Structural Failure Analysis and Prediction Methods for Aerospace Vehicles and Structures

The prospects for realizing a magnetohydrodynamic (MHD) bypass hypersonic airbreathing engine are examined from the standpoint of fundamental thermodynamic feasibility. The MHD-bypass engine, first proposed as part of the Russian AJAX vehicle concept, is based on the idea of redistributing energy between various stages of the propulsion system flow train. The system uses an MHD generator to extract a portion of the aerodynamic heating energy from the inlet and an MHD accelerator to reintroduce this power as kinetic energy in the exhaust stream. In this way, the combustor entrance Mach number can be limited to a specified value even as the flight Mach number increases. Thus, the fuel and air can be efficiently mixed and burned within a practical combustor length, and the flight Mach number operating envelope can be extended. In this paper, we quantitatively assess the performance potential and scientific feasibility of MHD-bypass engines using a simplified thermodynamic analysis. This cycle analysis, based on a thermally and calorically perfect gas, incorporates a coupled MHD generator-accelerator system and accounts for aerodynamic losses and thermodynamic process efficiencies in the various engine components. It is found that the flight Mach number range can be significantly extended; however, overall performance is hampered by non-isentropic losses in the MHD devices.

New Results in Numerical and Experimental Fluid Mechanics III During the last decade, rapid growth of knowledge in the field of jet, rocket, nuclear, ion and electric propulsion has resulted in many advances useful to the student, engineer and scientist. The purpose for offering this course is to make available to them these recent advances in theory and design. Accordingly, this course is organized into seven parts: Part 1 Introduction; Part 2 Jet Propulsion; Part 3 Rocket Propulsion; Part 4 Nuclear Propulsion; Part 5 Electric and Ion Propulsion; Part 6 Theory on Combustion, Detonation and Fluid Injection; Part 7 Advanced Concepts and Mission Applications. It is written in such a way that it may easily be adopted by other universities as a textbook for a one semester senior or graduate course on the subject. In addition to the undersigned who served as the course instructor and wrote Chapter I, 2 and 3, guest lecturers included: DR. G. L. DUGGER who wrote Chapter 4 "Ram-jets and Air-Augmented Rockets," DR. GEORGE P. SUTTON who wrote Chapter 5 "Rockets and Cooling Methods," DR. MARTIN SUMMERFIELD who wrote Chapter 6 "Solid Propellant Rockets," DR. HOWARD S. SEIFERT who wrote Chapter 7 "Hybrid Rockets," DR. CHANDLER C. Ross who wrote Chapter 8 "Advanced Nuclear Rocket Design," MR. GEORGE H. MC LAFFERTY who wrote Chapter 9 "Gaseous Nuclear Rockets," DR. S. G. FORBES
who wrote Chapter 10 "Electric and Ion Propulsion," DR. R. H. BODEN who wrote Chapter 11 "Ion Propulsion," DR.

Scramjet Propulsion The third edition of this easy-to-understand text continues to provide students with a sound understanding of the fundamental concepts of various physical phenomena of science of fluid mechanics. It adds a new chapter (Vortex Theory) which presents a vivid interpretation of vortex motions that are of fundamental importance in aerodynamics and in the performance of many other engineering devices. It elaborately explains the dynamics of vortex motion with the help of Helmholtz's theorems and provides illustrations of how the manifestations of Helmholtz's theorems can be observed in daily life. Several new problems along with answers are added at the end of Chapter 4 on Boundary Layer. The book is suitable for a one-semester course in fluid mechanics for undergraduate students of mechanical, aerospace, civil and chemical engineering students. A Solutions Manual containing solutions to end-of-chapter problems is available for use by instructors.

AIAA Aerospace Sciences Meeting and Exhibit, 42nd The 24th International Symposium on Shock Waves (ISSW24) was held at the Beijing Friendship Hotel during July 11-16, 2004, in Beijing. It was a great pleasure for the Local Organizing Committee to organize the ISSW in China for the first time, because forty-seven years have passed since the First Shock Tube Symposium was held in 1957 at Albuquerque. The ISSW24 had to be postponed for one year because of the SARS outbreak in Beijing shortly before the Symposium was scheduled to be held in 2003, but it has achieved success due to the continuous support and kind understanding from all the delegates. It is very heart-warming to have had such an experience and I am very happy to have served as chairman for the Symposium. I would like to thank all for the contributions and help that they have given us over the past three years, without which we would not have had the Symposium. A total of 460 abstracts were submitted to the ISSW24. Each of the abstracts was evaluated by three members of the Scientific Review Committee and the decision on acceptance was made based on the reviewers' reports. 195 oral papers, including 9 plenary lectures, were accepted to be presented in three parallel sessions, and 135 poster papers in three dedicated poster sessions. Topics discussed in these papers cover all aspects of shock wave research.

Advanced Turbulent Combustion Physics and Applications The University of Manchester hosted the 28th International Symposium on Shock Waves between 17 and 22 July 2011. The International Symposium on Shock Waves first took place in 1957 in Boston and has since become an internationally acclaimed series of meetings for the wider Shock Wave Community. The ISSW 28 focused on the following areas: Blast Waves, Chemically Reacting Flows, Dense Gases and Rarefied Flows, Detonation and Combustion, Diagnostics, Facilities, Flow Visualisation, Hypersonic Flow, Ignition, Impact and Compaction, Multiphase Flow, Nozzle Flow, Numerical Methods, Propulsion, Richtmyer-Meshkov, Shockwave Boundary Layer Interaction, Shock Propagation and Reflection, Shock Vortex Interaction, Shockwave Phenomena and Applications, as well as Medical and Biological Applications. The two Volumes contain the papers presented at the symposium and serve as a reference for the participants of the ISSW 28 and individuals interested in these fields.


Hypersonic Aerothermodynamics The renewed interest in high-speed propulsion has led to increased activity in the development of the supersonic combustion ramjet engine for hypersonic flight applications. In the hypersonic regime the scramjet engine's specific thrust exceeds that of other propulsion systems. This book, written by a leading researcher, describes the processes and characteristics of the scramjet engine in a unified manner, reviewing both theoretical and experimental research. The focus is on the phenomena that dictate the thermo-aerodynamic processes encountered in the scramjet engine, including component analyses and flowpath considerations; fundamental theoretical topics related to internal flow with chemical reactions and non-equilibrium effects, high-temperature gas dynamics, and hypersonic effects are included. Cycle and component analyses are further described, followed by flowpath examination. Finally, the book reviews experimental and
theoretical capabilities and describes ground testing facilities and computational fluid dynamics facilities developed for the study of time-accurate, high-temperature aerodynamics.


High-Speed Flight Propulsion Systems This proceedings present the results of the 29th International Symposium on Shock Waves (ISSW 29) which was held in Madison, Wisconsin, U.S.A., from July 14 to July 19, 2013. It was organized by the Wisconsin Shock Tube Laboratory, which is part of the College of Engineering of the University of Wisconsin-Madison. The ISSW 29 focused on the following areas: Blast Waves, Chemically Reactive Flows, Detonation and Combustion, Facilities, Flow Visualization, Hypersonic Flow, Ignition, Impact and Compaction, Industrial Applications, Magnetohydrodynamics, Medical and Biological Applications, Nozzle Flow, Numerical Methods, Plasmas, Propulsion, Richtmyer-Meshkov Instability, Shock-Boundary Layer Interaction, Shock Propagation and Reflection, Shock Vortex Interaction, Shock Waves in Condensed Matter, Shock Waves in Multiphase Flow, as well as Shock Waves in Rarefield Flow. The two volumes contain the papers presented at the symposium and serve as a reference for the participants of the ISSW 29 and individuals interested in these fields.

Developments In High-Speed Vehicle Propulsion Systems This volume contains the proceedings of the Workshop on Combustion, sponsored by the Institute for Computer Applications in Science and Engineering (ICASE) and the NASA Langley Research Center (LaRC). It was held on October 12-14, 1992, and was the second workshop in the series on the subject. The first was held in 1989, and its proceedings were published by Springer-Verlag under the title "Major Research Topics in Combustion," edited by M. Y. Hussaini, A. K. Kumar, and R. G. Voigt. The focus of the second workshop was directed towards the development, analysis, and application of basic models in high speed propulsion of particular interest to NASA. The exploration of a dual approach combining asymptotic and numerical methods for the analysis of the models was particularly encouraged. The objectives of this workshop were i) the genesis of models that would capture or reflect the basic physical phenomena in SCRAMJETs and/or oblique detonation-wave engines (ODWE), and ii) the stimulation of a greater interaction between NASA experimental research community and the academic community. The lead paper by D. Bushnell on the status and issues of high speed propulsion relevant to both the SCRAMJET and the ODWE parallels his keynote address which set the stage of the workshop. Following the lead paper were five technical sessions with titles and chairs: Experiments (C. Rogers), Reacting Free Shear Layers (C. E. Grosch), Detonations (A. K. Kapila), Ignition and Structure (J. Buckmaster), and Unsteady Behaviour ('1. L. Jackson).

Numerical Flow Simulation II

29th International Symposium on Shock Waves 1 Demand for high-speed propulsion has renewed development of the supersonic combustion ramjet engine (Scramjet engine) for hypersonic flight applications.
Selected Aerothermodynamic Design Problems of Hypersonic Flight Vehicles

Molecular Physics and Hypersonic Flows In this book selected aerothermodynamic design problems in hypersonic vehicles are treated. Where applicable, it emphasizes the fact that outer surfaces of hypersonic vehicles primarily are radiation-cooled, an interdisciplinary topic with many implications.

Advanced Hypersonic Test Facilities The aim of this series is to publish promptly and in a detailed form new material from the field of Numerical Fluid Mechanics including the use of advanced computer systems. Published are reports on specialized conferences, workshops, research programs, and monographs. Contents: This volume contains nineteen reports on work, which is conducted since 1998 in the Collaborative Research Programme "Numerical Flow Simulation" of the Centre National de la Recherche Scientifique (CNRS) and the Deutsche Forschungsgemeinschaft (DFG). French and German engineers and mathematicians present their joint research on the topics "Development of Solution Techniques", "Crystal Growth and Melts", "Flows of Reacting Gases", and "Turbulent Flows". In the background of their work is the still strong growth of the performance of super-computer architectures, which, together with large advances in algorithms, is opening vast new application areas of numerical flow simulation in research and industrial work. Results of this programme from the period 1996 to 1998 have been presented in NNFM 66 (1998)

Basics of Aerothermodynamics

Theoretical Aerodynamics Aircraft Propulsion and Gas Turbine Engines, Second Edition builds upon the success of the book’s first edition, with the addition of three major topic areas: Piston Engines with integrated propeller coverage; Pump Technologies; and Rocket Propulsion. The rocket propulsion section extends the text’s coverage so that both Aerospace and Aeronautical topics can be studied and compared. Numerous updates have been made to reflect the latest advances in turbine engines, fuels, and combustion. The text is now divided into three parts, the first two devoted to air breathing engines, and the third covering non-air breathing or rocket engines.


28th International Symposium on Shock Waves Molecular Physics and Hypersonic Flows bridges the gap between the fluid dynamics and molecular physics communities, emphasizing the role played by elementary processes in hypersonic flows. In particular, the work is primarily dedicated to filling the gap between microscopic and macroscopic treatments of the source terms to be inserted in the fluid dynamics codes. The first part of the book describes the molecular dynamics of elementary processes both in the gas phase and in the interaction with surfaces by using quantum mechanical and phenomenological approaches. A second group of contributions describes thermodynamics and transport properties of air components, with special attention to the transport of internal energy. A series of papers is devoted to the experimental and theoretical study of the flow of partially ionized gases. Subsequent contributions treat modern computational techniques for 3-D hypersonic flow. Non-equilibrium vibrational kinetics are then described, together with the coupling of vibration-dissociation processes as they affect hypersonic flows. Special emphasis is given to the interfacing of non-equilibrium models with computational fluid dynamics methods. Finally, the last part of the book deals with the application of direct Monte Carlo methods in describing rarefied flows.
Inlets for Supersonic Missiles This volume contains 59 papers presented at the 13th Symposium of STAB (German Aerospace Aerodynamics Association). In this association, all those German scientists and engineers from universities, research establishments and industry are involved who are doing research and project work in numerical and experimental fluid mechanics and aerodynamics, mainly for aerospace but also in other applications. Many of the contributions give results from federal and European-Union sponsored projects. The volume gives a broad overview of the ongoing work in this field in Germany. Covered are flow problems of high and low aspect-ratio wings and bluff bodies, laminar flow control and transition, hypersonic flows, transition and fluid mechanical modelling, LES and DNS, numerical simulation, aeroelasticity, measuring techniques and propulsion flows.

The Scramjet Engine Annotation Leading researchers provide a cohesive treatment of the complex issues in high-speed propulsion, as well as introductions to the current capabilities for addressing several fundamental aspects of high-speed vehicle propulsion development. Includes more than 380 references, 290 figures and tables, and 185 equations.

Thermodynamic Cycle Analysis of Magnetohydrodynamic-bypass Hypersonic Airbreathing Engines Theoretical Aerodynamics is a user-friendly text for a full course on theoretical aerodynamics. The author systematically introduces aerofoil theory, its design features and performance aspects, beginning with the basics required, and then gradually proceeding to higher level. The mathematics involved is presented so that it can be followed comfortably, even by those who are not strong in mathematics. The examples are designed to fix the theory studied in an effective manner. Throughout the book, the physics behind the processes are clearly explained. Each chapter begins with an introduction and ends with a summary and exercises. This book is intended for graduate and advanced undergraduate students of Aerospace Engineering, as well as researchers and Designers working in the area of aerofoil and blade design. Provides a complete overview of the technical terms, vortex theory, lifting line theory, and numerical methods Presented in an easy-to-read style making full use of figures and illustrations to enhance understanding, and moves well simpler to more advanced topics Includes a complete section on fluid mechanics and thermodynamics, essential background topics to the theory of aerodynamics Blends the mathematical and physical concepts of design and performance aspects of lifting surfaces, and introduces the reader to the thin aerofoil theory, panel method, and finite aerofoil theory Includes a Solutions Manual for end-of-chapter exercises, and Lecture slides on the book's Companion Website

Air-breathing Aerospace Plane Development Essential: Hypersonic Propulsion Flight Tests This book provides a comprehensive basics-to-advanced course in an aero-thermal science vital to the design of engines for either type of craft. The text classifies engines powering aircraft and single/multi-stage rockets, and derives performance parameters for both from basic aerodynamics and thermodynamics laws. Each type of engine is analyzed for optimum performance goals, and mission-appropriate engines selection is explained. Fundamentals of Aircraft and Rocket Propulsion provides information about and analyses of: thermodynamic cycles of shaft engines (piston, turboprop, turboshift and propfan); jet engines (pulsejet, pulse detonation engine, ramjet, scramjet, turbojet and turbofan); chemical and non-chemical rocket engines; conceptual design of modular rocket engines (combustor, nozzle and turbopumps); and conceptual design of different modules of aero-engines in their design and off-design state. Aimed at graduate and final-year undergraduate students, this textbook provides a thorough grounding in the history and classification of both aircraft and rocket engines, important design features of all the engines detailed, and particular consideration of special aircraft such as unmanned aerial and short/vertical takeoff and landing aircraft. End-of-chapter exercises make this a valuable student resource, and the provision of a downloadable solutions manual will be of further benefit for course instructors.

Shock Waves Knowledge is not merely everything we have come to know, but also ideas we have pondered long enough to know in which way they are related, and how these ideas can be put to practical use. Modern aviation has been made possible as a result of much scientific research. However, the very first useful results of this research became available a considerable length of time after the aviation pioneers had made their first flights. Apparently, researchers were not able to nd an adequate
exp- nation for the occurrence of lift until the beginning of the 21st century. Also, for the fundamentals of stability and control, there was no theory available that the pioneers could rely on. Only after the rst motorized ights had been successfully made did researchers become more interested in the science of aviation, which from then on began to take shape. In modern day life, many millions of passengers are transported every year by air. People in the western societies take to the skies, on average, several times a year. Especially in areas surrounding busy airports, travel by plane has been on the rise since the end of the Second World War. Despite becoming familiar with the sight of a jumbo jet commencing its ight once or twice a day, many nd it astonishing that such a colossus with a mass of several hundred thousands of kilograms can actually lift off from the ground.

Viscous Hypersonic Flow This book deals with structural failure (induced by mechanical, aerodynamic, acoustic and aero-thermal, loads, etc.) of modern aerospace vehicles, in particular high-speed aircraft, solid propellant rocket systems and hypersonic flight vehicles, where structural integrity, failure prediction and service life assessment are particularly challenging, due to the increasingly more demanding mission requirements and the use of non-traditional materials, such as non-metallic composites, in their construction. Prediction of the complex loading environment seen in high-speed operation and constitutive / fracture models which can adequately describe the non-linear behaviour exhibited by advanced alloys and composite materials are critical in analyzing the non-linear structural response of modern aerospace vehicles and structures. The state-of-the-art of the different structural integrity assessment and prediction methodologies (including non-destructive structural health monitoring techniques) used for the structural design, service life assessment and failure analysis of the different types of aerospace vehicles are presented. The chapters are written by experts from aerospace / defence research organizations and academia in the fields of solid mechanics, and structural mechanics and dynamics of aircraft, rocket and hypersonic systems. The book will serve as a useful reference document containing specialist knowledge on appropriate prediction methodologies for a given circumstance and experimental data acquired from multi-national collaborative programs.

Hypersonic and High Temperature Gas Dynamics The last two decades have brought two important developments for aerothermo- dynamics. One is that airbreathing hypersonic flight became the topic of technology programmes and extended system studies. The other is the emergence and maturing of the discrete numerical methods of aerodynamics/aerothermodynamics complementary to the ground-simulation facilities, with the parallel enormous growth of computer power. Airbreathing hypersonic flight vehicles are, in contrast to aeroassisted re-entry vehicles, drag sensitive. They have, further, highly integrated lift and propulsion systems. This means that viscous effects, like boundary-layer development, laminar-turbulent transition, to a certain degree also strong interaction phenomena, are much more important for such vehicles than for re-entry vehicles. This holds also for the thermal state of the surface and thermal surface effects, concerning viscous and thermo-chemical phenomena (more important for re-entry vehicles) at and near the wall. The discrete numerical methods of aerodynamics/aerothermodynamics permit now - what was twenty years ago not imaginable - the simulation of high speed flows past real flight vehicle configurations with thermo-chemical and viscous effects, the description of the latter being still handicapped by in sufficient flow-physics models. The benefits of numerical simulation for flight vehicle design are enormous: much improved aerodynamic shape definition and optimization, provision of accurate and reliable aerodynamic data, and highly accurate determination of thermal and mechanical loads. Truly mul- disciplinary design and optimization methods regarding the layout of thermal protection systems, all kinds of aero-servoelasticity problems of the airframe, et cetera, begin now to emerge.

Flight Physics Annotation There have been impressive achievements in the last few years in the technologies associated with turboramjets and other combined cycle engines. These technologies, including their thermal management and integration with the vehicle, are the principal concerns of this volume. Drawing on the expertise of international engineers and researchers in the field of high-speed vehicle propulsion systems, these articles, written by experts from the United States, Russia, Germany, Japan, Belgium, and Israel, highlight developments in the industry.

FLUID MECHANICS
Aircraft Propulsion and Gas Turbine Engines This volume contains the papers of a German symposium dealing with research and project work in numerical and experimental aerodynamics and fluid mechanics for aerospace and other applications. It gives a broad overview over the ongoing work in this field in Germany.

Hypersonic Airbreathing Propulsion Explore a thorough overview of the current knowledge, developments and outstanding challenges in turbulent combustion and application.

30th International Symposium on Shock Waves A modern treatment of hypersonic aerothermodynamics for students, engineers, scientists, and program managers involved in the study and application of hypersonic flight. It assumes an understanding of the basic principles of fluid mechanics, thermodynamics, compressible flow, and heat transfer. Ten chapters address: general characterization of hypersonic flows; basic equations of motion; defining the aerothermodynamic environment; experimental measurements of hypersonic flows; stagnation-region flowfield; the pressure distribution; the boundary layer and convective heat transfer; aerodynamic forces and moments; viscous interactions; and aerothermodynamics and design considerations. Includes sample exercises and homework problems. Annotation copyright by Book News, Inc., Portland, OR

Monitoring, Controlling and Architecture of Cyber Physical Systems

New Results in Numerical and Experimental Fluid Mechanics IV Winner of the Summerfield Book Award. The next great leap for jet propulsion will be to power-sustained, efficient flight through the atmosphere.

Combustion in High-Speed Flows Treats in detail inter-relationships between an inlet and other engine components and interactions between an installed inlet and vehicle components. The main theme and supporting examples focus on the development of fixed geometry members of the axisymmetric two-dimensional and three-dimensional families.

Fundamentals of Aircraft and Rocket Propulsion This book is a self-contained text for those students and readers interested in learning hypersonic flow and high-temperature gas dynamics. It assumes no prior familiarity with either subject on the part of the reader. If you have never studied hypersonic and/or high-temperature gas dynamics before, and if you have never worked extensively in the area, then this book is for you. On the other hand, if you have worked and/or are working in these areas, and you want a cohesive presentation of the fundamentals, a development of important theory and techniques, a discussion of the salient results with emphasis on the physical aspects, and a presentation of modern thinking in these areas, then this book is also for you. In other words, this book is designed for two roles: 1) as an effective classroom text that can be used with ease by the instructor, and understood with ease by the student; and 2) as a viable, professional working tool for engineers, scientists, and managers who have any contact in their jobs with hypersonic and/or high-temperature flow.

Jet, Rocket, Nuclear, Ion and Electric Propulsion Annotation "Design Methodologies for Space Transportation Systems is a sequel to the author's earlier text, "Space Transportation: A Systems Approach to Analysis and Design. Both texts represent the most comprehensive exposition of the existing knowledge and practice in the design and project management of space transportation systems, and they reflect a wealth of experience by the author with the design and management of space systems. The text discusses new conceptual changes in the design philosophy away from multistage expendable vehicles to winged, reusable launch vehicles and presents an overview of the systems engineering and vehicle design process as well as systems trades and analysis. Individual chapters are devoted to specific disciplines such as aerodynamics, aerothermal analysis, structures, materials, propulsion, flight mechanics and trajectories, avionics and computers, and control systems. The final chapters deal with human factors, payload, launch and mission operations, safety, and mission assurance. The two texts by the author provide a
valuable source of information for the space transportation community of designers, operators, and managers. A companion CD-ROM succinctly packages some oversized figures and tables, resources for systems engineering and launch ranges, and a compendium of software programs. The computer programs include the USAF AIRPLANE AND MISSILE DATCOM CODES (with extensive documentation); COSTMODL for software costing; OPGUID launch vehicle trajectory generator; SUPERFLO-a series of 11 programs intended for solving compressible flow problems in ducts and pipes found in industrial facilities; and a wealth of Microsoft Excel spreadsheet programs covering the disciplines of statistics, vehicle trajectories, propulsion performance, math utilities.

Discovery A nnotation A design textbook attempting to bridge the gap between traditional academic textbooks, which emphasize individual concepts and principles; and design handbooks, which provide collections of known solutions. The airbreathing gas turbine engine is the example used to teach principles and methods. The first edition appeared in 1987. The disk contains supplemental material. Annotation c. Book News, Inc., Portland, OR (booknews.com).

A dvances in A pplied M echanical Engineering This book presents select peer reviewed proceedings of the International Conference on Applied Mechanical Engineering Research (ICAMER 2019). The books examines various areas of mechanical engineering namely design, thermal, materials, manufacturing and industrial engineering covering topics like FEA, optimization, vibrations, condition monitoring, tribology, CFD, IC engines, turbo-machines, automobiles, manufacturing processes, machining, CAM, additive manufacturing, modelling and simulation of manufacturing processing, optimization of manufacturing processing, supply chain management, and operations management. In addition, recent studies on composite materials, materials characterization, fracture and fatigue, advanced materials, energy storage, green building, phase change materials and structural change monitoring are also covered. Given the contents, this book will be useful for students, researchers and professionals working in mechanical engineering and allied fields.

F oundations and Practical A pplications of Cognitive Systems and Information Processing "Foundations and Practical Applications of Cognitive Systems and Information Processing" presents selected papers from the First International Conference on Cognitive Systems and Information Processing, held in Beijing, China on December 15-17, 2012 (CSIP2012). The aim of this conference is to bring together experts from different fields of expertise to discuss the state-of-the-art in artificial cognitive systems and advanced information processing, and to present new findings and perspectives on future development. This book introduces multidisciplinary perspectives on the subject areas of Cognitive Systems and Information Processing, including cognitive sciences and technology, autonomous vehicles, cognitive psychology, cognitive metrics, information fusion, image/video understanding, brain-computer interfaces, visual cognitive processing, neural computation, bioinformatics, etc. The book will be beneficial for both researchers and practitioners in the fields of Cognitive Science, Computer Science and Cognitive Engineering. Fuchun Sun and Huaping Liu are both professors at the Department of Computer Science & Technology, Tsinghua University, China. Dr. Dewen Hu is a professor at the College of Mechatronics and Automation, National University of Defense Technology, Changsha, China.

D esign M ethodologies for Space Transportation Systems

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