

K. Takayama
A. Saso (Eds.)

Ram Accelerators

Proceedings of the
Third International Workshop
on Ram Accelerators
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Ram Accelerators

Daniel F McAuley



Ram Accelerators:

Ram Accelerators Kazuyoshi Takayama, Akihiro Sasoh, 2012-12-06 Ram accelerators are among the most advanced tools for generating fluid dynamics data in supersonic reacting systems. They require the combined action of combustion wave systems and turbulence and are still a serious challenge for physicists and engineers. This book will serve as an introductory textbook on ram accelerators and gives a thorough overview on research activities, performance modeling, and high pressure detonation dynamics.

Hypervelocity Launchers Friedrich Seiler, Ozer Igra, 2016-02-02 In the present volume numerous descriptions of Ram accelerators are presented. These descriptions provide good overview on the progress made and the present state of the Ram accelerator technology worldwide. In addition, articles describing light gas gun ballistic range including a chapter dealing with shock waves in solids are given. Along with the technical description of considered facilities, samples of obtained results are also included. Each chapter is written by an expert in the described topic providing a comprehensive description of the discussed phenomena.

Experimental Demonstration of a 120-mm Ram Accelerator, 1996 Ram acceleration is an emerging propulsion technology in which a projectile similar in shape to the centerbody of a ramjet aircraft engine is injected at high speed into a tube filled with a combustible gaseous mixture. As the projectile moves into the tube under supersonic conditions, shocks occur on and around the projectile. If the gases are then ignited either by the energy in the shock system or an external mechanism, the combustion around or behind the projectile can be self-sustaining. The net effect is to generate a localized high pressure region around and/or behind the projectile which produces acceleration. Work at the University of Washington, Seattle has demonstrated velocities in excess of 2.6 km/s in 38 mm caliber while theory predicts velocities above 7 km/s may be obtainable. The first successful ram acceleration experiment at 120 mm caliber is presented. Performance at this larger caliber was as predicted from scaling considerations. Reported experiments have shown that propellant mixing by partial pressure is a viable alternative to more complex mixing schemes for obtaining homogeneous propellant mixtures in ram accelerators. The usefulness of inert firings to analyze obturator performance and shock pressure structure in ram accelerators has been further validated. Finally, the scaling potential of ram acceleration has been firmly established with the first successful test at 120 mm caliber.

RAMAC-IV P. Bauer, 2000

Second International Workshop on Ram Accelerators, 1995 RAMAC II is the second in a series of workshops on the topic of the ram accelerator, a hypervelocity projectile launcher concept based on ramjet-in-tube principles. The first RAMAC workshop was held in September 1993 at ISL, the French-German Research Institute in Saint-Louis, France, and its success prompted the organization of regular biennial meetings among researchers in this field.

Experimental Investigation of Baffled Tube Ram Accelerator Operational Characteristics Colin Hugh Hambling, 2017 An experimental investigation of the baffled tube ram accelerator operational characteristics is presented. The ram accelerator is a novel hypervelocity launcher concept wherein a sub-caliber projectile, as it travels through a stationary tube filled with a premixed fuel and oxidizer,

initiates and sustains a combustion wave generating continuous thrust A quasi steady one dimensional blackbox model is used to predict the acceleration and thus the thrust generation of the smooth bore thermally choked ram accelerator propulsive mode The baffled tube ram accelerator is a modern spin on the smooth bore ram accelerator Designed to contain a forward surging combustion wave the baffled tube ram accelerator permits the use of highly energetic propellants and up to a certain degree prevents the limiting condition of an unstart from occurring Smooth bore ram accelerator operation is bound by three gas dynamic limits a minimum Mach number required to keep the diffuser started a minimum heat release required to keep the normal shock on the body and lastly a maximum heat release beyond which the normal shock will be driven over the projectile Due to the simple fact that the baffled tube ram accelerator is designed to expand these limits difficulties arise when attempting to accurately predict the performance using the previously mentioned blackbox model Prior experiments at the UW have attempted to develop a model better fit to understand operation in the baffled tube This investigation is motivated by the need for empirical data to find correlation between performance models and experimental work all with the intent to push the baffled tube ram accelerator closer to real world applications A new series of approximately 30 firings is presented to explore the unknown operational envelope of a methane oxygen nitrogen propellant mixture Both entrance velocity of the projectile and heat release of the propellant were varied to map the initial experimental envelope of operation Within the scope of this experimental investigation the limits of the baffled tube ram accelerator running a methane oxygen nitrogen propellant mixture have been identified and the operational characteristics at and around these limits have been explored Furthermore concerns regarding the structural integrity of two part and or hollow projectiles were suppressed through a sub series of experiments This opened doors in to new possibilities for projectile design and configuration Ultimately the results suggest the need for future work as the baffled tube ram accelerator envelope of operation has yet to be fully developed However the results also highlight great potential in the application of ram accelerators An experimental investigation of the baffled tube ram accelerator operational characteristics is presented The ram accelerator is a novel hypervelocity launcher concept wherein a subcaliber projectile as it travels through a stationary tube filled with a premixed fuel and oxidizer initiates and sustains a combustion wave generating continuous thrust A quasi steady one dimensional blackbox model is used to predict the acceleration and thus the thrust generation of the smooth bore thermally choked ram accelerator propulsive mode The baffled tube ram accelerator is a modern spin on the smooth bore ram accelerator Designed to contain a forward surging combustion wave the baffled tube ram accelerator permits the use of highly energetic propellants and up to a certain degree prevents the limiting condition of an unstart from occurring Smooth bore ram accelerator operation is bound by three gas dynamic limits a minimum Mach number required to keep the diffuser started a minimum heat release required to keep the normal shock on the body and lastly a maximum heat release beyond which the normal shock will be driven over the projectile Due to the simple fact that the baffled tube ram

accelerator is designed to expand these limits difficulties arise when attempting to accurately predict the performance using the previously mentioned blackbox model Prior experiments at the UW have attempted to develop a model better fit to understand operation in the baffled tube This investigation is motivated by the need for empirical data to find correlation between performance models and experimental work all with the intent to push the baffled tube ram accelerator closer to real world applications A new series of approximately 30 firings is presented to explore the unknown operational envelope of a methane oxygen nitrogen propellant mixture Both entrance velocity of the projectile and heat release of the propellant were varied to map the initial experimental envelope of operation Within the scope of this experimental investigation the limits of the baffled tube ram accelerator running a methane oxygen nitrogen propellant mixture have been identified and the operational characteristics at and around these limits have been explored Furthermore concerns regarding the structural integrity of two part and or hollow projectiles were suppressed through a sub series of experiments This opened doors in to new possibilities for projectile design and configuration Ultimately the results suggest the need for future work as the baffled tube ram accelerator envelope of operation has yet to be fully developed However the results also highlight great potential in the application of ram accelerators

30th AIAA/ASME/SAE/ASEE Joint Propulsion Conference ,1994 [32nd AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit ,1996](#) **34th AIAA/ASME/SAE/ASEE Joint Propulsion Conference & Exhibit ,1998** **33rd Aiaa/Asme/Sae/Asee Joint Propulsion Conference & Exhibit ,1997** **40th AIAA Aerospace Sciences Meeting & Exhibit ,2002** **35th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit ,1999** **Theoretical Performance Model and Initial Experimentation of a Baffled-tube Ram Accelerator** Jeffrey F. Glusman,2016

The baffled tube ram accelerator is an innovation in hypervelocity launch technology that allows the acceleration of axisymmetric projectiles in the velocity range of 500 to 3000 meters per second This device has the potential to double the thrust performance of the conventional smooth bore ram accelerator while reducing its minimum starting velocity The baffled tube ram accelerator utilizes a series of internal baffles to suppress the forward surge of a combustion driven shock wave thus enabling operation in propellants having two to three times the energy release of those used with conventional smooth bore ram accelerators An experimental and theoretical investigation of this device is currently on going at the University of Washington Operation at velocities between 620 and 1220 meters per second has been demonstrated to date Theoretical modeling indicates that momentum loss due to baffle interactions is a key factor in the baffled tube ram accelerator which reduces its performance Nevertheless baffled tube experiments have demonstrated thrusts 30 100 % greater than that of a smooth bore ram accelerator operating at the same fill pressure The design modeling and experimental results from a 38 mm bore two meter long baffled tube ram accelerator apparatus are presented

Transactions of the Japan Society for Aeronautical and Space Sciences ,1997 *Photoshop 4 for Macintosh*
Elaine Weinmann,Peter Lourekas,1997 Used as a standard textbook in countless classrooms and as a table top reference by

freelance computer artists everywhere this Visual Quickstart Guide is the book that explains Photoshop techniques clearly and quickly color insert

Modern Developments in Energy, Combustion, and Spectroscopy Forman Arthur Williams, 1993 This compendium is dedicated to Professor Stanford Solomon Penner in celebration of his seventieth birthday The authors are his former students associates and friends who have been profoundly influenced by him primarily as a consequence of the example he set forth by his own work and habits as well as by the leadership he provided in many technological endeavours As one of the most prominent scientists of our times he has been particularly instrumental in advancing the frontiers of combustion technology while concomitantly developing quantitative spectroscopy into a significant diagnostic discipline and assuming a world renown position of leadership in energy issues This book consists of papers in the fields of energy combustion and spectroscopy subjects resplendent with his pioneering contributions Among the topics included here are turbulent combustion flame structure detonation spectroscopic diagnostics spectroscopy of atmospheric gases and physical problems associated with nuclear reactors as well as electric power distribution and energy conservation Contained here also is his remarkable curriculum vitae and the formidable list of his publications The editors take this opportunity of conveying to him their best wishes for continuing productive scholarship the trademark of his life for many years to come

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Table of Contents Ram Accelerators

1. Understanding the eBook Ram Accelerators
 - The Rise of Digital Reading Ram Accelerators
 - Advantages of eBooks Over Traditional Books
2. Identifying Ram Accelerators
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Ram Accelerators
 - User-Friendly Interface
4. Exploring eBook Recommendations from Ram Accelerators
 - Personalized Recommendations
 - Ram Accelerators User Reviews and Ratings
 - Ram Accelerators and Bestseller Lists

5. Accessing Ram Accelerators Free and Paid eBooks
 - Ram Accelerators Public Domain eBooks
 - Ram Accelerators eBook Subscription Services
 - Ram Accelerators Budget-Friendly Options
6. Navigating Ram Accelerators eBook Formats
 - ePub, PDF, MOBI, and More
 - Ram Accelerators Compatibility with Devices
 - Ram Accelerators Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Ram Accelerators
 - Highlighting and Note-Taking Ram Accelerators
 - Interactive Elements Ram Accelerators
8. Staying Engaged with Ram Accelerators
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Ram Accelerators
9. Balancing eBooks and Physical Books Ram Accelerators
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Ram Accelerators
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Ram Accelerators
 - Setting Reading Goals Ram Accelerators
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Ram Accelerators
 - Fact-Checking eBook Content of Ram Accelerators
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

-
- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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