

Spacecraft Dynamics & Control

A PRACTICAL
ENGINEERING
APPROACH

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Spacecraft Dynamics and Control Enrico Canuto, Carlo Novara, Donato Carlucci, Carlos Perez-Montenegro, Luca Massotti, 2018-03-08 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

Spacecraft Dynamics and Control Anton H. de Ruiter, Christopher Damaren, James R. Forbes, 2012-12-05 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

Fault-Tolerant Attitude Control of Spacecraft Qinglei Hu, Bing Xiao, Bo Li, Youmin Zhang, 2021-06-09 Fault Tolerant Attitude Control of Spacecraft presents the fundamentals of spacecraft fault tolerant attitude control systems along with the most recent research and advanced

nonlinear control techniques This book gives researchers a self contained guide to the complex tasks of envisaging designing implementing and experimenting by presenting designs for integrated modeling dynamics fault tolerant attitude control and fault reconstruction for spacecraft Specifically the book gives a full literature review and presents preliminaries and mathematical models robust fault tolerant attitude control fault tolerant attitude control with actuator saturation velocity free fault tolerant attitude control finite time fault tolerant attitude tracking control and active fault tolerant attitude control Finally the book looks at the future of this interesting topic offering readers a one stop solution for those working on fault tolerant attitude control for spacecraft Presents the fundamentals of fault tolerant attitude control systems for spacecraft in one practical solution Gives the latest research and thinking on nonlinear attitude control fault tolerant control and reliable attitude control Brings together concepts in fault control theory fault diagnosis and attitude control for spacecraft Covers advances in theory technological aspects and applications in spacecraft Presents detailed numerical and simulation results to assist engineers Offers a clear systematic reference on fault tolerant control and attitude control for spacecraft Fault Diagnosis of Nonlinear Systems Using a Hybrid Approach Ehsan Sobhani-Tehrani, Khashayar Khorasani, 2009-06-22

The increasing complexity of space vehicles such as satellites and the cost reduction measures that have affected satellite operators are increasingly driving the need for more autonomy in satellite diagnostics and control systems Current methods for detecting and correcting anomalies onboard the spacecraft as well as on the ground are primarily manual and labor intensive and therefore tend to be slow Operators inspect telemetry data to determine the current satellite health They use various statistical techniques and models but the analysis and evaluation of the large volume of data still require extensive human intervention and expertise that is prone to error Furthermore for spacecraft and most of these satellites there can be potentially unduly long delays in round trip communications between the ground station and the satellite In this context it is desirable to have onboard fault diagnosis system that is capable of detecting isolating identifying or classifying faults in the system without the involvement and intervention of operators Toward this end the principle goal here is to improve the efficiency accuracy and reliability of the trend analysis and diagnostics techniques through utilization of intelligent based and hybrid based methodologies **Advances in Spacecraft Attitude Control** Timothy Sands, 2020-01-15 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 *Fast Solar Sailing* Giovanni Vulpatti, 2012-08-10 The range of solar sailing is very

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