Abstract

In this paper, a new method and modern for Preliminary design and optimization mass turbopump in a liquid propellant rocket engine (LPRE) using the gradient algorithm has been developed. The cycle type of LPRE is open cycle and configuration of turbopump feed system consists of a impulse Turbine at the end of the shaft, an oxidizing centrifugal pumps and a fuel pump centrifugal that have been each other back-to-back on a common shaft. The proposed approach is based on four characteristics, optimal power system performs turbopump. These four characteristics are to achieve the desired characteristic of cavitation in pumps, in particular pump-balanced oxidizer turbine production capacity and total power consumption of the rotor pump-structures and also to estimate the mass of the turbopump feeding system as a result of this process. The design of the input parameters for the preliminary design of each component is determined and then use algorithms that are designed for the pump and turbine box design, preliminary design done. This is the optimal point, the gradient algorithm is obtained and the results with data from a real engine with a similar orbit, have been compared. Compare the
results with similar inputs real engine design, the proposed method proves correct and improve
the performance characteristics of the power system shows turbopump.

References

1. F.W. Huber, PD. Johnson" Design of advanced turbopump drive turbines for National
Launch System application" AIAAJSAE /AS M E JASSE 28th Joint Propulsion Conference and
Exhibit, July 6-8, 1992.
2. R.J. Gerth, Spreadsheet Approach to Minimum Cost Tolerancing For Rocket
Engines,Computers industrial Engineering Vol. 27, Nos 1-4, pp.549-552,1994
3. V.H. Katherine, J. Bailey,A. Majumdar, Nmernical prediction of transient Axial thrust and
intrnral flows in rocket engine turbopump, AIAA-99-2189,1999
4. V.N. Kurshevd, Two problems of analyzing of turbopump of LPE, KAI, ISSN
5. E.U. Fatuev, Investigation of modification of LPE RD-120 for 1-st stage of Space
6. Dr. David Japikse & K. Fettatsidi" Preliminary Design of a Singular Fuel/Oxidizer
Turbopump " 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit Von Braun
7. 1 Y. Demyanenko, A. Dmitrenko, V.Rachuk"Single-Shaft Turbopumps in Liquid Rocket
Engines"AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit, Sacramento,
California, pp 9 - 12, July 2006.
8. Michael A. Arguello"THE CONCEPT DESIGN OF A SPLIT FLOW LIQUID HYDROGEN
9. MIZUNO Tsutomu & KOBAYASHI Satoshi" Development of Turbopump for LE-X Engine"
P. E. Jp, Manager, Space Technology Group, Research & Engineering Division, Aero-Engine &
10. William L. Murray, Matthew W. Steiner" Design and Analysis of a High Speed, High
Pressure Peroxide/RP-1 Turbopump" Aeronautics and Astronautics, Purdue University, Indiana,
AIAA, 2014.
11. Avsianikov, B., "Theory and calculation of feed systems’s elements of liquid propellant
rocket engines", Mashinostroyne, In Russian , 1983
12. Avsianikov, B., "Theory and calculation of aggregates supply of liquid rocket engines"
13. A.F.Goref, D.N.Surnov, D.D.Sevruk, Construction and Strength Calculation of space
Electrorocket Engine, Moscow, 1970.
15. Ronald W.Humble, Gary N. Henry, Wiley J. Larson , space propulsion analysis and
design, United States Department , pp266,1997.
16. NASA SP-8107, Monograph of National Aeronatics and Space Adminestration, Lewis
Research Center, ,Turbopump Systems for Liquid Rocket Engine, NASA Space Vehicle Design
Criteria (Chemical Propultion) ,pp.33-34,August 1974.
17. M.J.Montazeri, R. Ebrahimi, New preliminary design method of pump-fed system in
fcryogenic lpre base on gradient and genetic algorithms, ModaresMechanical
18. F-1 ENGINE FAMILIARIZATION TRAINING MANUAL" Section I. R-3896-1, November 1970

Index Terms

Computer Science | Algorithms

Keywords

Liquid Rocket engine, Turbopump, Preliminary design, feed system, Gradient algorithm