Fuel Burn Modeling Of Turboprop Aircraft

This book offers a unified presentation that does not discriminate between atmospheric and space flight. It demonstrates that the two disciplines have evolved from the same set of physical principles and introduces a broad range of critical concepts in an accessible, yet mathematically rigorous presentation. The book presents many MATLAB and Simulink-based numerical examples and real-world simulations. Replete with illustrations, end-of-chapter exercises, and selected solutions, the work is primarily useful as a textbook for advanced undergraduate and beginning graduate-level students.

In this thesis we examine how fuel price variation affects the optimal mix of services in intercity transportation. Towards this end, we make two main contributions. The first is the development of an analytic total logistics cost model of intercity transportation, which is sensitive to fuel price and incorporates multiple classes of vehicles serving passengers with differentiated values of time. The second is an empirical investigation of the cost relationship between fuel price and operating cost for intercity transportation vehicles. The analytic total logistics cost models are combined with the empirical models to gain insights into the impact of fuel price on optimal service mixes in representative corridors. We consider a scheduled intercity transportation corridor on which different classes of intercity transportation vehicles serve passengers with differentiated values of time. In determining optimal service mix, we consider a central planner choosing the vehicles and service frequencies that provide the minimum total logistics cost for an intercity transportation corridor. The total logistics cost is the sum of the two main intercity transportation cost components: vehicle operator cost and passenger cost. In considering operating and passenger costs together, we balance cost efficiency and level of service of alternative vehicles with different cost structures and service attributes. In developing the total logistics cost model, we seek both analytic insights and numerical examples. To keep the model analytically tractable while at the same time incorporating multiple objectives, including fuel cost, operating cost, schedule delay, and line-haul time, we incorporate the continuum approximation method from logistics. In employing the continuum approximation, discrete variables are considered continuous, leading to analytic functions from which we can evaluate qualitatively the relationships among fuel price, service level, and comparative vehicle cost. An investigation of the analytic model suggests that, while a fuel price increase would increase costs for any corridor, the rate of cost increase for a corridor served by a mix of vehicle technologies diminishes more rapidly with fuel price. We also find that an increase in fuel price causes vehicles to become more differentiated with respect to the value of time of the passengers they serve. In other words, under high fuel prices the total logistics cost can be minimized by effectively segregating passengers on different types of vehicles according to their values of time. We complement the analytic findings with an empirical investigation of the cost relationship between fuel price and operating cost for different classes of intercity transportation vehicles. We perform this analysis for a subset of intercity transportation vehicles for which data is readily available: jet and turboprop aircraft. In developing a translog operating cost model for jet aircraft, we estimate a flexible functional form that provides a detailed representation of the empirical relationship between fuel cost and operating cost, allowing for substitution, scale, aircraft age, and other effects - including interactions - to be captured. The function reveals that as fuel price increases, airlines will take steps to use fuel more efficiently by leveraging other inputs; however, the potential for this supplier input substitution for fuel is rather modest. This finding reinforces the formulation of the analytic total logistics cost model, in which the only actions available to a central planner to reduce costs are changing technologies and service frequencies. It also proves that empirical models with simpler functional forms are able to accurately predict operating costs, despite the lack of variable interactions. Using linear empirical operating cost models, we estimate operating cost

and total logistics costs for intercity transportation corridors served by single vehicle fleets of three different aircraft classes. We find that a specific turboprop aircraft model, with a relatively low fuel consumption rate, provides intercity transportation service with the minimum operating cost compared with a jet with smaller seating capacity over all fuel prices considered and medium-capacity jets for some fuel prices. However, this is no longer the case when total logistics cost is considered, due to the lower quality of passenger service turboprops provide. At a given intercity transportation corridor distance, the fuel price for which the total logistics cost per passenger is equal across turboprops and low-capacity jets is in the fuel price range experienced from 2004 and expected through 2020. For this fuel price range, the total logistics cost per passenger for the medium-capacity jet is generally lower than the turboprop and always lower the low-capacity jet. This suggests that a mix of services between intercity transportation vehicles could minimize cost for this range of fuel price. To investigate the possibility of mixing services to reduce costs further, we combine the analytic total logistics cost model with the empirical models. In addition to a jet and turboprop aircraft model, we build a high speed rail cost model and consider high speed rail as an additional intercity transportation technology. We find the minimum cost vehicle combination to be sensitive to fuel price in a small transition zone within which the cost ordering of vehicle combinations changes significantly, whereas outside this zone the orderings are stable. As the transition area is in the range of fuel prices forecasted between the years 2010-2035, the results indicate fuel price changes between 2010 and 2035 may dramatically alter the most cost-effective ways to provide intercity passenger transport. We find that high speed rail is a part of a mixed vehicle service that can reduce total logistics cost, suggesting that an integrated air and rail strategy could be an effective tool to manage costs and fuel consumption for an intercity transportation system.

This book addresses the core issues involved in the dynamic modeling, simulation and control of a selection of energy systems such as gas turbines, wind turbines, fuel cells and batteries. The principles of modeling and control could be applied to other non-convention methods of energy generation such as solar energy and wave energy. A central feature of Dynamic Modeling, Simulation and Control of Energy Generation is that it brings together diverse topics in thermodynamics, fluid mechanics, heat transfer, electro-chemistry, electrical networks and electrical machines and focuses on their applications in the field of energy generation, its control and regulation. This book will help the reader understand the methods of modelling energy systems for controller design application as well as gain a basic understanding of the processes involved in the design of control systems and regulators. It will also be a useful guide to simulation of the dynamics of energy systems and for implementing monitoring systems based on the estimation of internal system variables from measurements of observable system variables. Dynamic Modeling, Simulation and Control of Energy Generation will serve as a useful aid to designers of hybrid power generating systems involving advanced technology systems such as floating or offshore wind turbines and fuel cells. The book introduces case studies of the practical control laws for a variety of energy generation systems based on nonlinear dynamic models without relying on linearization. Also the book introduces the reader to the use nonlinear model based estimation techniques and their application to energy systems.

Popular Science gives our readers the information and tools to improve their technology and their world. The core belief that Popular Science and our readers share: The future is going to be better, and science and technology are the driving forces that will help make it better.

This report is the final deliverable of an internship which is part of the fifth year curriculum of the faculty of Aerospace Engineering at the Delft University of Technology. The two authors had the privilege of conducting their internship at the John A. Volpe National Transportation Systems Center. There they worked in the Environmental Measurement and Modeling

Division. The main assignment consisted of finding a method to model the fuel burn of turboprop aircraft flying over America's national parks. To do this the authors first had to get familiarized with the Aviation Environmental Design Tool (AEDT), which is a model capable of calculating the noise and fuel burn emissions of aircraft.

Popular Mechanics inspires, instructs and influences readers to help them master the modern world. Whether it’s practical DIY home-improvement tips, gadgets and digital technology, information on the newest cars or the latest breakthroughs in science -- PM is the ultimate guide to our high-tech lifestyle.

Aircraft Performance: An Engineering Approach introduces flight performance analysis techniques that enable readers to determine performance and flight capabilities of aircraft. Flight performance analysis for prop-driven and jet aircraft is explored, supported by examples and illustrations, many in full color. MATLAB programming for performance analysis is included, and coverage of modern aircraft types is emphasized. The text builds a strong foundation for advanced coursework in aircraft design and performance analysis.

"This report documents work done to enhance turbo-propeller aircraft fuel consumption modeling in the Federal Aviation Administration's Aviation Environmental Design Tool (AEDT). Fuel consumption and flight performance data were collected from aircraft flight manuals. These data were used to develop methods for predicting aircraft fuel consumption as a function of the aircraft flight state. The primary method developed for this report showed a difference from the flight manual reported fuel consumption of about 12% in cruise mode."--Technical report documentation page.

This leading strategy text presents the complexities of strategic management through up-to-date scholarship and hands-on applications. Highly respected authors Charles Hill, Gareth Jones, and Melissa Schilling integrate cutting-edge research on topics including corporate performance, governance, strategic leadership, technology, and business ethics through both theory and case studies. Based on real-world practices and current thinking in the field, the eleventh edition of STRATEGIC MANAGEMENT features an increased emphasis on the changing global economy and its role in strategic management. The high-quality case study program contains 31 cases covering small, medium, and large companies of varying backgrounds. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

This study developed data on General Electric common core derivative engines for use in Maritime Patrol Aircraft (MPA) concept formulation studies. The study included the screening of potential General Electric turbofan and turboprop/turboshaft engines and the preparation of technical and planning information on three of the most promising engine candidates. Screening of General Electric derivative candidates was performed utilizing an analytical MPA model using synthesized mission profiles to rank the candidates in terms of fuel consumption, weight, cost and complexity. The three turboprop engines selected for further study were as follows: TF34 growth derivative version with boost and new LPT (TF34/T7 Study A1), F404 derivative with booster stages and new LPT (F404/T1 Study A1), and GE27 scaled and boosted study engine (GE27/T3 Study A1). Volume I summarizes the screening analysis and contains technical, planning, installation, cost and development data for the three selected turboprop

engines. Volumes II, III and IV of this report contain the detailed performance data estimates for the GE27/T3 Study A1, TF34/T7 Study A1 and F404/T1 Study A1 turboprop engines, respectively. (Author).

National security decision makers face an uncertain world where the accelerated growth of knowledge has changed the character of technological advance and destabilized long-standing relations within and among the military services. Dr Mandeles separates the principles that guide decision making from the proverbs through a case study of decision making in the early post-World War II period.

This study examines the impact of organization on the invention and development of jet propulsion-in the form of the B-52-and illustrates both the organizational conditions conducive to developing new operational concepts and the organizational innovations necessary to implement new technology. This study also examines how the Air Force organized to learn and acquire new technology, how the Air Force conceived or identified problems, and how it organized to ensure management would respond to program failure or errors. Attention is devoted to the origins of the weapons system operational requirement, the initial concept of operation, the evolution of technology, organizational structure, and implementation.

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