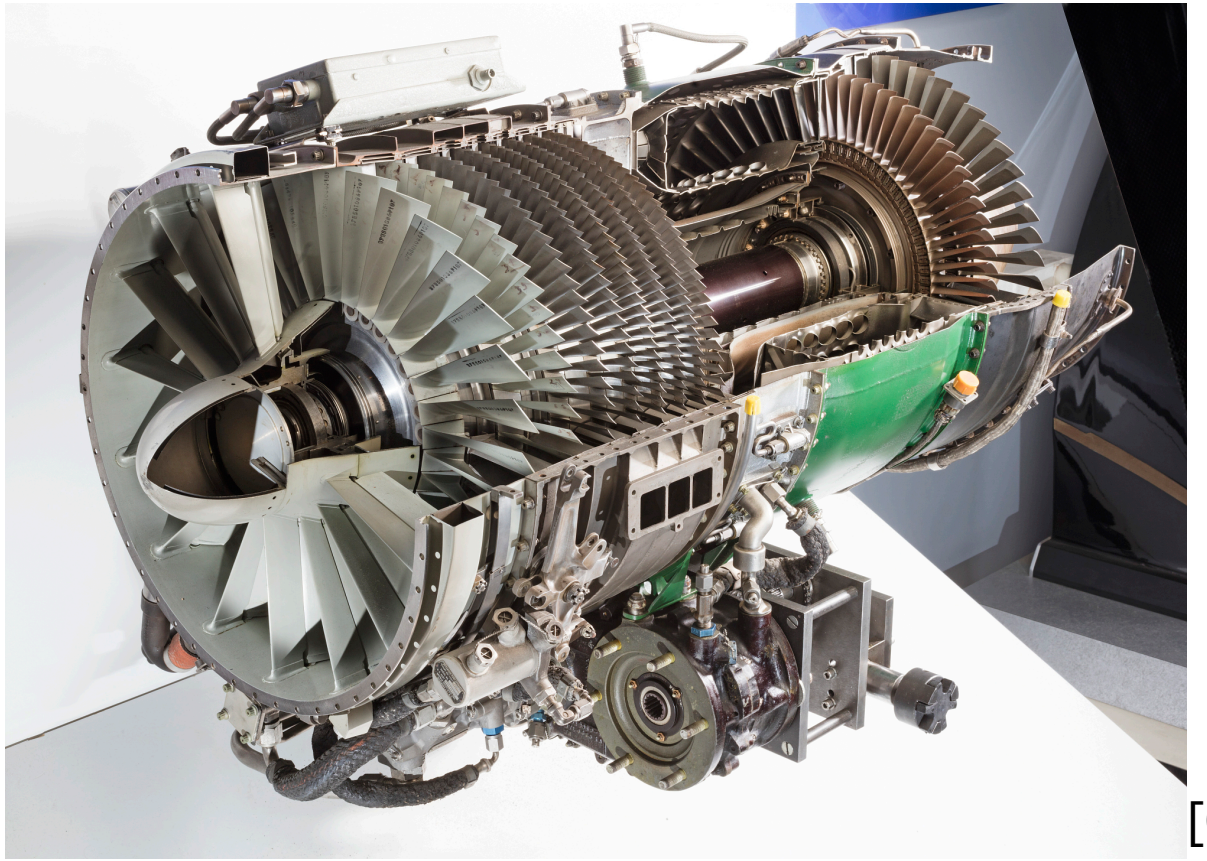
Assignment Description

Conceptual design of a HPC axial compressor

Main Objective

To Design the HPC Axial Compressor of the NASA Energy Efficient Engine E^3



[Courtesy of GE]

Background of E^3 Program

The **Energy Efficient Engine** was a program funded by NASA in the 1970s to develop technologies suitable for energy efficient turbofans. Its goal was to improve thrust specific fuel consumption by 12% compared to a GE CF6-50C. Both General Electric and Pratt & Whitney produced turbofans for the program. The GE core featured a 23:1 high-pressure (HP) ratio HP compressor, later used in the GE90 and GEnx. P&W had a nine-stage HP compressor in their core with a pressure ratio of 14:1.

Students are challenged to make the conceptual design of the E^3 engine HPC compressor!

[source: Wikipedia]

Design Specifications of the HPC E^3 Compressor of GE Engine

Parameter	Maximum Climb
Corrected Speed, % Design	98.4
Corrected Airflow, kg/s (lbm/s)	54.4 (120.0)
Total Pressure Ratio	23.0
Adiabatic Efficiency	0.860
Polytropic Efficiency	0.906
Inlet Temperature, K (° R)	304.8 (548.6)
Inlet Pressure, N/m^2 (lb/in^2)	60,469 (8.77)

Rules of Engagement of the Assignment

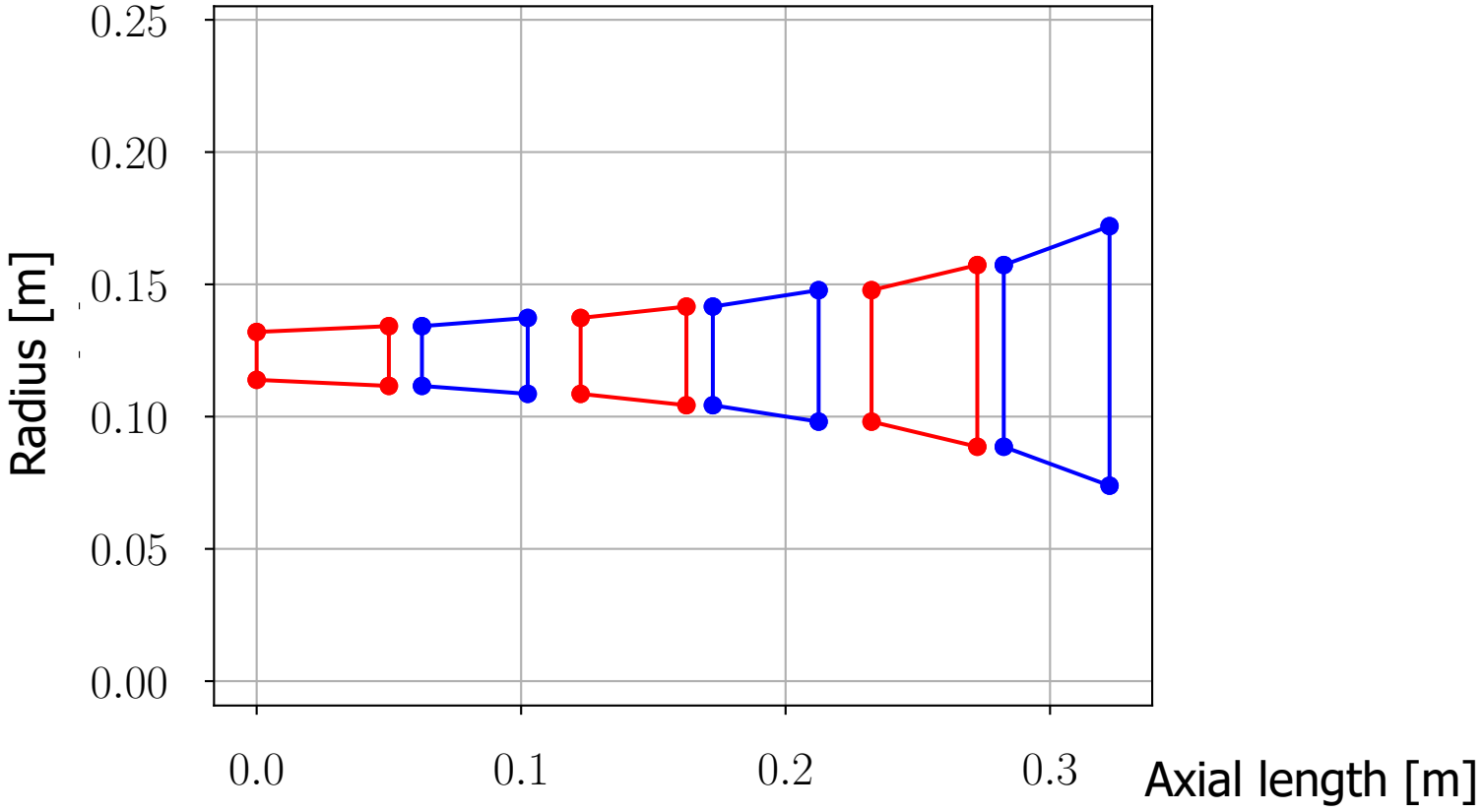
1. This is a group assignment. The ideal number of group members is **3**. Groups of 2 people are allowed only in exceptional circumstances.
2. The final product is a **short** report (no more than **5 pages**)
3. The report must contain the following:
   - Problem Statement
   - Assumptions (e.g. perfect gas, adiabatic machine, etc.)
   - Explanation of design choices and design procedure
   - Results-1: meridional gas-path, velocity triangles, *h-s* diagram, η_p, η_{tt}
   - Results-2: Aero-thermodynamic flow properties along gas path in dimensionless form, namely $\frac{P}{P_{t0}}, \frac{P_t}{P_{t0}}, \frac{T_t}{T_{t0}}, \beta_{stage}$
   - Conclusions (short and in the form of max 2/3 bullet points)

Rules of Engagement for the Assignment

4. The due date for the delivery is **01/12/2020 (midnight)**. The pdf, along with the mathematical/numerical calculations (source code or Excel sheet), must be submitted via Brightspace. **Please make a single .zip folder** containing the report in pdf format (any other format will not be accepted) and your calculation sheets (e.g. a single Excel sheets or Matlab/Python scripts).

5. After the delivery, the lecturers can randomly ask a group to give a presentation to explain the results of the assignment. In case a group member shows little awareness of the project contents, this will be considered as a failure for the entire group.

Example of Meridional Gas-Path



Example of Aero-Thermodynamic Flow Properties along Gas Path