

University of Wales Trinity Saint David

School of Engineering

Independent Project Proposal

Independent Project – ACMA6013

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Date: 24/09/2023

Word count (Excluding cover page, contents page, and Reference list) – 706.

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1. Introduction

This report highlights reasons and relevance for selected project followed with timescales, provisional work plan and aims for the project.

Background research is to be undertaken to date, with bibliography of utilised technical publications that have been obtained.

Details of facilities required inclusive of software and laboratory support needed to complete work.

Finally, any details of cooperative industrial partners utilised.

2. Reasons for and Relevance of the Project

An independent project is to be carried out, with the aim of improving the LPT (Low Pressure Turbine) module/section of an aircraft engine. With the constant demand for improved fuel-efficiency, improvements in component longevity, and reduction in overall costs, these are a few reasons for carrying out this project, as well as with the constant strive for improvement occurring in the industry as a whole, improvements can be explored to try and improve, or potentially resolve some of these issues highlighted.

3. Aims of the Project

The aim of the project is, as mentioned, discussion of potential improvements in fuel-efficiency, component longevity, and cost reduction. These are some of the biggest ongoing changes with the LPT module at present. With one issue being the LPT modules major loss of efficiency due to LPT blades having a thin trailing edge. Additionally, there are other issues such as high compression requirements, Fouling, Erosion, Corrosion, Heat (High heat).

4. Timescales and Provisional Work Plan

Timescale as follows:

- Initial research – Commence 09/23 – Conclude 10/23
- Introduction to project – Commence 10/23 – Conclude 11/23
- Main body of research – Commence 11/23 – Conclude 01/24
- Main body of dissertation – Commence 02/24 – 04/24
- Conclusion – Commence 04/24 – 05/24

Any testing/test and CFD proposals will be completed during the main body of Report being produced.

Timescales and work plan will be created/updated throughout the construction of the report with the use of a Gantt Chart.

5. Background Research Carried Out To Date

The following research/thesis papers, websites, and journals were utilised in the initial research, and ultimately decision making of this report. Extensively discussing the current issues faced with both the LPT (Low Pressure Turbine) and HPT (High Pressure Turbine). Some papers such as (Wakeley, 1997) discuss steam turbine optimisation, yet these principles correspond with gas turbine issues.

- (Francesco Bertini, 2012)
- (Vogt, 2005)
- (J.P. Clark, 2010)
- (Kyrpianidis, 2010)
- (Wakeley, 1997)
- (Khairuddin, 2017)
- (WorldWideScience, 2023)
- (Sensatek, 2020)

6. Details of Facilities Required

Various software will be required throughout the construction of this report to enable construction and design of potentially modified LPT components, such as blades, nozzles, shrouds, spline seals, shroud clips etc. These modified components will then need to be simulated with the use of CFD software to determine factors such as flow over individual stages of nozzles, and/or blades. Whether flow is of laminar, or turbulent origin, and if so, can blade/nozzle orientation/design be manipulated to improve length/time of laminar flow to ultimately increase efficiency of LPT.

7. Details of any Cooperative Industrial Partners

Relevant information and resources will be utilised from GE Aerospace as required. Software will be utilised from UWTSD as required, this will likely be to produce CAD blade and/or nozzle examples, as well as CFD software, as mentioned in section 6. This is to produce a simulation showing whether a turbulent or laminar flow is being produced from the blades designed, and if so, at what point does the flow transition to turbulent, Can something be changed to the blade/nozzles to its advantage for increased efficiency, maybe create a temporary flow separation, followed by a reattachment. Maybe take advantage of the hydrodynamic boundary layer. All of these will be discussed in more depth within the report.

8. Conclusion

It can be seen that improvements are to be found within the LPT module of an aircraft engine. Some issues have been highlighted throughout the sections mentioned.

The initial research that has been carried out highlights varying issues, however the majority of the issues present predominantly lead back to LPT efficiency. The amount of evidence covering these issues is vast.

Information can be easily obtained from sources mentioned in Section 7. Due to the company currently working with these components on a daily basis, this also means that previous variants of CFD simulations provided within the company may possibly be available for use within this project.

Bibliography

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