

Electric Flight – Potential and Limitations

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ABSTRACT

During the last years, the development of electric propulsion systems is pushed strongly, most notably for automotive applications. For ground based transportation, the system mass is relevant, but of relatively low importance. This paper addresses the application of electric propulsion systems in aeronautics, where all systems are much more constrained by their mass. After comparing different propulsion system architectures the focus is cast on the energy storage problem and here especially on battery storage systems. Using first order principles the limitations and required technology developments are demonstrated by introducing battery powered electric propulsion systems to small and medium sized aircraft.

Abbreviations and Symbols

b = wing span [m]

C = capacity [Wh]

D = drag force [N]

E' = mass specific energy content [Wh/kg]

f_e = empty mass fraction m_e / m

g = gravity acceleration [m/s^2]

L = lift force [N]

m = mass [kg]

$m_{initial}$ = initial mass at takeoff [kg]

m_e = empty mass without fuel and payload [kg]

m_{final} = final mass at landing [kg]

$m_{battery}$ = battery mass [kg]

$m_{payload}$ = payload mass [kg]

m_{pass} = mass per passenger [kg]

PAX = number of passengers

P = power [W]

$P_{battery}$ = electric power provided by battery [W]

R = range [m]

t = time [s]

T = thrust [N]

V' = volume specific energy content [Wh/m³]

v_∞ = flight speed [m/s]

η = efficiency

ρ_∞ = density of air [kg/m³]

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Electrified Aircraft Propulsion Kiruba Haran,Nateri Madavan,Tim C. O'Connell,2022-05-26 What are the benefits of electrified propulsion for large aircraft What technology advancements are required to realize these benefits How can the aerospace industry transition from today s technologies to state of the art electrified systems Learn the answers with this multidisciplinary text combining expertise from leading researchers in electrified aircraft propulsion The book includes broad coverage of electrification technologies spanning power systems and power electronics materials science superconductivity and cryogenics thermal management battery chemistry system design and system optimization and a clear cut road map identifying remaining gaps between the current state of the art and future performance technologies Providing expert guidance on areas for future research and investment and an ideal introduction to cutting edge advances and outstanding challenges in large electric aircraft design this is a perfect resource for graduate students researchers electrical and aeronautical engineers policymakers and management professionals interested in next generation commercial flight technologies

Vehicle Electrification Igor Bolvashenkov,Jörg Kammermann,Alexander Rubinraut,Hans-Georg Herzog,Ilia Frenkel,2021-09-15 This book provides a comprehensive assessment and presentation of various feasible application of electric propulsion system considering their weight volume reliability and fault tolerance The results of feasibility analysis can be used today or in the near future for development of electric propulsion system for the ships planes helicopters and spacecrafts To solve the above task new theoretical approaches are applied including combined random process methods the Lz transform technique for multistate systems and statistical data processing *Proceedings of IDEAS 2022* Luciana Pereira,Petter Krus,Magnus Klofsten,2023-04-15 This book explores the cutting edge ideas that are shaping the future of innovation design entrepreneurship and sustainability The proceedings of the interdisciplinary Conference on Innovation Design Entrepreneurship and Sustainable Systems offer new perspectives on these topics This book navigates the most recent research trends and practices and gains unique insights on how to address innovation design and entrepreneurship on a sustainable basis This book is an essential reference for anyone interested in staying up to date on the latest research whether they are academics designers entrepreneurs or sustainability enthusiasts Get your copy now and take part in the debate about the future of sustainable innovation [Green Aviation](#) Ramesh Agarwal,Fayette Collier,Andreas Schaefer,Allan Seabridge,2016-09-20 Green Aviation is the first authoritative overview of both engineering and operational measures to mitigate the environmental impact of aviation It addresses the current status of measures to reduce the environmental impact of air travel The chapters cover such items as Engineering and technology related subjects aerodynamics engines fuels structures etc Operations air traffic management and infrastructure Policy and regulatory aspects regarding atmospheric and noise pollution With contributions from leading experts this volume is intended to be a valuable addition and useful resource for aerospace manufacturers and suppliers governmental and industrial aerospace

research establishments airline and aviation industries university engineering and science departments and industry analysts consultants and researchers *Electric Flight Systems* ,1982 *Study of a Common Solar-electric-propulsion Upper Stage for High-energy Unmanned Missions. Volume 1 - Summary Final Report* ,1971 Terrestrial Magnetism and Atmospheric Electricity ,1937 *Illustrated Electrical Review* ,1897 **Electric Power** ,1890 *NASA SP.* ,1991 **Future Epidemiologic Studies of Health Effects of Electric and Magnetic Fields** P. A. Buffler,1992 **Engineering Index Annual** ,1929 *Astronautics Information. Literature Search* Jet Propulsion Laboratory (U.S.),1965 **The Electrical Review** ,1912 *The Man Behind the Flight* Assen Jordanoff,1942 Electrical Review ,1892 **A Collection of Technical Papers** ,1984 93-2207 - 93-2249 ,1992 **Aero Digest** ,1945-10 **Aeronautical Engineering Review** ,1957

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