

Spacecraft Attitude Dynamics Peter C Hughes

Spacecraft Dynamics and Control: The Embedded Model Control Approach provides a uniform and systematic way of approaching space engineering control problems from the standpoint of model-based control, using state-space equations as the key paradigm for simulation, design and implementation. The book introduces the Embedded Model Control methodology for the design and implementation of attitude and orbit control systems. The logic architecture is organized around the embedded model of the spacecraft and its surrounding environment. The model is compelled to include disturbance dynamics as a repository of the uncertainty that the control law must reject to meet attitude and orbit requirements within the uncertainty class. The source of the real-time uncertainty estimation/prediction is the model error signal, as it encodes the residual discrepancies between spacecraft measurements and model output. The embedded model and the uncertainty estimation feedback (noise estimator in the book) constitute the state predictor feeding the control law. Asymptotic pole placement (exploiting the asymptotes of closed-loop transfer functions) is the way to design and tune feedback loops around the embedded model (state predictor, control law, reference generator). The design versus the uncertainty class is

driven by analytic stability and performance inequalities. The method is applied to several attitude and orbit control problems. The book begins with an extensive introduction to attitude geometry and algebra and ends with the core themes: state-space dynamics and Embedded Model Control. Fundamentals of orbit, attitude and environment dynamics are treated giving emphasis to state-space formulation, disturbance dynamics, state feedback and prediction, closed-loop stability. Sensors and actuators are treated giving emphasis to their dynamics and modelling of measurement errors. Numerical tables are included and their data employed for numerical simulations. Orbit and attitude control problems of the European GOCE mission are the inspiration of numerical exercises and simulations. The suite of the attitude control modes of a GOCE-like mission is designed and simulated around the so-called mission state predictor. Solved and unsolved exercises are included within the text - and not separated at the end of chapters - for better understanding, training and application. Simulated results and their graphical plots are developed through MATLAB/Simulink code. An examination of the AIDS crisis exposes the federal government for its inaction, health authorities for their greed, and scientists for their desire for prestige in the face of the AIDS pandemic. Comprehensive coverage includes environmental torques, energy dissipation,

motion equations for four archetypical systems, orientation parameters, illustrations of key concepts with on-orbit flight data, and typical engineering hardware. 1986 edition.

Spacecraft Attitude Dynamics Courier Corporation

Created by NASA for high school students interested in space science, this collection of worked problems covers a broad range of subjects, including mathematical aspects of NASA missions, computation and measurement, algebra, geometry, probability and statistics, exponential and logarithmic functions, trigonometry, matrix algebra, conic sections, and calculus. In addition to enhancing mathematical knowledge and skills, these problems promote an appreciation of aerospace technology and offer valuable insights into the practical uses of secondary school mathematics by professional scientists and engineers. Geared toward high school students and teachers, this volume also serves as a fine review for undergraduate science and engineering majors.

Numerous figures illuminate the text, and an appendix explores the advanced topic of gravitational forces and the conic section trajectories.

More than three decades after its first publication, Edward Said's groundbreaking critique of the West's historical, cultural, and political perceptions of the East has become a modern classic. In this wide-ranging, intellectually vigorous study, Said

traces the origins of "orientalism" to the centuries-long period during which Europe dominated the Middle and Near East and, from its position of power, defined "the orient" simply as "other than" the occident. This entrenched view continues to dominate western ideas and, because it does not allow the East to represent itself, prevents true understanding. Essential, and still eye-opening, *Orientalism* remains one of the most important books written about our divided world.

Topics include orbital and attitude maneuvers, orbit establishment and orbit transfer, plane rotation, interplanetary transfer and hyperbolic passage, lunar transfer, reorientation with constant momentum, attitude determination, more. Answers to selected exercises. 1976 edition.

This book explores topics that are central to the field of spacecraft attitude determination and control. The authors provide rigorous theoretical derivations of significant algorithms accompanied by a generous amount of qualitative discussions of the subject matter. The book documents the development of the important concepts and methods in a manner accessible to practicing engineers, graduate-level engineering students and applied mathematicians. It includes detailed examples from actual mission designs to help ease the transition from theory to practice and also provides prototype algorithms that are readily

available on the author's website. Subject matter includes both theoretical derivations and practical implementation of spacecraft attitude determination and control systems. It provides detailed derivations for attitude kinematics and dynamics and provides detailed description of the most widely used attitude parameterization, the quaternion. This title also provides a thorough treatise of attitude dynamics including Jacobian elliptical functions. It is the first known book to provide detailed derivations and explanations of state attitude determination and gives readers real-world examples from actual working spacecraft missions. The subject matter is chosen to fill the void of existing textbooks and treatises, especially in state and dynamics attitude determination. MATLAB code of all examples will be provided through an external website.

Following on from the hugely successful previous editions, the third edition of Spacecraft Systems Engineering incorporates the most recent technological advances in spacecraft and satellite engineering. With emphasis on recent developments in space activities, this new edition has been completely revised. Every chapter has been updated and rewritten by an expert engineer in the field, with emphasis on the bus rather than the payload. Encompassing the fundamentals of spacecraft engineering, the book begins with front-end system-level issues, such as environment, mission analysis and system engineering, and

progresses to a detailed examination of subsystem elements which represent the core of spacecraft design - mechanical, electrical, propulsion, thermal, control etc. This quantitative treatment is supplemented by an appreciation of the interactions between the elements, which deeply influence the process of spacecraft systems design. In particular the revised text includes * A new chapter on small satellites engineering and applications which has been contributed by two internationally-recognised experts, with insights into small satellite systems engineering. * Additions to the mission analysis chapter, treating issues of aeromanoeuvring, constellation design and small body missions. In summary, this is an outstanding textbook for aerospace engineering and design students, and offers essential reading for spacecraft engineers, designers and research scientists. The comprehensive approach provides an invaluable resource to spacecraft manufacturers and agencies across the world.

The Dynamics of Persuasion has been a staple resource for teaching persuasion for nearly two decades. Author Richard M. Perloff speaks to students in a style that is engaging and informational, explaining key theories and research as well as providing timely and relevant examples. The companion website includes materials for both students and instructors and expanding the pedagogical utilities. The sixth edition includes: updated theoretical and applied research in a

variety of areas, including framing, inoculation, and self-affirmation; new studies of health campaigns; expanded coverage of social media marketing; enhanced discussion of the Elaboration Likelihood Model in light of continued research and new applications to everyday persuasion. The fundamentals of the book – emphasis on theory, clear-cut explanation of findings, in-depth discussion of persuasion processes and effects, and easy-to-follow real-world applications – continue in the sixth edition.

On February 1, 2003, the unthinkable happened. The space shuttle Columbia disintegrated 37 miles above Texas, seven brave astronauts were killed and America's space program, always an eyeblink from disaster, suffered its second catastrophic in-flight failure. Unlike the Challenger disaster 17 years earlier, Columbia's destruction left the nation one failure away from the potential abandonment of human space exploration. Media coverage in the immediate aftermath focused on the possible cause of the disaster, and on the nation's grief. But the full human story, and the shocking details of NASA's crucial mistakes, have never been told -- until now. Based on dozens of exclusive interviews, never-before-published documents and recordings of key meetings obtained by the authors, Comm Check takes the reader inside the conference rooms and offices where NASA's best and brightest managed the nation's multi-billion-dollar

shuttle program -- and where they failed to recognize the signs of an impending disaster. It is the story of a space program pushed to the brink of failure by relentless political pressure, shrinking budgets and flawed decision making. The independent investigation into the disaster uncovered why Columbia broke apart in the sky above Texas. Comm Check brings that story to life with the human drama behind the tragedy. Michael Cabbage and William Harwood, two of America's most respected space journalists, are veterans of all but a handful of NASA's 113 shuttle missions. Tapping a network of sources and bringing a combined three decades of experience to bear, the authors provide a rare glimpse into NASA's inner circles, chronicling the agency's most devastating failure and the challenges that face NASA as it struggles to return America to space.

Excellent graduate-level text explores virtually every important subject in the fields of subsonic, transonic, supersonic, and hypersonic aerodynamics and dynamics, demonstrating their interface in atmospheric flight vehicle design. 1974 edition.

In Ruling Capital, Kevin P. Gallagher demonstrates how several emerging market and developing countries (EMDs) managed to reregulate cross-border financial flows in the wake of the global financial crisis, despite the political and economic

difficulty of doing so at the national level. Gallagher also shows that some EMDs, particularly the BRICS coalition, were able to maintain or expand their sovereignty to regulate cross-border finance under global economic governance institutions. Gallagher combines econometric analysis with in-depth interviews with officials and interest groups in select emerging markets and policymakers at the International Monetary Fund, the World Trade Organization, and the G-20 to explain key characteristics of the global economy. Gallagher develops a theory of countervailing monetary power that shows how emerging markets can counter domestic and international opposition to the regulation of cross-border finance. Although many countries were able to exert countervailing monetary power in the wake of the crisis, such power was not sufficient to stem the magnitude of unstable financial flows that continue to plague the world economy. Drawing on this theory, Gallagher outlines the significant opportunities and obstacles to regulating cross-border finance in the twenty-first century.

This book discusses all spacecraft attitude control-related topics: spacecraft (including attitude measurements, actuator, and disturbance torques), modeling, spacecraft attitude determination and estimation, and spacecraft attitude controls. Unlike other books addressing these topics, this book focuses on quaternion-based methods because of its many merits. The book lays a brief, but necessary

background on rotation sequence representations and frequently used reference frames that form the foundation of spacecraft attitude description. It then discusses the fundamentals of attitude determination using vector measurements, various efficient (including very recently developed) attitude determination algorithms, and the instruments and methods of popular vector measurements. With available attitude measurements, attitude control designs for inertial point and nadir pointing are presented in terms of required torques which are independent of actuators in use. Given the required control torques, some actuators are not able to generate the accurate control torques, therefore, spacecraft attitude control design methods with achievable torques for these actuators (for example, magnetic torque bars and control moment gyros) are provided. Some rigorous controllability results are provided. The book also includes attitude control in some special maneuvers, such as orbital-raising, docking and rendezvous, that are normally not discussed in similar books. Almost all design methods are based on state-spaced modern control approaches, such as linear quadratic optimal control, robust pole assignment control, model predictive control, and gain scheduling control. Applications of these methods to spacecraft attitude control problems are provided. Appendices are provided for readers who are not familiar with these topics.

The only comprehensive text available on space propulsion for students and professionals in astronautics.

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.

Fundamentals of Space Systems was developed to satisfy two objectives: the first is to provide a text suitable for use in an advanced undergraduate or beginning graduate course in both space systems engineering and space system design. The second is to be a primer and reference book for space professionals wishing to broaden their capabilities to develop, manage the development, or operate space systems. The authors of the individual chapters are practicing engineers that have had extensive experience in developing sophisticated experimental and operational spacecraft systems in addition to having experience teaching the subject material. The text presents the fundamentals of all the subsystems of a spacecraft missions and includes illustrative examples drawn from actual experience to enhance the learning experience. It includes a chapter on each of the relevant major disciplines and

subsystems including space systems engineering, space environment, astrodynamics, propulsion and flight mechanics, attitude determination and control, power systems, thermal control, configuration management and structures, communications, command and telemetry, data processing, embedded flight software, survivability and reliability, integration and test, mission operations, and the initial conceptual design of a typical small spacecraft mission. Satellites are used increasingly in telecommunications, scientific research, surveillance, and meteorology, and these satellites rely heavily on the effectiveness of complex onboard control systems. This 1997 book explains the basic theory of spacecraft dynamics and control and the practical aspects of controlling a satellite. The emphasis throughout is on analyzing and solving real-world engineering problems. For example, the author discusses orbital and rotational dynamics of spacecraft under a variety of environmental conditions, along with the realistic constraints imposed by available hardware. Among the topics covered are orbital dynamics, attitude dynamics, gravity gradient stabilization, single and dual spin stabilization, attitude maneuvers, attitude stabilization, and structural dynamics and liquid sloshing.

This treatment for upper-level undergraduates, graduate students, and professionals makes special reference to stability and control of airplanes, with extensive numerical examples covering a variety of vehicles. 260 illustrations. 1972 edition.

Roger D. Werking Head, Attitude Determination and Control Section National Aeronautics and Space Administration/ Goddard Space Flight Center Extensive work has been done for many years in the areas of attitude determination, attitude prediction, and attitude control. During this time, it has been difficult to obtain reference material that provided a comprehensive overview of attitude support activities. This lack of reference material has made it difficult for those not

intimately involved in attitude functions to become acquainted with the ideas and activities which are essential to understanding the various aspects of spacecraft attitude support. As a result, I felt the need for a document which could be used by a variety of persons to obtain an understanding of the work which has been done in support of spacecraft attitude objectives. It is believed that this book, prepared by the Computer Sciences Corporation under the able direction of Dr. James Wertz, provides this type of reference. This book can serve as a reference for individuals involved in mission planning, attitude determination, and attitude dynamics; an introductory textbook for students and professionals starting in this field; an information source for experimenters or others involved in spacecraft-related work who need information on spacecraft orientation and how it is determined, but who have neither the time nor the resources to pursue the varied literature on this subject; and a tool for encouraging those who could expand this discipline to do so, because much remains to be done to satisfy future needs.

Spacecraft attitude maneuvers comply with Euler's moment equations, a set of three nonlinear, coupled differential equations. Nonlinearities complicate the mathematical treatment of the seemingly simple action of rotating, and these complications lead to a robust lineage of research. This book is meant for basic scientifically inclined readers, and commences with a chapter on the basics of spaceflight and leverages this remediation to reveal very advanced topics to new spaceflight enthusiasts. The topics learned from reading this text will prepare students and faculties to investigate interesting spaceflight problems in an era where cube satellites have made such investigations attainable by even small universities. It is the fondest hope of the editor and authors that readers enjoy this book.

Michel van Pelt explains for the first time the principle of space tethers: what they are and how they can be used in space. He introduces non-technical space enthusiasts to the various possibilities and feasibility of space tethers including the technological challenges and potential benefits. He illustrates how, because of their inherent simplicity, space tethers have the potential to make space travel much cheaper, while ongoing advances in tether material technology may make even seemingly far-fetched ideas a reality in the not too distant future.

Revisions to 5th Edition by: Zhili Sun, University of Surrey, UK New and updated edition of this authoritative and comprehensive reference to the field of satellite communications engineering Building on the success of previous editions, *Satellite Communications Systems, Fifth Edition* covers the entire field of satellite communications engineering from orbital mechanics to satellite design and launch, configuration and installation of earth stations, including the implementation of communications links and the set-up of the satellite network. This book provides a comprehensive treatment of satellite communications systems engineering and discusses the technological applications. It demonstrates how system components interact and details the relationship between the system and its environment. The authors discuss the systems aspects such as techniques enabling equipment and system dimensioning and state of the art technology for satellite platforms, payloads and earth stations. New features and updates for the fifth edition include: More information on techniques allowing service provision of multimedia content Extra material on techniques for broadcasting, including recent standards DVB-RCS and DVB-S2 (Digital Video Broadcasting -Return Channel Satellite and -Satellite Version 2) Updates on onboard processing By offering a detailed and practical overview, *Satellite Communications Systems* continues to be an authoritative text for advanced

students, engineers and designers throughout the field of satellite communications and engineering.

Good, No Highlights, No Markup, all pages are intact, Slight Shelfwear, may have the corners slightly dented, may have slight color changes/slightly damaged spine.

Designed for undergraduate courses in Spacecraft Dynamics and Orbital Mechanics, this new edition offers a three-dimensional treatment of dynamics discussions of rigid body dynamics, rocket trajectories, and the space environment. An expert in his field, author William E. Wiesel presents a wealth of information in an easy-to-understand manner without the daunting mathematical rigor of graduate texts. Reference is made to actual flight vehicles and satellites to give students background on the type of work currently being done in this field.

Cover -- Half-title -- Title -- Copyright -- Dedication -- Contents -- Preface -- 1 Youth and Media -- 2 Then and Now -- 3 Themes and Theoretical Perspectives -- 4 Infants, Toddlers, and Preschoolers -- 5 Children -- 6 Adolescents -- 7 Media and Violence -- 8 Media and Emotions -- 9 Advertising and Commercialism -- 10 Media and Sex -- 11 Media and Education -- 12 Digital Games -- 13 Social Media -- 14 Media and Parenting -- 15 The End -- Notes -- Acknowledgments -- Index -- A -- B -- C -- D -- E -- F -- G -- H -- I -- J -- K -- L -- M -- N -- O -- P -- Q -- R -- S -- T -- U -- V -- W -- X -- Y -- Z

This textbook covers fundamental and advanced topics in orbital mechanics and astrodynamics to expose the student to the basic dynamics of space flight. The engineers and graduate students who read this class-tested text will be able to apply their knowledge to mission design and navigation of space missions. Through highlighting basic, analytic and computer-based methods for designing interplanetary and orbital trajectories, this text provides

excellent insight into astronomical techniques and tools. This book is ideal for graduate students in Astronautical or Aerospace Engineering and related fields of study, researchers in space industrial and governmental research and development facilities, as well as researchers in astronautics. This book also:

- Illustrates all key concepts with examples
- Includes exercises for each chapter
- Explains concepts and engineering tools a student or experienced engineer can apply to mission design and navigation of space missions
- Covers fundamental principles to expose the student to the basic dynamics of space flight

Provides the basics of spacecraft orbital dynamics plus attitude dynamics and control, using vectrix notation. *Spacecraft Dynamics and Control: An Introduction* presents the fundamentals of classical control in the context of spacecraft attitude control. This approach is particularly beneficial for the training of students in both of the subjects of classical control as well as its application to spacecraft attitude control. By using a physical system (a spacecraft) that the reader can visualize (rather than arbitrary transfer functions), it is easier to grasp the motivation for why topics in control theory are important, as well as the theory behind them. The entire treatment of both orbital and attitude dynamics makes use of vectrix notation, which is a tool that allows the user to write down any vector equation of motion without consideration of a reference frame. This is particularly suited to the treatment of multiple reference frames. Vectrix notation also makes a very clear distinction between a physical vector and its coordinate representation in a reference frame. This is very important in spacecraft dynamics and control problems, where often multiple coordinate representations are used (in different reference frames) for the same physical vector. Provides an accessible, practical aid for teaching and self-study with a layout enabling a fundamental understanding of the subject. Fills a

gap in the existing literature by providing an analytical toolbox offering the reader a lasting, rigorous methodology for approaching vector mechanics, a key element vital to new graduates and practicing engineers alike. Delivers an outstanding resource for aerospace engineering students, and all those involved in the technical aspects of design and engineering in the space sector. Contains numerous illustrations to accompany the written text. Problems are included to apply and extend the material in each chapter. Essential reading for graduate level aerospace engineering students, aerospace professionals, researchers and engineers. This handbook, designed to help analysts assess cost estimates of space systems, covers planning an estimate and identifying the key data needed. It also provides typical cost ranges for components of relevant historical space programs. It supplements the Air Force Cost Analysis Agency's spacecraft training course by focusing on the cost analysis implications of the systems and processes covered in the course.

The idea of "The Green Book" is to give the Motorist and Tourist a Guide not only of the Hotels and Tourist Homes in all of the large cities, but other classifications that will be found useful wherever he may be. Also facts and information that the Negro Motorist can use and depend upon. There are thousands of places that the public doesn't know about and aren't listed. Perhaps you know of some? If so send in their names and addresses and the kind of business, so that we might pass it along to the rest of your fellow Motorists. You will find it handy on your travels, whether at home or in some other state, and is up to date. Each year we are compiling new lists as some of these places move, or go out of business and new business places are started giving added employment to members of our race.

Very Good, No Highlights or Markup, all pages are intact.

Introduces young readers to Catholic beliefs as expressed in the Catechism of the Catholic Church.

This book unifies all aspects of flight dynamics for the efficient development of aerospace vehicle simulations. It provides the reader with a complete set of tools to build, program, and execute simulations. Unlike other books, it uses tensors for modeling flight dynamics in a form invariant under coordinate transformations. For implementation, the tensors are converted to matrices, resulting in compact computer code. The reader can pick templates of missiles, aircraft, or hypersonic vehicles to jump-start a particular application. It is the only textbook that combines the theory of modeling with hands-on examples of three-, five-, and six-degree-of-freedom simulations. Included is a link to the CADAC Web Site where you may apply for the free CADAC CD with eight prototype simulations and plotting programs. Amply illustrated with 318 figures and 44 examples, the text can be used for advanced undergraduate and graduate instruction or for self-study. Also included are 77 problems that enhance the ability to model aerospace vehicles and nine projects that hone the skills for developing three-, five-, and six-degree-of-freedom simulations.

The ultimate non-technical guide to the fast-developing world of quantum computing Computer technology has improved exponentially over the last 50 years. But the headroom for bigger and better electronic solutions is running out. Our best hope is to engage the power of quantum physics. 'Quantum algorithms' had already been written long before hardware was built. These would enable, for example, a quantum computer to exponentially speed up an information search, or to crack the mathematical trick behind internet security. However, making a quantum computer is incredibly difficult. Despite hundreds of laboratories around the

world working on them, we are only just seeing them come close to 'supremacy' where they can outperform a traditional computer. In this approachable introduction, Brian Clegg explains algorithms and their quantum counterparts, explores the physical building blocks and quantum weirdness necessary to make a quantum computer, and uncovers the capabilities of the current generation of machines.

Fully revised and updated, the second edition of the International Encyclopedia of the Social and Behavioral Sciences, first published in 2001, offers a source of social and behavioral sciences reference material that is broader and deeper than any other. Available in both print and online editions, it comprises over 3,900 articles, commissioned by 71 Section Editors, and includes 90,000 bibliographic references as well as comprehensive name and subject indexes. Provides authoritative, foundational, interdisciplinary knowledge across the wide range of behavioral and social sciences fields Discusses history, current trends and future directions Topics are cross-referenced with related topics and each article highlights further reading "Space Vehicle Dynamics and Control provides a solid foundation in dynamic modeling, analysis, and control of space vehicles. More than 200 figures, photographs, and tables are featured in detailed sections covering the fundamentals of controlling orbital, attitude, and structural motions of space vehicles. The textbook highlights a range of orbital maneuvering and control problems: orbital transfer, rendezvous, and halo orbit determination and control. Rotational maneuvering and attitude control problems of space vehicles under the influence of reaction jet firings, internal energy dissipation, or momentum transfer via reaction wheels and control moment gyros are treated in detail. The textbook also highlights the analysis and design of attitude control systems in the presence of structural flexibility and/or propellant

sloshing. At the end of each chapter, Dr. Wie includes a helpful list of references for graduate students and working professionals studying spacecraft dynamics and control. A bibliography of more than 350 additional references in the field of spacecraft guidance, control, and dynamics is also provided at the end of the book. This text requires a thorough knowledge of vector and matrix algebra, calculus, ordinary differential equations, engineering mechanics, and linear system dynamics and control. The first two chapters provide a summary of such necessary background material. Since some problems may require the use of software for the analysis, control design, and numerical simulation, readers should have access to computational software (i.e., MATLAB) on a personal computer.

Aimed at students, faculty and professionals in the aerospace field, this book provides practical information on the development, analysis, and control of a single and/or multiple spacecraft in space. This book is divided into two major sections: single and multiple satellite motion. The first section analyses the orbital mechanics, orbital perturbations, and attitude dynamics of a single satellite around the Earth. Using the knowledge of a single satellite motion, the translation of a group of satellites called formation flying or constellation is explained. Formation flying has been one of the main research topics over the last few years and this book explains different control approaches to control the satellite attitude motion and/or to maintain the constellation together. The control schemes are explained in the discrete domain such that it can be easily implemented on the computer on board the satellite. The key objective of this book is to show the reader the practical and the implementation process in the discrete domain. Explains the orbital motion and principal perturbations affecting the satellite Uses the Ares V rocket as an example to explain the attitude motion of a space vehicle

Presents the practical approach for different control actuators that can be used in a satellite. Pointing a satellite in the right direction requires an extremely complex system — one that describes the satellite's orientation and at the same time predicts and either uses or neutralizes external influences. From its roots in classical mechanics and reliance on stability theory to the evolution of practical stabilization ideas, Spacecraft Attitude Dynamics offers comprehensive coverage of environmental torques encountered in space; energy dissipation and its effects on the attitude stability of spinning bodies; motion equation for four archetypical systems derived and used repeatedly throughout the text; orientation parameters (not limited to Euler angles); illustrations of key concepts with on-orbit flight data; and typical engineering hardware, with examples of the implementation of dynamic ideas. Suitable as a text for advanced undergraduates and graduate students, this unified treatment is also a valuable reference for professional engineers studying the analysis and application of modern spacecraft attitude dynamics. The sole prerequisites are a fundamental knowledge of vector dynamics and matrix algebra. Over 250 diagrams appear throughout the text, along with extensive problem sets at the end of each chapter, 350 references (cited, interpreted, and placed in perspective to reinforce the material), and two helpful appendixes.

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