Electric Aircraft Dynamics — A Systems Engineering Approach
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This is an R&D phase book for electric aircraft researchers. Based on a literature review of recent electric aircraft studies, the author has invoked systems engineering to generate a list of six technology limitations which require significant improvement to advance electric aircraft performance. The book is a review of those technologies, as a preparation for future research.

Chapter 1 is a brief introduction of the recent history and unique issues in the design of electric aircraft when compared to conventional aircraft. From this comparison, the author identifies the following technology improvements as critical for successful electric aircraft: 1) high efficiency motors, 2) high energy density batteries, 3) significant improvements in aircraft lift/drag ratio, 4) low noise propellers, 5) high reliability power electronics, and 6) propulsion-based flight control.

To address the six electric aircraft performance issues identified in the introduction: 1) Chapters 2, 4 and 7 review the design equations for various types of electric motors; 2) Chapter 3 reviews battery design, and Chapter 10 reviews photovoltaic power; 3) Chapter 5 develops boundary layer theory, and Chapter 9 discusses drag reduction using plasma actuators; 4) Chapter 6 reviews propeller design, and Chapter 8 develops the aero-acoustics equations with a discussion of noise reduction; 5) Chapter 11 reviews semiconductors and power electronics; and 6) Chapter 12 covers flight control and discusses the need for optimal flight planning.

Typical aircraft design steps as well as systems engineering language, tools and methods are absent. Missing are operational analyses, system need analyses, logical architecture, physical architecture, and building strategy methods, as well as analyses of mission requirements, aircraft sizing, wing loading, fuselage design, tail design, motor sizing, power storage sizing, weight distribution and CG, control surface sizing, performance analysis, cost estimates, and the associated parametric trade studies.

The book focuses on understanding the six technology limitations for electric aircraft the author has identified. This principally supports future research and development to improve these limitations. Therefore, the book will be a useful resource for those researching the six particular issues identified by the author, but it will have limited use for those using systems engineering techniques to design and develop electric aircraft.

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