Aircraft Gas Turbine Engine Technology Treager

This paper presents a historical perspective of the advancement of

control technologies for aircraft gas turbine engines. The paper primarily covers technology advances in the United States in the last 60 years (1940 to approximately 2002). The paper

emphasizes the pioneering technologies that have been tested or implemented during this period, assimilating knowledge and experience from industry experts, including personal interviews with both current and

retired experts. Since the first United States-built aircraft gas turbine engine was flown in 1942, engine control technology has evolved from a simple hydro-mechanical fuel metering valve to a full-authority

digital electronic control system (FADEC) that is common to all modern aircraft propulsion systems. At the same time, control systems have provided engine diagnostic functions. Engine diagnostic

capabilities have also evolved from pilot observation of engine gauges to the automated on-board diagnostic system that uses mathematical models to assess engine health and assist in post-flight

troubleshooting and maintenance. Using system complexity and capability as a measure, we can break the historical development of control systems down to four phases: (1) the start-up phase

(1942 to 1949), (2) the growth phase (1950 to 1969), (3) the electronic phase (1970 to 1989), and (4) the integration phase (1990 to 2002). In each phase, the state-of-the-art control technology is described and the engines that

have become historical landmarks, from the control and diagnostic standpoint, are identified. Finally, a historical perspective of engine controls in the last 60 years is presented in terms of control system

complexity, number of sensors, number of lines of software (or embedded code), and other factors.Jaw, Link C.a and Garg, SanjayGlenn Research CenterE LECTRONIC CONTROL;

ENGINE CONTROL; PROPULSION SYSTEM CONFIG URATIONS; GAS TURBINE ENGINES; PHASE CONTROL; MEASURING INSTRUMENTS; MATHEMATICAL MODELS; MAINTENANCE...

Aircraft Propulsion and Gas Turbine Engines, Second Edition builds upon the success of the book's first edition, with the addition of three major topic areas: Piston Engines with integrated propeller coverage; Pump

Technologies; and Rocket Propulsion. The rocket propulsion section extends the text's coverage so that both Aerospace and Aeronautical topics can be studied and compared. Numerous updates have been

made to reflect the latest advances in turbine engines, fuels, and combustion. The text is now divided into three parts, the first two devoted to air breathing engines, and the third covering non-air breathing or

rocket engines. Aircraft Engines and Gas Turbines is widely used as a text in the United States and abroad, and has also become a standard reference for professionals in the aircraft engine industry. Unique in

treating the engine as a complete system at increasing levels of sophistication, it covers all types of modern aircraft engines, including turbojets, turbofans, and turboprops, and also discusses hypersonic

propulsion systems of the future. Performance is described in terms of the fluid dynamic and thermodynamic limits on the behavior of the principal components: inlets,

compressors, combustors, turbines, and nozzles. Environmental factors such as atmospheric pollution and noise are treated along with performance. This new edition has been substantially

revised to include more complete and up-to-date coverage of compressors, turbines, and combustion systems, and to introduce current research directions. The discussion of high-bypass turbofans

has been expanded in keeping with their great commercial importance. Propulsion for civil supersonic transports is taken up in the current context. The chapter on hypersonic air breathing engines

has been expanded to reflect interest in the use of scramjets to power the National Aerospace Plane. The discussion of exhaust emissions and noise and associated regulatory structures have

been updated and there are many corrections and clarifications.

Jet Power

Power for Progress in the Air

A Simple Guide to the Aerodynamic and Thermodynamic Design and Performance of

Jet Engines Reducing Global Carbon Emissions Operation, Components and Systems

New edition of the successful textbook updated to include new material on UAVs, design guidelines in aircraft engine component systems

and additional end of chapter problems Aircraft Propulsion, Second Edition follows the successful first edition textbook with comprehensive treatment of the subjects in airbreathing propulsion, from the basic principles to more advanced treatments in engine

components and system integration. This new edition has been extensively updated to include a number of new and important topics. A chapter is now included on General Aviation and Uninhabited Aerial Vehicle (UAV) Propulsion Systems that includes a

discussion on electric and hybrid propulsion. Propeller theory is added to the presentation of turboprop engines. A new section in cycle analysis treats Ultra-High Bypass (UHB) and Geared Turbofan engines. New material on drop-in biofuels and design for sustainability is added

to refl ect the FAA's 2025 Vision. In addition, the design guidelines in aircraft engine components are expanded to make the book user friendly for engine designers. Extensive review material and derivations are included to help the reader navigate through the subject

with ease. Key features: General Aviation and UAV Propulsion Systems are presented in a new chapter Discusses Ultra-High Bypass and Geared Turbofan engines Presents alternative drop-in jet fuels Expands on engine components' design guidelines The end-of-chapter

problem sets have been increased by nearly 50% and solutions are available on a companion website Presents a new section on engine performance testing and instrumentation Includes a new 10-Minute Quiz appendix (with 45 quizzes) that can be used as a continuous

assessment and improvement tool in teaching/learning propulsion principles and concepts Includes a new appendix on Rules of Thumb and Trends in aircraft propulsion Aircraft Propulsion, Second Edition is a must-have textbook for graduate and undergraduate students, and is also an

excellent source of information for researchers and practitioners in the aerospace and power industry.

Aircraft Engines and Gas Turbines is widely used as a text in the United States and abroad, and has also become a standard reference for professionals in the

aircraft engine industry. Unique in treating the engine as a complete system at increasing levels of sophistication, it covers all types of modern aircraft engines, including turbojets, turbofans, and turboprops, and also discusses hypersonic propulsion systems of the future.

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emissions and noise and associated regulatory structures have been updated and there are many corrections and clarifications.Jack L. Kerrebrock is Richard Cockburn Maclaurin Professor of Aeronautic's and Astronautics at the Massachusetts Institute of

Technology.

The primary human activities that release carbon dioxide (CO2) into the atmosphere are the combustion of fossil fuels (coal, natural gas, and oil) to generate electricity, the provision of energy for transportation, and as a consequence of some industrial processes. Although

aviation CO2 emissions only make up approximately 2.0 to 2.5 percent of total global annual CO2 emissions, research to reduce CO2 emissions is urgent because (1) such reductions may be legislated even as commercial air travel grows, (2) because it takes new technology a long time to propagate

into and through the aviation fleet, and (3) because of the ongoing impact of global CO2 emissions. Commercial Aircraft Propulsion and Energy Systems Research develops a national research agenda for reducing CO2 emissions from commercial aviation. This report focuses on propulsion and energy

technologies for reducing carbon emissions from large, commercial aircraftâ€" single-aisle and twin-aisle aircraft that carry 100 or more passengersâ€"because such aircraft account for more than 90 percent of global emissions from commercial aircraft. Moreover, while

smaller aircraft also emit CO2, they make only a minor contribution to global emissions, and many technologies that reduce CO2 emissions for large aircraft also apply to smaller aircraft. As commercial aviation continues to grow in terms of revenue-passenger miles and

cargo ton miles, CO2 emissions are expected to increase. To reduce the contribution of aviation to climate change, it is essential to improve the effectiveness of ongoing efforts to reduce emissions and initiate research into new approaches.

Gas Turbine Performance

The History of Aircraft Gas Turbine Engine Development in the United States
Aircraft Engines and Gas Turbines
Department of Defense Procurement Management Review: Aircraft Gas Turbine Engine Acquisition and Logistics Support
An Introduction to Systems Functions

This book is intended for those who wish to broaden their knowledge of jet engine technology and associated subjects. It covers turbojet, turboprop and turbofan designs and is applicable to

civilian and military usage. It commences with an overview of the main design types and fundamentals and then looks at air intakes, compresors, turbines and exhaust systems in great detail. Annotation A

design textbook attempting to bridge the gap between traditional academic textbooks, which emphasize individual concepts and principles; and design handbooks, which provide

collections of known solutions. The airbreathing gas turbine engine is the example used to teach principles and methods. The first edition appeared in 1987. The disk contains supplemental material.

Annotation c. Book News, Inc., Portland, OR (booknews.com). A significant addition to the literature on gas turbine technology, the second edition of Gas Turbine Performance is a lengthy text covering product

advances and technological developments. Including extensive figures, charts, tables and formulae, this book will interest everyone concerned with gas turbine technology,

whether they are designers, marketing staff or users.

General Electric Jet Engines

Aircraft Propulsion

Aircraft Engines and Gas Turbines, second edition

Aircraft Gas-Turbine Engine

with Coolant Injection for Effective Thrust Augmentation as Controlled Object

A Heritage of Aircraft Turbine Technology

Major changes in gas turbine design, especially in the design and complexity of

engine control systems, have led to the need for an up to date, systems-oriented treatment of gas turbine propulsion. Pulling together all of the systems and subsystems associated with gas turbine engines in aircraft and marine applications, Gas

Turbine Propulsion Systems discusses the latest developments in the field. Chapters include aircraft engine systems functional overview, marine propulsion systems, fuel control and power management systems, engine lubrication and

scavenging systems, nacelle and ancillary systems, engine certification, unique engine systems and future developments in gas turbine propulsion systems. The authors also present examples of specific engines and applications. Written from a wholly

practical perspective by two authors with long careers in the gas turbine & fuel systems industries, Gas Turbine Propulsion Systems provides an excellent resource for project and program managers in the gas turbine engine community,

the aircraft OEM community, and tier 1 equipment suppliers in Europe and the United States. It also offers a useful reference for students and researchers in aerospace engineering. Provides the reader with a working understanding of

modern aircraft gas turbine engines, with the applicability (or lack of applicability) to military use such as Army jets and helicopters, interwoven into the text. Details of specific makes and models of turbines are provided as examples. Chapters

include ...(1) Theory of Gas Turbine Engines ...(2) Principles of Operation ...(3) Engine Components ...(4) Testing and Inspection ...(5) The Lycoming T53 ...(6) The Lycoming T55 ...(7) The Solar T62 ...(8) The Allison T63 ...(9) The Pratt and Whitney T73 ...(10)

The Pratt and Whitney T74 ...(11) The General Electric T700 ...(12) Appendix, References and Subject Index.

This is the second edition of Cumpsty's excellent self-contained introduction to the aerodynamic and thermodynamic

design of modern civil and military jet engines. Through two engine design projects, first for a new large passenger aircraft, and second for a new fighter aircraft, the text introduces, illustrates and explains the important facets of modern engine

design. Individual sections cover aircraft requirements and aerodynamics, principles of gas turbines and jet engines, elementary compressible fluid mechanics, bypass ratio selection, scaling and dimensional analysis, turbine

and compressor design and characteristics, design optimization, and off-design performance. The book emphasises principles and ideas, with simplification and approximation used where this helps understanding. This edition has been

thoroughly updated and revised, and includes a new appendix on noise control and an expanded treatment of combustion emissions. Suitable for student courses in aircraft propulsion, but also an invaluable reference for engineers in the

engine and airframe industry.
Commercial Aircraft Propulsion and Energy Systems Research
German Jet Engine and Gas Turbine Development, 1930-45
Aircraft Engine Design
Improving the Efficiency of

Engines for Large Nonfighter Aircraft Propulsion Control Technology Development in the United States a Historical Perspective

This text provides an introduction to gas turbine engines and jet propulsion for

aerospace or mechanical engineers. The text is divided into four parts: introduction to aircraft propulsion; basic concepts and one-dimensional/gas dynamics; parametric (design point)

and performance (off-design) analysis of air breathing propulsion systems; and analysis and design of major gas turbine engine components (fans, compressors, turbines,

inlets, nozzles, main burners, and afterburners). Design concepts are introduced early (aircraft performance in introductory chapter) and integrated throughout. Written with extensive

student input on the design of the book, the book builds upon definitions and gradually develops the thermodynamics, gas dynamics, and gas turbine engine principles. This landmark joint

publication between the National Air and Space Museum and the American Institute of Aeronautics and Astronautics chronicles the evolution of the small gas turbine engine through its comprehensive

study of a major aerospace industry. Drawing on in-depth interviews with pioneers, current project engineers, and company managers, engineering papers published by the manufacturers,

and the tremendous document and artifact collections at the National Air and Space Museum, the book captures and memorializes small engine development from its earliest stage. Leyes and

Fleming leap back nearly 50 years for a first look at small gas turbine engine development and the seven major corporations that dared to produce, market, and distribute the products that contributed

to major improvements and uses of a wide spectrum of aircraft. In non-technical language, the book illustrates the broad-reaching influence of small turbinesfrom commercial and

executive aircraft to helicopters and missiles deployed in recent military engagements. Detailed corporate histories and photographs paint a clear historical picture of

turbine development up to the present. See for yourself why The History of North American Small Gas Turbine Aircraft Engines is the most definitive reference book in its field. The publication

of The History of North American Small Gas Turbine Aircraft Engines represents an important milestone for the National Air and Space Museum (NASM) and the American Institute of Aeronautics and

Astronautics (AIAA). For the first time, there is an authoritative study of small gas turbine engines, arguably one of the most significant spheres of aeronautical technology in

the second half o

Prepared at the request of NASA, Aeronautical Technologies for the Twenty-First Century presents steps to help prevent the erosion of U.S. dominance in the global aeronautics

market. The book recommends the immediate expansion of research on advanced aircraft that travel at subsonic speeds and research on designs that will meet expected future demands for

supersonic and short-haul aircraft, including helicopters, commuter aircraft, "tiltrotor," and other advanced vehicle designs. These recommendations are intended to address the

needs of improved aircraft performance, greater capacity to handle passengers and cargo, lower cost and increased convenience of air travel, greater aircraft and air traffic

management system safety, and reduced environmental impacts. Aerothermodynamics of Aircraft Engine Components Aircraft Gas Turbine Engines Fundamentals of Theory, Design and Operation

Design Principles and Methods for Aircraft Gas Turbine Engines
A History of Jet Engine Progress at General Electric
This chapter deals with some intensive methods regarding

aircraft gas-turbine-engine performance enhancement, which are suitable alternatives for the most common temporarily thrust increasing method-the afterburning. Coolant injection

method, into the compressor or into the combustor, realizes the desired thrust increase for a short period, when the flight conditions or other aircraft necessities require this. Both methods

were studied from aircraft engine's point of view, considering it as controlled object. New engine's mathematical model was built up, following the thermo- and gas-dynamics changes and some quality

studies were performed, based on engine's time behavior simulations; some control options and schemes were also studied. Quantitative studies were based on the model of an existing turbo-

engine; mathematical model's coefficients are both experimentally determined (in the Aerospace Engineering Division labs) as well as estimated based on graphic-analytic methods. This

approach and the presented methods could be applied to any other turbo-jet engine and used even in the stage of pre-design of a new engine, to estimate its stability and quality.

The symposium dealt with design

approaches for military aircraft propulsion systems to provide enhanced operational flexibility, longer range, better fuel efficiency and improved affordability. All classes of gas turbines were

addressed in nine sessions as follows: Engine Design and Analysis (Part 1) (5 papers); Mechanical Systems (6 papers); Controls (4 papers); Combustors/Augmentors (4 papers); Compressor Systems (Part I)

(5 papers); Compressor Systems (Part II) (3 papers); Turbines (Part I) (5 papers); Turbines (Part II) (4 papers); Engine Design and Analysis (Part II) (4 papers) These proceedings also include a

Technical Evaluation Report and a Keynote address published in French and English.

Future aircraft engines must provide ultra-low emissions and high efficiency at low cost while maintaining the

reliability and operability of present day engines. The demands for increased performance and decreased emissions have resulted in advanced combustor designs that are critically

dependent on efficient fuel/air mixing and lean operation. However, all combustors, but most notably lean-burning low-emissions combustors, are susceptible to combustion instabilities. These

instabilities are typically caused by the interaction of the fluctuating heat release of the combustion process with naturally occurring acoustic resonances. These interactions can

produce large pressure oscillations within the combustor and can reduce component life and potentially lead to premature mechanical failures. Active Combustion Control which

consists of feedback-based control of the fuel-air mixing process can provide an approach to achieving acceptable combustor dynamic behavior while minimizing emissions, and thus can provide

flexibility during the combustor design process. The NASA Glenn Active Combustion Control Technology activity aims to demonstrate active control in a realistic environment relevant to

aircraft engines by providing experiments tied to aircraft gas turbine combustors. The intent is to allow the technology maturity of active combustion control to advance to eventual

demonstration in an engine environment. Work at NASA Glenn has shown that active combustion control, utilizing advanced algorithms working through high frequency fuel actuation, can effectively

suppress instabilities in a combustor which emulates the instabilities found in an aircraft gas turbine engine. Current efforts are aimed at extending these active control technologies to advanced ultra-

low-emissions combustors such as those employing multi-point lean direct injection.

Gas Turbine Emissions

Aircraft Gas Turbine Engine Technology

Elements of Gas Turbine Propulsion

Aerothermodynamics of Gas Turbine and Rocket Propulsion

Jet Engines

Because of the important national defense contribution of large, non-fighter aircraft, rapidly

increasing fuel costs and increasing dependence on imported oil have triggered significant interest in increased aircraft engine efficiency by the U.S. Air Force. To help address this

need, the Air Force asked the National Research Council (NRC) to examine and assess technical options for improving engine efficiency of all large non-fighter aircraft under Air Force command. This

report presents a review of current Air Force fuel consumption patterns; an analysis of previous programs designed to replace aircraft engines; an examination of proposed engine

modifications; an assessment of the potential impact of alternative fuels and engine science and technology programs, and an analysis of costs and funding requirements. Now in its third

edition, Jet Propulsion offers a self-contained introduction to the aerodynamic and thermodynamic design of modern civil and military jet engine design. Through two-engine design

projects for a large passenger and a new fighter aircraft, the text explains modern engine design. Individual sections cover aircraft requirements, aerodynamics, principles of

gas turbines and jet engines, elementary compressible fluid mechanics, bypass ratio selection, scaling and dimensional analysis, turbine and compressor design and characteristics,

design optimization, and off-design performance. The civil aircraft, which formed the core of Part I in the previous editions, has now been in service for several years as the Airbus A380. Attention in the

aircraft industry has now shifted to two-engine aircraft with a greater emphasis on reduction of fuel burn, so the model created for Part I in this edition is the new efficient aircraft, a twin

aimed at high efficiency. The development of clean, sustainable energy systems is one of the preeminent issues of our time. Most projections indicate that combustion-based energy

conversion systems will continue to be the predominant approach for the majority of our energy usage, and gas turbines will continue to be important combustion-based energy conversion devices for many

decades to come, used for aircraft propulsion, ground-based power generation, and mechanical-drive applications. This book compiles the key scientific and technological knowledge

associated with gas turbine emissions into a single authoritative source. The book has three sections: the first section reviews major issues with gas turbine combustion, including design

approaches and constraints, within the context of emissions. The second section addresses fundamental issues associated with pollutant formation, modeling, and prediction. The

third section features case studies from manufacturers and technology developers, emphasizing the system-level and practical issues that must be addressed in developing different types of gas turbines

that emit pollutants at acceptable levels. Substitution for Cobalt and Chromium in the Aircraft Gas Turbine Engine The History of North American Small Gas Turbine Aircraft Engines

Commercial Aircraft Gas Turbine Engines

Engine Compression Technology

A Tradition of Excellence

This report presents the results of a ten month study effort. The primary purpose

of this effort was to: perform a comprehensive review of the policies, procedures and practices used by the Air Force in acquiring and supporting aircraft gas turbine engines; assess the current process in terms of

its effectiveness in the areas of management, technology, development, acquisition, logistics support, and life cycle costs; and where appropriate, develop recommendations for new or improved

policies, procedures and practices. A secondary purpose was to review and document the practices used by selected commercial airlines for acquiring and supporting aircraft engines. The scope of the study included all major

facets affecting Air Force management of aircraft gas turbine engines, from the basic technology, to the stated operational requirement for an engine, through its logistics support in the active inventory. Leadership in gas

turbine technologies is of continuing importance as the value of gas turbine production is projected to grow substantially by 2030 and beyond. Power generation, aviation, and the oil and gas industries rely on advanced

technologies for gas turbines. Market trends including world demographics, energy security and resilience, decarbonization, and customer profiles are rapidly changing and influencing the future of these industries and gas

turbine technologies. Technology trends that define the technological environment in which gas turbine research and development will take place are also changing - including inexpensive, large scale computational

capabilities, highly autonomous systems, additive manufacturing, and cybersecurity. It is important to evaluate how these changes influence the gas turbine industry and how to manage these changes moving forward. Advanced

Technologies for Gas Turbines identifies high-priority opportunities for improving and creating advanced technologies that can be introduced into the design and manufacture of gas turbines to enhance their performance.

The goals of this report are to assess the 2030 gas turbine global landscape via analysis of global leadership, market trends, and technology trends that impact gas turbine applications, develop a prioritization

process, define high-priority research goals, identify high-priority research areas and topics to achieve the specified goals, and direct future research. Findings and recommendations from this report are important in guiding

research within the gas turbine industry and advancing electrical power generation, commercial and military aviation, and oil and gas production.

Aircraft Gas Turbine Engine TechnologyG lencoe/McGraw-Hill

School Publishing CompanyAircraft Engines and Gas TurbinesMit Press

Airframe and Powerplant Mechanics Powerplant Handbook

Systems of Commercial Turbofan Engines

Aircraft Propulsion and Gas Turbine Engines
Materials Substitution in Aircraft Gas Turbine Engine Applications
Gas Turbine Propulsion Systems
Annotation Design and R & D engineers and

students will value the comprehensive, meticulous coverage in this volume. Beginning with the basic principles and concepts of aeropropulsion combustion, chapters explore specific processes, limitations, and

analytical methods as they bear on component design. The report presents the requirements for advancement of technology in the state-of-the-art of aircraft gas turbine engine monitoring instrumentation. The report discusses data on

causes of engine removal for overhaul for aircraft gas turbine engines used by the Navy. It is seen that engine monitoring may result in a substantial increase in average time between overhauls.

Advancement of technology requires realization of the benefits available through engine monitoring. It also requires a scientific determination of the parameters necessary to accurately define engine conditions

and studies to define the extent of inflight computation and monitoring. Also required is accurate turbine inlet gas temperature measurement up to 3500F, and a hot section analysis system which evaluates

material fatigue, thermal shock, and creep. (Author). The German war machine resulted in many innovations in jet engine and gas turbine development. The most noteworthy was the Me262, the world's first operational jet

fighting aircraft.
Toward a New Generation of High-performance
Aircraft Gas Turbine Engine Controls
Jet Propulsion Seven Decades of Progress
A Simple Guide to the Aerodynamics and Thermodynamic

Design and Performance of Jet Engines

Advanced Technologies for Gas Turbines

Newly revised and comprehensive information on aircraft gas turbine powerplants and updated coverage of jet engine technology.

Extensive cross-reference between today's aircraft and engines. Now includes over 500 illustrations, charts and tables. Written by Otis and Vosbury. ISBN# 0-88487-311-0. 514 pages. Behandler udviklingen af fly-gasturbinemotorer i

USA

To understand the operation of aircraft gas turbine engines, it is not enough to know the basic operation of a gas turbine. It is also necessary to understand the operation and the design of its auxiliary systems. This book fills that

need by providing an introduction to the operating principles underlying systems of modern commercial turbofan engines and bringing readers up to date with the latest technology. It also offers a basic overview of the

tubes, lines, and system components installed on a complex turbofan engine. Readers can follow detailed examples that describe engines from different manufacturers. The text is recommended for aircraft engineers and mechanics,

aeronautical engineering students, and pilots. Aircraft Gas Turbine Powerplants Aeronautical Technologies for the Twenty-First Century Combustion Dynamics and Control for Ultra Low Emissions in

Aircraft Gas-Turbine Engines
A Systems-oriented Research Program Requirements for Advancement of Technology Gas Turbine Engine Monitoring Instrumentation