Liquid Rocket Engine Design

Liquid propellant rocket engines have propelled all the manned space flights, all the space vehicles flying to the planets or deep space, virtually all satellites, and the majority of medium range or intercontinental range ballistic missiles.

This book intends to build a bridge for the student and the young engineer: to link the rocket propulsion fundamentals and elements with the actual rocket engine design and development work as it is carried out in the industry. The book attempts to further the understanding of the realistic application of liquid rocket propulsion theories, and to help avoid or at least reduce time and money consuming errors and disappointments. This book was written "on the job" for use by those active in all phases of engine systems, design, development, and application, in industry.

This conference paper covers the agenda as follows: 1) Overview of the Space Transportation Market, Current Space Vehicles and Propulsion Systems; 2) Challenges in Liquid-Propellant Rocket Engine Development and Future Direction; 3) Video on the Current State-of-the-Practice in Rocket Engine Turbine Blade Design and Analysis; 4) Key Rocket Engine Components, Examples of Current Engineering Practices, Technology Needs for the Future; and, 5) Conclusions and some thoughts on University, Government and Industry collaboration.

The book presents design fundamentals of liquid fuel rocket engines (ZhRD). It considers questions of design of the engine chamber and the propulsion system on the whole. Basic statements of the theory, methods of calculation and description of subassemblies and units of devices with liquid fuel rocket engine are given. Processes of expansion of gases in nozzles, carburetion and heat exchange are expounded, as well methods of profiling nozzles, calculation of injectors, determination of forms and volumes of combustion chambers. An analysis of work of installations with open and closed circuits is given. Supply systems with turbopump assemblies and pressure feed systems with gas, powder, and liquid pressure generators are considered. Much attention is allotted to work of installations with closed circuits and methods of power coordination of such circuits. Examples of propulsion systems were given, in particular, a description of the propulsion system of the rocket 'Vostok.' (Author).

This book intends to build a bridge for the student and the young engineer: to link the rocket propulsion fundamentals and elements (which are well covered in the literature) with the actual rocket engine design and development work as it is carried out in industry (which is very little, if at all covered in literature). The book attempts to further the understanding of the realistic application of liquid rocket propulsion theories, and to help avoid or at least reduce time and money consuming errors and disappointments. In so doing, it also attempts to digest and consolidate numerous closely related subjects, hitherto often treated as separate, bringing them up to date at the same time.

Tutor in Book's Design of Liquid Propellant Rockets - This book intends to build a bridge for the student and the young engineer: to link the rocket propulsion fundamentals and elements

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This book concentrates on modeling and numerical simulations of combustion in liquid rocket engines, covering liquid propellant atomization, evaporation of liquid droplets, turbulent flows, turbulent combustion, heat transfer, and combustion instability. It presents some state of the art models and numerical methodologies in this area. The book can be categorized into two parts. Part 1 describes the modeling for each subtopic of the combustion process in the liquid rocket engines. Part 2 presents detailed numerical methodology and several representative applications in simulations of rocket engine combustion.
Theoretical and design principles of liquid rocket engines are presented. Extensive coverage is given to processes taking place in the combustion chamber, calculations of mixing systems, the cooling and contour calculation of the nozzles, calculation and selection of optimal parameters, turbopump and fuel feed pressurization systems, generation of the working medium for the turbine and fuel feed pressurization system, design and integration of pneumohydraulic systems for liquid rocket engines, calculation methods and selection of a liquid rocket engine parameters with a closed generation circuit of the working medium for the turbine. Basic theoretical and design principles of processes taking place in different types of liquid rocket engines are presented. The operation of main subsystems and the calculation of their characteristics are discussed. (Author).
The piping in a liquid rocket can assume complex configurations due to multiple tanks, multiple engines, and structures that must be piped around. The capability to handle some of these complex configurations have been incorporated into the NYQUIST code. The capability to modify the input on line has been implemented. The configurations allowed include multiple tanks, multiple engines, and the splitting of a pipe into unequal segments going to different (or the same) engines. This program will handle the following type elements: straight pipes, bends, inline accumulators, tuned stub accumulators, Helmholtz resonators, parallel resonators, pumps, split pipes, multiple tanks, and multiple engines. The code is too large to compile as one program using Microsoft FORTRAN 5; therefore, the code was broken into two segments: NYQUIST1.FOR and NYQUIST2.FOR. These are compiled separately and then linked together. The final run code is not too large (approximately equals 344,000 bytes). Armstrong, Wilbur C. Unspecified Center COMPUTER AIDED DESIGN; COMPUTER PROGRAMS; LIQUID PROPELLANT ROCKET ENGINES; NYQUIST DIAGRAM; PIPES (TUBES); ROCKET ENGINE DESIGN; USER MANUALS (COMPUTER PROGRAMS); ACCUMULATORS; FORTRAN; HELMHOLTZ RESONATORS; PERSONAL COMPUTERS; PROPELLANT TANKS; PUMPS...
Soviet Mixed Power Experimental Fighter Aircraft Piston-Liquid Propellant Rocket Engine/Piston-Ramjet/Piston-Pulsejet & Piston-Compressor Jet Engine Designs of the 1940's
The intent of this research paper is to provide an overview of the Soviet experimental fighter aircraft programs employing mixed power plants - piston-liquid propellant rocket engine, piston-ramjet, piston-pulsejet and piston-compressor jet engine accelerator technology, in the World War II and early post war period of the 1940's. A number of piston fighter aircraft types were converted for experimental roles from the Design Bureaus of Lavochkin and Yakovlev to test liquid propellant rocket engines and ramjet accelerators to increase maximum speed of in-service fighter aircraft, Sukhoi also developing the purpose designed Su-7 as a piston-liquid propellant rocket engine powered aircraft. Lavochkin also tested pulsejet accelerators on the La-7 and La-9 piston engine fighter families whilst Mikoyan, Sukhoi and Yakovlev tested piston-

compressor jet engine accelerators. The latter employed a conversion from a serial piston engine fighter whist Mikoyan and Sukhoi developed new designs for their respective piston-compressor jet engine accelerator test programs. As no design provided the necessary combination of speed performance and reliability, the respective piston-liquid propellant rocket engine, piston-ramjet, piston-pulsejet and piston-compressor jet engine development programs, all of which were unreliable and over complex in their operation, would fall by the wayside due to the promise of better performance from the first generation exclusively jet powered fighter aircraft designs.

This book is intended for students and engineers who design and develop liquid-propellant rocket engines, offering them a guide to the theory and practice alike. It first presents the fundamental concepts (the generation of thrust, the gas flow through the combustion chamber and the nozzle, the liquid propellants used, and the combustion process) and then qualitatively and quantitatively describes the principal components involved (the combustion chamber, nozzle, feed systems, control systems, valves, propellant tanks, and interconnecting elements). The book includes extensive data on existing engines, typical values for design parameters, and worked-out examples of how the concepts discussed can be applied, helping readers integrate them in their own work. Detailed bibliographical references (including books, articles, and items from the “gray literature”) are provided at the end of each chapter, together with information on valuable resources that can be found online. Given its scope, the book will be of particular interest to undergraduate and graduate students of aerospace engineering.

The piping in a liquid rocket can assume complex configurations due to multiple tanks, multiple engines, and structures that must be piped around. The capability to handle some of these complex configurations have been incorporated into the ADMIT code. The capability to modify the input on line has been implemented. The configurations allowed include multiple tanks, multiple engines, the splitting of a pipe into unequal segments going to different (or the same) engines. This program will handle the following type elements: straight pipes, bends, inline accumulators, tuned stub accumulators, Helmholtz resonators, parallel resonators, pumps, split pipes, multiple tanks, and multiple engines. Armstrong, Wilbur C. Unspecified Center COMPUTER AIDED DESIGN; COMPUTER PROGRAMS; LIQUID PROPELLANT ROCKET ENGINES; PIPES (TUBES); PRESSURE; ROCKET ENGINE DESIGN; TRANSFER FUNCTIONS; USER MANUALS (COMPUTER PROGRAMS); ACCUMULATORS; HELMHOLTZ RESONATORS; PUMPS...

The present book is the result of two masters works about liquid propulsion. These works were developed at the Technological Institute of Aeronautics (ITA) in collaboration with the Institute of Aeronautics and Space (IAE). The main focus of the book is the development of an experimental educational tool which can be used in the formation of graduate students, training of personnel of the Institute of Aeronautics and Space (IAE) and also in research on liquid rocket engines. Covered topics include liquid rocket engine fundamentals, design and calculation of liquid rocket engines, methodology of laboratory work, development of test stand installation, measurement systems and uncertainty measures, control and data acquisition system and program development methodology. Audience for which the book was written: professionals and students involved in space technology, including researchers, engineers, designers and managers.

This is a textbook about rocket engineering, concentrating on the nitrous oxide hybrid rocket engine, both small and large. It’s also a book about the science of chemical rockets in detail: three of the chapters are full of in-depth rocket science

describing how all chemical rockets work. After a first chapter brushing up on the science and maths you'll need, the book describes the choice and safe use of hybrid rocket propellants, and how they're handled in practice. Then there are the rocket science chapters. Then you learn how to design, construct, and operate, a large hybrid rocket engine capable of getting you into Space. The book also includes a practical guide to the testing of hybrid rocket engines large and small, and how to fly them safely. Included are full instructions for programming a rocket trajectory simulator in Microsoft Excel, and several appendices containing rocketry information and equations, and instructions on how to design a bell nozzle.

The definitive text on rocket propulsion—now revised to reflect advancements in the field For sixty years, Sutton's Rocket Propulsion Elements has been regarded as the single most authoritative sourcebook on rocket propulsion technology. As with the previous edition, coauthored with Oscar Biblarz, the Eighth Edition of Rocket Propulsion Elements offers a thorough introduction to basic principles of rocket propulsion for guided missiles, space flight, or satellite flight. It describes the physical mechanisms and designs for various types of rockets' and provides an understanding of how rocket propulsion is applied to flying vehicles. Updated and strengthened throughout, the Eighth Edition explores: The fundamentals of rocket propulsion, its essential technologies, and its key design rationale The various types of rocket propulsion systems, physical phenomena, and essential relationships The latest advances in the field such as changes in materials, systems design, propellants, applications, and manufacturing technologies, with a separate new chapter devoted to turbopumps Liquid propellant rocket engines and solid propellant rocket motors, the two most prevalent of the rocket propulsion systems, with in-depth consideration of advances in hybrid rockets and electrical space propulsion Comprehensive and coherently organized, this seminal text guides readers evenhandedly through the complex factors that shape rocket propulsion, with both theory and practical design considerations. Professional engineers in the aerospace and defense industries as well as students in mechanical and aerospace engineering will find this updated classic indispensable for its scope of coverage and utility.

This is the first major publication on liquid-rocket combustion devices since 1960, and includes 20 chapters prepared by world-renowned experts. Each chapter focuses on a specific aspect of liquid-propellant combustion and thrust chamber dynamics, and is incorporated into the volume in a well-organized, cohesive manner. There are contributions from nine different countriesChina, France, Germany, Italy, Japan, the Netherlands, Russia, Sweden, and the United States.