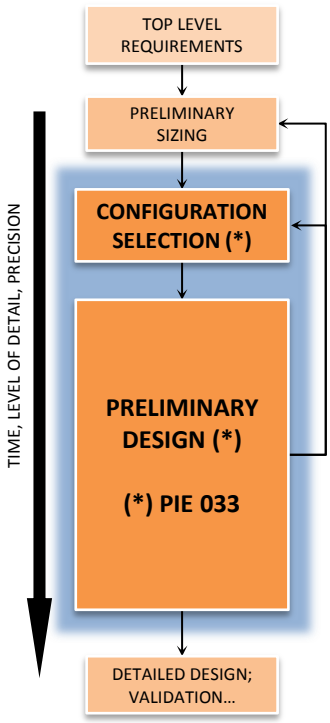


source: https://zunum.aero/technology/

Description & Objectives

Current global environmental (but also economical) circumstances impose a necessity to rethink civilian airplane technology, and consequently the related design methods. One of the most prominent airplane subsystems that will evolve is the propulsive system. One of the prominent trends in paradigm shifting is **hybridisation/electrification** of the aircraft, and especially that **of the propulsion system**.

PIE 033 will continue the work carried out by PIE 004 (2017). To kick off, the group will pick up the previous PIE output : preliminary sizing of a **small airplane** propelled with a hybrid-electric propulsive system (baseline airplane: **Pilatus PC12**). This means that the macroscopic parameters (e.g. mass characteristics, drag polar, hybridisation degree) to describe the aircraft designed to fly a prescribed mission will be available as the project input. Starting from these numbers, the PIE group will carry out a **configuration selection** for the targeted platform, and then pursue the **preliminary multidisciplinary design** of the selected configuration. That way, the preliminary sizing results will be further developed, this time taking into account the configuration (airframe outline, systems, etc.) as well.



The design will ultimately converge to a detailed set of **airplane geometry, systems and performance specifications**, which make the first deliverable of PIE 032. The second deliverable will be a summary of multidisciplinary analysis and design **methodology** developed by the group to reach the outlined targets.

Expected Results

- Aircraft configuration
- Detailed overview of airframe and propulsive system geometry
- Layout of the airplane interior and the systems (e.g. ECS, HLD, LG…)
- Propulsive system definition (cycles, components…)
- Energy breakdown of the aircraft
- Aerodynamic properties
- Weight properties
- Synthesis of the methodology used for obtaining the above results

Expected Skills

Science/engineering:

- Multidisciplinary analysis & design
- Airplane propulsion
- Electrical systems
- Aerodynamics and basic flight mechanics
- Non-propulsive systems

Tools:

- Programming (Python)
- CAD (Catia)

Study of Viability of a Hybrid/ Electric ECS for a SMR Airplane

PIE 034

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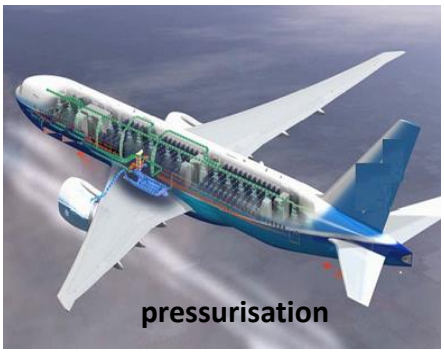

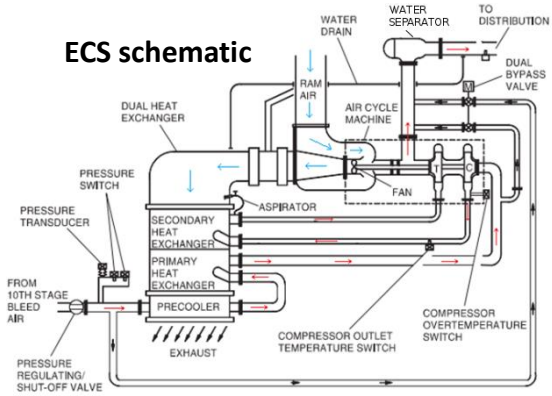

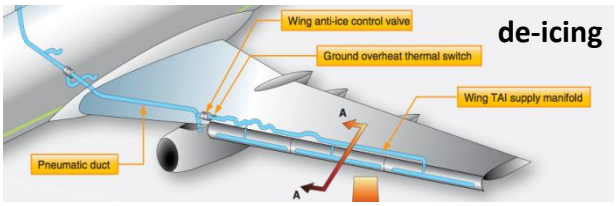

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Description & Objectives

The aviation industry is currently moving towards **More Electric Aircraft** (**MEA**). In this framework, the issue is about the electrification of the engine, but also of the aircraft non-propulsive systems. For instance, for the cabin pressurisation, the wing de-icing and the electronic device cooling, the long range B787 Dreamliner is equipped with an **electric Environmental Control System (ECS)**.

In this study, the objective is to focus on the ECS electrification for a **Short-Middle Range aircraft (SMR)**. The work will be dedicated to the definition of one (or several) hybrid/ electric ECS and to compare the impact on the aircraft performance with a conventional system at the step of aircraft **pre-sizing**. The assessments of interest are about the airplane global mass, the additional drag and the power balance during a flight mission.

This project pursues another PIE from the previous year which has provided the definition of the ECS needs during a flight mission and a pre-sizing of a moto-compressor, and also a PIR about the preliminary drag estimation of additional air intakes.

Expected results

- Hybrid/electric ECS architectures definition,
- Mass assessment and comparison with a conventional pneumatic architecture,
- Global drag assessment and comparison with a conventional architecture,
- Power consumption assessment and comparison with a conventional architecture.

Expected skills

- Aircraft non-propulsive systems, systems design,
- More Electric Aircraft,
- Aerodynamics, thermodynamics,
- Turbomachinery.