

# FUNDAMENTALS OF AIRCRAFT AND AIRSHIP DESIGN

## *Volume I—Aircraft Design*

Leland M. Nicolai  
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# Fundamentals Of Aircraft And Airship Design

**Michal Rosen-Zvi**



## **Fundamentals Of Aircraft And Airship Design:**

Fundamentals of Aircraft and Airship Design Leland Malcolm Nicolai, Grant Carichner, 2010 The aircraft is only a transport mechanism for the payload and all design decisions must consider payload first Simply stated the aircraft is a dust cover Fundamentals of Aircraft and Airship Design Volume 1 Aircraft Design emphasizes that the science and art of the aircraft design process is a compromise and that there is no right answer however there is always a best answer based on existing requirements and available technologies Fundamentals of Aircraft and Airship Design Leland Malcolm Nicolai, 2010 **Fundamentals of Aircraft and Airship Design** Grant E. Carichner, Leland Malcolm Nicolai, 2013 Fundamentals of aircraft and airship design volume 2 airship design and case studies examines a modern conceptual design of both airships and hybrids and features nine behind the scenes case studies It will benefit graduate and upper level undergraduate students as well as practicing engineers The authors address the conceptual design phase comprehensively for both civil and military airships from initial consideration of user needs material selection and structural arrangement to the decision to iterate the design one more time The book is the only available source of design instruction on single lobe airships multiple lobe hybrid airships and balloon configurations on solar and gasoline powered airship systems human powered aircraft and no power aircraft and on estimates of airship hybrid aerodynamics performance propeller selection S nine case studies including SR 71 X 35B B 777 HondaJet Hybrid Airship Daedalus Cessna 172 T 46A and hang gliders and full color photographs of many airships and aircraft Publisher description **Introduction to Aircraft Design** John P. Fielding, 2017-04-03 The new edition of this popular textbook provides a modern accessible introduction to the whole process of aircraft design from requirements to conceptual design manufacture and in service issues Highly illustrated descriptions of the full spectrum of aircraft types their aerodynamics structures and systems allow students to appreciate good and poor design and understand how to improve their own designs Cost data is considerably updated many new images have been added and new sections are included on the emerging fields of Uninhabited Aerial Vehicles and environmentally friendly airlines Examples from real aircraft projects are presented throughout demonstrating to students the applications of the theory Three appendices and a bibliography provide a wealth of information much not published elsewhere including simple aerodynamic formulae an introduction to airworthiness and environmental requirements aircraft engine and equipment data and a case study of the conceptual design of a large airliner *Jet Sense: The Philosophy and the Art of Jet Transport Design* Zarir D. Pastakia, 2024-02-06 Embark on an exciting aviation journey with Jet Sense Zarir s groundbreaking book that unveils the intricacies of commercial aircraft design This work offers an enlightening perspective for aviation enthusiasts and industry professionals Explore the heart of aircraft design where market demands shape every curve and detail Zarir s expertise guides you through the art of compromise creating aircraft that excel in both function and market appeal What sets Jet Sense apart is its unwavering focus on the interplay of geometry and integration From wing design to landing gear

integration and more This book doesn't just analyze it guides helping you navigate the complex world of jet transport design Discover Zarir's innovative approach to initial sizing tailored for commercial aircraft Bid farewell to one size fits all solutions and welcome a design philosophy aligned with market needs Whether you're in single aisle workhorses or long haul twin aisle giants Jet Sense is your essential companion Zarir's wealth of meticulously gathered data ensures you work with trusted solutions Jet Sense is your ultimate resource for commercial aircraft design a must have for every designer Whether you're a pilot aviation executive enthusiast or aerospace professional prepare for an engaging read that demystifies the secrets of aviation design Enjoy the journey Jet Sense focuses on commercial aircraft It is not an introductory aircraft design book covering all types of aircraft But for commercial aircraft designers this should be on every designer's desk Scott Eberhardt Ph.D Aerospace Consultant and Author of Understanding Flight ISBN 9781468605990 ISBN 9781468606003 ISBN 9781468606010 DOI 10.4271.9781468606003 Fundamentals of Materials for Energy and Environmental Sustainability David S. Ginley, David Cahen, 2011-11-30 How will we meet rising energy demands What are our options Are there viable long term solutions for the future Learn the fundamental physical chemical and materials science at the heart of renewable non renewable energy sources future transportation systems energy efficiency and energy storage Whether you are a student taking an energy course or a newcomer to the field this textbook will help you understand critical relationships between the environment energy and sustainability Leading experts provide comprehensive coverage of each topic bringing together diverse subject matter by integrating theory with engaging insights Each chapter includes helpful features to aid understanding including a historical overview to provide context suggested further reading and questions for discussion Every subject is beautifully illustrated and brought to life with full color images and color coded sections for easy browsing making this a complete educational package Fundamentals of Materials for Energy and Environmental Sustainability will enable today's scientists and educate future generations **Aircraft Performance** Mohammad H. Sadraey, 2017-01-27 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 **General Aviation Aircraft Design** Snorri Gudmundsson, 2021-10-31 General Aviation Aircraft Design Second Edition continues to be the engineer's best source for answers to realistic aircraft design questions The book has been expanded to provide design guidance for additional classes of aircraft including seaplanes biplanes UAS high speed business jets and electric airplanes In addition to conventional powerplants design guidance for battery systems electric motors and complete electric powertrains is offered The second edition contains new chapters Thrust Modeling for Gas Turbines Longitudinal Stability and Control Lateral and Directional Stability and Control

These new chapters offer multiple practical methods to simplify the estimation of stability derivatives and introduce hinge moments and basic control system design Furthermore all chapters have been reorganized and feature updated material with additional analysis methods This edition also provides an introduction to design optimization using a wing optimization as an example for the beginner Written by an engineer with more than 25 years of design experience professional engineers aircraft designers aerodynamicists structural analysts performance analysts researchers and aerospace engineering students will value the book as the classic go to for aircraft design The printed book is now in color with 1011 figures and illustrations Presents the most common methods for conceptual aircraft design Clear presentation splits text into shaded regions separating engineering topics from mathematical derivations and examples Design topics range from the new 14 CFR Part 23 to analysis of ducted fans All chapters feature updated material with additional analysis methods Many chapters have been reorganized for further help Introduction to design optimization is provided using a wing optimization as an example for the beginner Three new chapters are offered two of which focus on stability and control These offer multiple practical methods to simplify the estimation of stability derivatives The chapters introduce hinge moments and basic control system design Real world examples using aircraft such as the Cirrus SR 22 and Learjet 45

**Conceptual Aircraft Design** Ajoy Kumar Kundu, Mark A. Price, David Riordan, 2019-04-08 Provides a Comprehensive Introduction to Aircraft Design with an Industrial Approach This book introduces readers to aircraft design placing great emphasis on industrial practice It includes worked out design examples for several different classes of aircraft including Learjet 45 Tucano Turboprop Trainer BAe Hawk and Airbus A320 It considers performance substantiation and compliance to certification requirements and market specifications of take off landing field lengths initial climb high speed cruise turning capability and payload range Military requirements are discussed covering some aspects of combat as is operating cost estimation methodology safety considerations environmental issues flight deck layout avionics and more general aircraft systems The book also includes a chapter on electric aircraft design along with a full range of industry standard aircraft sizing analyses Split into two parts Conceptual Aircraft Design An Industrial Approach spends the first part dealing with the pre requisite information for configuring aircraft so that readers can make informed decisions when designing vessels The second part devotes itself to new aircraft concept definition It also offers additional analyses and design information e g on cost manufacture systems role of CFD etc integral to conceptual design study The book finishes with an introduction to electric aircraft and futuristic design concepts currently under study Presents an informative industrial approach to aircraft design Features design examples for aircraft such as the Learjet 45 Tucano Turboprop Trainer BAe Hawk Airbus A320 Includes a full range of industry standard aircraft sizing analyses Looks at several performance substantiation and compliance to certification requirements Discusses the military requirements covering some combat aspects Accompanied by a website hosting supporting material Conceptual Aircraft Design An Industrial Approach is an excellent resource for those designing and building modern aircraft for commercial military and

private use      Fundamentals of Aircraft and Airship Design: Aircraft design. Introduction ; Review of practical aerodynamics ; Aircraft performance methods ; Aircraft operating envelope ; Preliminary estimate of takeoff weight ; Estimating the takeoff wing loading ; Selecting the planform and airfoil section ; Preliminary fuselage sizing and design ; High-lift devices ; Takeoff and landing analysis ; Preliminary sizing of the vertical and horizontal tails ; Designing for survivability (stealth) ; Estimating wing-body aerodynamics ; Propulsion system fundamentals ; Turbine engine inlet design ; Corrections for turbine engine installation ; Propeller propulsion systems ; Propulsion system thrust sizing ; Structures and materials ; Refined weight estimate ; Static stability and control ; Trim drag and maneuvering flight ; Control surface sizing criteria ; Life cycle cost ; Trade studies and sizing Leland M. Nicolai, Grant Carichner, 2010      Computer Aided Design and Manufacturing Zhuming Bi, Xiaoqin Wang, 2020-04-06

Broad coverage of digital product creation from design to manufacture and process optimization This book addresses the need to provide up to date coverage of current CAD CAM usage and implementation It covers in one source the entire design to manufacture process reflecting the industry trend to further integrate CAD and CAM into a single unified process It also updates the computer aided design theory and methods in modern manufacturing systems and examines the most advanced computer aided tools used in digital manufacturing Computer Aided Design and Manufacturing consists of three parts The first part on Computer Aided Design CAD offers the chapters on Geometric Modelling Knowledge Based Engineering Platforming Technology Reverse Engineering and Motion Simulation The second part on Computer Aided Manufacturing CAM covers Group Technology and Cellular Manufacturing Computer Aided Fixture Design Computer Aided Manufacturing Simulation of Manufacturing Processes and Computer Aided Design of Tools Dies and Molds TDM The final part includes the chapters on Digital Manufacturing Additive Manufacturing and Design for Sustainability The book is also featured for being uniquely structured to classify and align engineering disciplines and computer aided technologies from the perspective of the design needs in whole product life cycles utilizing a comprehensive Solidworks package add ins toolbox and library to showcase the most critical functionalities of modern computer aided tools and presenting real world design projects and case studies so that readers can gain CAD and CAM problem solving skills upon the CAD CAM theory Computer Aided Design and Manufacturing is an ideal textbook for undergraduate and graduate students in mechanical engineering manufacturing engineering and industrial engineering It can also be used as a technical reference for researchers and engineers in mechanical and manufacturing engineering or computer aided technologies      **Airships** Iver P. Cooper, 2025-05-15 Many people may know about the blazing crash of the Hindenburg in 1937 but are possibly unaware that it had made 62 flights before its final journey including one transporting author Leslie Charteris creator of The Saint The disaster however did not end the airship era blimps escorted convoys during World War II and were a part of air defense systems in the 1950s and 1960s Airships still fly today and new models are in the construction phase This book examines this branch of aviation history delving into the science and engineering of airships and their design flaws weather difficulties and

operational errors The chapters focus on function lift propulsion materials ground handling and so forth The book concludes with speculations about future airship designs and missions

*Introduction to Unmanned Aircraft Systems* R. Kurt Barnhart, Douglas M. Marshall, Eric Shappee, 2021-03-04 Introduction to Unmanned Aircraft Systems Third Edition surveys the basics of unmanned aircraft systems UAS from sensors controls and automation to regulations safety procedures and human factors Featuring chapters by leading experts this fully updated bestseller fills the need for an accessible and effective university textbook Focussing on the civilian applications of UAS the text begins with an historical overview of unmanned aerial vehicles and proceeds to examine each major UAS subsystem Its combination of understandable technical coverage and up to date information on policy and regulation makes the text appropriate for both Aerospace Engineering and Aviation programs

Lighter Than Air Systems Dhwani Shukla, 2022-11-28 This book presents select peer reviewed proceedings of the International Conference on Design and Engineering of Lighter Than Air Systems DELTAs 2022 which was held at the Department of Aerospace Engineering Indian Institute of Technology IIT Bombay It highlights current research trends and advancements in the field of lighter than air LTA systems The topics covered include design conventional and unconventional aerodynamics CFD structures loads and materials stability and control operations and ground handling multidisciplinary design optimization and novel applications of LTA systems The book will be a valuable reference for researchers and professionals interested in lighter than air systems and allied fields

Innovative Design and Development Practices in Aerospace and Automotive Engineering Ram P. Bajpai, U. Chandrasekhar, 2016-09-17 The book presents the best articles presented by researchers academicians and industrial experts in the International Conference on Innovative Design and Development Practices in Aerospace and Automotive Engineering I DAD 2016 The book discusses new concept designs analysis and manufacturing technologies where more swing is for improved performance through specific and or multifunctional linguistic design aspects to downsize the system improve weight to strength ratio fuel efficiency better operational capability at room and elevated temperatures reduced wear and tear NVH aspects while balancing the challenges of beyond Euro IV Bharat Stage IV emission norms Greenhouse effects and recyclable materials The innovative methods discussed in the book will serve as a reference material for educational and research organizations as well as industry to take up challenging projects of mutual interest

*AEROTECH V: Progressive Aerospace Research* Renuganth Varatharajoo, Fairuz I. Romli, Kamarul Arifin Ahmad, Dayang Laila Majid, Faizal Mustapha, 2014-10-31 Selected peer reviewed papers from the AEROTECH V Conference October 29 30 2014 Kuala Lumpur Malaysia

Advances in Multidisciplinary Analysis and Optimization Raviprakash R. Salagame, Palaniappan Ramu, Indira Narayanaswamy, Dhish Kumar Saxena, 2020-08-10 This volume contains select papers presented during the 2nd National Conference on Multidisciplinary Analysis and Optimization It discusses new developments at the core of optimization methods and its application in multiple applications The papers showcase fundamental problems and applications which include domains such as aerospace

automotive and industrial sectors The variety of topics and diversity of insights presented in the general field of optimization and its use in design for different applications will be of interest to researchers in academia or industry

**Transdisciplinary Perspectives on Complex Systems** Franz-Josef Kahlen, Shannon Flumerfelt, Anabela Alves, 2016-08-16 This book presents an internationally comprehensive perspective into the field of complex systems It explores the challenges of and approaches to complexity from a broad range of disciplines including big data health care medicine mathematics mechanical and systems engineering air traffic control and finance The book's interdisciplinary character allows readers to identify transferable and mutually exclusive lessons learned among these disciplines and beyond As such it is well suited to the transfer of applications and methodologies between ostensibly incompatible disciplines This book provides fresh perspectives on comparable issues of complexity from the top minds on systems thinking

*Flight Dynamics* Robert F. Stengel, 2022-11-01 An updated and expanded new edition of an authoritative book on flight dynamics and control system design for all types of current and future fixed wing aircraft Since it was first published *Flight Dynamics* has offered a new approach to the science and mathematics of aircraft flight unifying principles of aeronautics with contemporary systems analysis Now updated and expanded this authoritative book by award winning aeronautics engineer Robert Stengel presents traditional material in the context of modern computational tools and multivariable methods Special attention is devoted to models and techniques for analysis simulation evaluation of flying qualities and robust control system design Using common notation and not assuming a strong background in aeronautics *Flight Dynamics* will engage a wide variety of readers including aircraft designers flight test engineers researchers instructors and students It introduces principles derivations and equations of flight dynamics as well as methods of flight control design with frequent reference to MATLAB functions and examples Topics include aerodynamics propulsion structures flying qualities flight control and the atmospheric and gravitational environment The second edition of *Flight Dynamics* features up to date examples a new chapter on control law design for digital fly by wire systems new material on propulsion aerodynamics of control surfaces and aeroelastic control many more illustrations and text boxes that introduce general mathematical concepts Features a fluid progressive presentation that aids informal and self directed study Provides a clear consistent notation that supports understanding from elementary to complicated concepts Offers a comprehensive blend of aerodynamics dynamics and control Presents a unified introduction of control system design from basics to complex methods Includes links to online MATLAB software written by the author that supports the material covered in the book

**Flight mechanics and flight control for a multibody aircraft** Köthe, Alexander, 2019-06-26 Aircraft operating as so called High Altitude Platform Systems HAPS have been considered as a complementary technology to satellites since several years These aircraft can be used for similar communication and monitoring tasks while operating at a fraction of the cost Such concepts have been successfully tested Those include the AeroVironment Helios and the Airbus Zephyr with an endurance of nearly 624 hours 26



days All these HAPS aircraft have a high aspect ratio wing using lightweight construction In gusty atmosphere this results in high bending moments and high structural loads which can lead to overloads Aircraft crashes for example from Google s Solara 50 or Facebook s Aquila give proof of that fact Especially in the troposphere where the active weather takes place gust loads occur which can lead to the destruction of the structure The Airbus Zephyr the only HAPS aircraft without flight accidents provides only a very small payload Thus it does not fully comply with the requirements for future HAPS aircraft To overcome the shortcomings of such single wing aircraft so called multibody aircraft are considered to be an alternative The concept assumes multiple aircraft connected to each other at their wingtips It goes back to the German engineer Dr Vogt In the United States shortly after the end of World War II he experimented with the coupling of manned aircraft This resulted in a high aspect ratio wing for the aircraft formation The range of the formation could be increased correspondingly The engineer Geoffrey S Sommer took up Vogt s idea and patented an aircraft configuration consisting of several unmanned aerial vehicles coupled at their wingtips However the patent does not provide any insight into the flight performance the flight mechanical modeling or the control of such an aircraft Single publications exist that deal with the performance of coupled aircraft A profound complete analysis however is missing so far This is where the present work starts For the first time a flying vehicle based on the concept of the multibody aircraft will be analyzed in terms of flight mechanics and flight control In a performance analysis the aircraft concept is analyzed in detail and the benefits in terms of bending moments and flight performance are clearly highlighted Limits for operation in flight are shown considering aerodynamic optimal points The joints at the wingtips allow a roll and pitch motion of the individual aircraft This results in additional degrees of freedom for the design through the implementation of different relative pitch and bank angles For example using individual pitch angles for individual aircraft further decreases the induced drag and increases flight performance Because the lift is distributed symmetrically but not homogenously along the wingspan a lateral trim of the individual aircraft in formation flight becomes necessary The thesis presents a new method to implement this trim by moving the battery mass along half the wingspan which avoids additional parasite drag Further a complete flight dynamics model is provided and analyzed for aircraft that are mechanically connected at their wingtips To study this model in detail a hypothetical torsional and bending spring between the aircraft is introduced If the spring constants are very high the flight dynamics model has properties similar to those of an elastic aircraft Rigid body and formation eigenmotions can be clearly distinguished If the spring constants are reduced towards zero which represents the case of the multibody aircraft classical flight mechanics eigenmotions and modes resulting from the additional degrees of freedom are coupled This affects the eigenstructure of the aircraft Hence normal motions with respect to the inertial space as known from a rigid aircraft cannot be observed anymore The plant also reveals unstable behavior Using the non linear flight dynamics model flight controllers are designed to stabilize the plant and provide the aircraft with an eigenstructure similar to conventional aircraft Different controller design

methods are used The flight controller shall further maintain a determined shape of the flight formation it shall control flight bank and pitch angles and it shall suppress disturbances Flight control theories in the time domain Eigenstructure assignment and in the frequency domain H infinity loop shaping are considered The resulting inner control loops yield a multibody aircraft behavior that is similar to the one of a rigid aircraft For the outer control loops classical autopilot concepts are applied Overall the flight trajectory of the multibody aircraft above ground is controlled and thus an actual operation as HAPS is possible In the last step the flight controller is successfully validated in non linear simulations with complete flight dynamics Flugzeuge in der Form von sogenannten H henplattformen engl High Altitude Platform Systems HAPS werden seit einigen Jahren als kosteng nstige Erg nzung zu teuren Satelliten betrachtet Diese Flugzeuge k nnen f r hnliche Kommunikations und bewachungsaufgaben eingesetzt werden Zu den gegenw rtigen Konzepten solcher Flugger te die bereits erfolgreich im Flugversuch eingesetzt wurden z hlen der Helios von AeroVironment und der Airbus Zephyr der eine Flugdauer von fast 624 Stunden 26 Tagen erreicht hat Alle diese HAPS Flugzeuge besitzen einen Fl gel langer Streckung der in Leichtbauweise konstruiert ist Hieraus resultieren in b iger Atmosph re hohe Biegemomente und starke strukturelle Belastungen die zu berbelastungen f hren k nnen Flugunf lle beispielsweise von Googles Solara 50 oder Facebooks Aquila belegen dies Insbesondere in der Troposph re in der das aktive Wetter stattfindet treten B enlasten auf die die Struktur zerst ren k nnen Der Airbus Zephyr der bisher als einziges HAPS Flugzeug frei von Flugunf llen ist besitzt nur eine sehr geringe Nutzlast Daher kann er die Anforderungen an zuk nftige HAPS Flugzeuge nicht vollst ndig erf llen Um die Schwachstellen solcher Ein Fl gel Konzepte zu berwinden wird in dieser Arbeit ein alternatives Flugzeugkonzept betrachtet das als Mehrk rperflugzeug bezeichnet wird Das Konzept geht von mehreren an den Fl gelspitzen miteinander verbundenen Flugzeugen aus und beruht auf Ideen des deutschen Ingenieurs Dr Vogt Dieser hatte in den USA kurz nach Ende des Zweiten Weltkrieges bemannte Flugzeuge aneinanderkoppeln lassen Hierdurch ergab sich ein Flugzeugverbund mit einem Fl gel langer Streckung Damit konnte die Reichweite des Verbundes gesteigert werden Geoffrey S Sommer griff die Idee von Vogt auf und lies sich eine Flugzeugkonfiguration patentieren die aus mehreren unbemannten Flugzeugen besteht die an den Enden der Tragfl chen miteinander gekoppelt sind Die Patentschrift gibt jedoch keinen Einblick in die Flugleistungen die flugmechanische Modellierung oder die Regelung eines solchen Flugger tes Vereinzelt existieren Ver ffentlichungen die sich mit den Flugleistungen von gekoppelten Luftfahrzeugen besch ftigen Eine tiefgreifende vollst ndige flugmechanische Analyse fehlt jedoch bisher Hier setzt die vorliegende Arbeit an Ein Flugger t basierend auf dem Konzept des Mehrk rperflug zeugs wird erstmalig hinsichtlich der Flugmechanik und Flugregelung untersucht In einer Flugleistungsbetrachtung wird das Flugzeugkonzept genau analysiert und die Vorteile hinsichtlich der Biegemomente und der Flugleistungen klar herausgestellt Die Grenzen des Einsatzes im Flugbetrieb werden mithilfe aerodynamischer Optimalpunkte aufgezeigt ber die Lager an den Fl gelspitzen die eine relative Roll und Nickbewegung der Flugzeuge untereinander erm glichen ergeben sich

durch die Einstellung unterschiedlicher Längslage und Höhenwinkel zur vertikalen Freiheitsgerade im Entwurf. Die Verwendung unterschiedlicher Nicklagewinkel der einzelnen Flugzeuge reduziert beispielsweise den induzierten Widerstand weiter und steigert die Flugleistung. Durch die symmetrische entlang der Spannweite jedoch nicht homogene Auftriebsverteilung ist auch eine laterale Trimmung der einzelnen Flugzeuge in der Formation notwendig. Hier stellt die Arbeit eine neuartige Möglichkeit vor, um diese Trimmung ohne zusätzlichen parasitären Widerstand mittels Verschiebung der Batteriemasse entlang der Halbspannweite umzusetzen. Weiterhin wird ein vollständiges flugdynamisches Modell für ber mechanische Lager verbundene Luftfahrzeuge aufgestellt und analysiert. Für diese Analyse wird eine hypothetische Torsions- und Biegefeder zwischen den Flugzeugen modelliert. Sind die Federsteifigkeiten hinreichend hoch, besitzt das flugdynamische Modell Eigenschaften, die einem elastischen Flugzeug entsprechen. Starrkörper- und elastische Eigenbewegungsformen sind in diesem Fall klar separiert. Bei immer weiterer Reduzierung bis auf eine Federsteifigkeit von Null kommt es zu Kopplungen zwischen den klassischen flugmechanischen Eigenbewegungsformen und den Moden aus den zusätzlichen Freiheitsgraden. Dies stellt den Auslegungsfall für das Mehrkörperflugzeug dar. Hierbei verändert sich die Eigenstruktur (engl. eigenstructure) des Flugzeugs und normale bei einem starren Flugzeug beobachtbare Bewegungen gegenüber dem inertialen Raum sind nicht mehr erkennbar. Zusätzlich zeigt die Strecke instabiles Verhalten. Basierend auf dem nichtlinearen flugdynamischen Modell werden mit verschiedenen Methoden Regler entworfen, die die Regelstrecke stabilisieren und dem Flugzeug eine Streckenstruktur zuweisen, die derjenigen klassischer Flugzeuge ähnelt. Zudem soll durch die Regler eine vorgegebene Form des Flugzeugverbundes beibehalten werden. Die Fahrt der Längs- und Rolllagewinkel sollen geregelt und Störungen unterdrückt werden. Als Auslegungsverfahren werden Theorien der Zustandsregelungen im Zeitbereich, Eigenstrukturvorgabe und Frequenzbereich,  $H_\infty$  loop shaping verwendet. Hierdurch wird durch die inneren Regelschleifen ein Verhalten des Mehrkörperflugzeugs erzielt, das dem eines starren Flugzeugs entspricht. Für die äußeren Regelschleifen werden anschließend klassische Konzepte von Autopiloten verwendet. Im Ergebnis ist eine Regelung des Flugweges über Grund des Mehrkörperflugzeugs und somit ein tatsächlicher Betrieb als HAPS möglich. Die Funktionalität des Reglers wird abschließend in nichtlinearen Simulationen mit vollständiger Flugdynamik verifiziert.

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