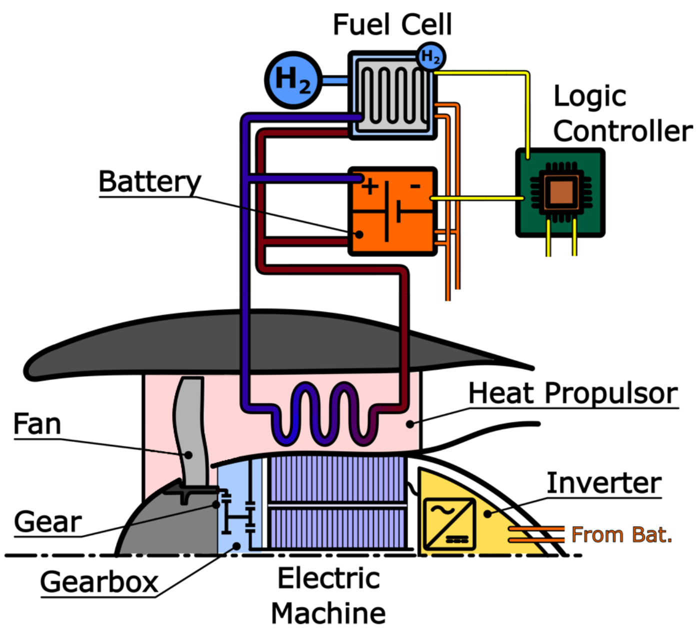
NOVEL RECUPERATION SYSTEM TO MAXIMIZE EXERGY FROM ANERGY FOR FUEL CELL POWERED GEARED ELECTRIC AIRCRAFT PROPULSION SYSTEM

EXFAN

Project Objective

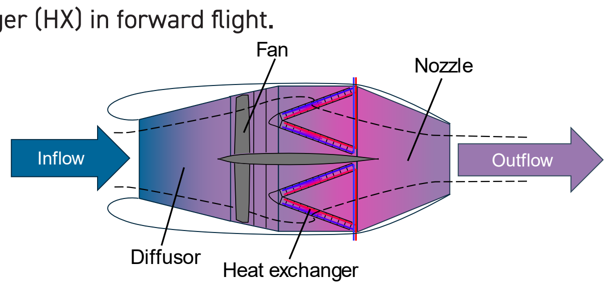
Hydrogen powered aircraft propulsion is one key technology to enable environmentally friendly aviation. The process intrinsically does neither produce NOx nor CO2 emissions in flight. Therefore, electrically driven and fuel cell powered propulsion systems enable zero in-flight CO2 emissions. One of the main challenges of fuel cell powered aviation is thermal management and heat rejection. Electrical efficiencies of fuel cells are predicted to reach 50% by 2030. This means each Watt of electricity produced in the fuel cell will generate a Watt of heat that needs to be dissipated. The partners of exFan will investigate a solution that enables the dissipation of waste heat without any additional drag losses and the use of such waste heat to generate additional thrust for the aircraft. The following main goal of the project was defined :

> The goal of the project exFan is to develop a concept for a novel thrust generating heat dissipation and recuperation system included in a geared electric fan propulsion system of mega-watt class that is powered by fuel cell technology up to TRL 3.



Operating Principle

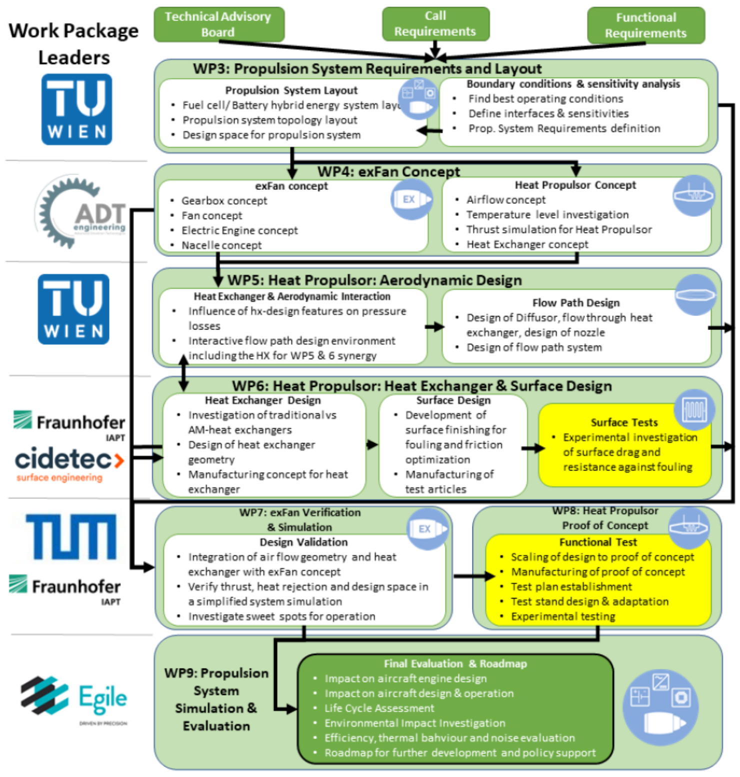
The underlying concept is the so-called Meredith effect, which occurs when air flowing through a duct is heated by a heat exchanger (HX) in forward flight.



The duct is designed in a way that the air flowing into the duct is compressed due to the ram air effect. The pressure loss from the heat exchanger reduces due to the decreased dynamic pressure, while the air flow through the heat exchanger is heated and the volumetric flowrate increases. The hot, pressurized air then exits through a convergent exhaust nozzle. This accelerates the air backwards and the reaction of this acceleration against the installation provides an additional forward thrust force. The efficiency of gaining additional propulsion power depends on the nozzle pressure ratio (NPR) which is the total pressure of the air entering the nozzle to the static pressure downstream of the nozzle. The system efficiency can hence be increased when combined with a compressor or fan.

Work Plan

The work plan of exFan is structured into nine work packages: 7 technical WPs and 2 transversal WPs related to project management and dissemination, communication and exploitation activities.



Current Status

At the current state of project (January - February 2024), TU Wien focuses on finding beneficial integration possibilities for the heat propulsor. Due to the potentially high surface area of the heat exchanger, an underwing mounted propulsion system might not be feasible. The advantages and disadvantages of different integration options are therefore explored. Furthermore, the favourable operating conditions for the thermal management, recuperation- and propulsion system as well as operating limits are identified.

Project Partners

Project Coordinator

cidetec surface engineering

Technical Coordinator

ADT engineering

Research Coordinator

TECHNISCHE UNIVERSITÄT WIEN

Egile, easn, powerid, Fraunhofer IAPT, IRES, Technische Universität München, DLR Deutsches Zentrum für Luft- und Raumfahrt

General

- Duration: 48 Months
- Start: 01.12.2023
- 10 European Partners

Funded by the European Union via Horizon Europe Cluster 5 "Climate, Energy, Mobility":

- Grant agreement 101138184
- Horizon-CL5-2023-D5-01

Topics:

- Carbon free aviation
- Fuel Cell
- Thermal Mangement
- Hydrogen

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