Military Laser Technology For Defense Technology For Revolutionizing 21st Century Warfare

This unique book reviews man-portable air defense system missile and countermeasure capabilities, weapon proliferation trends, and the impact on global mobility operations through 2025. Man-portable air defense systems are threatening places of the world where mobility operations occur daily and the U.S has spent billions of dollars trying to counter their effects to little avail. The continued ability to project and apply joint U.S. military power is jeopardized without suitable defensive systems for military and civilian mobility aircraft. Breakthroughs in laser and microwave weapon technologies are described and represent the best opportunity for transformational progress against these missile threats. Developing these technologies will ensure the U.S. has the capabilities to defeat the projected threats using a mix of ground-based and aircraft-based defensive systems to smartly defend all U.S. and coalition transport and tanker aircraft. This paper recommends changes to strategy, technology development, and doctrine to meet this force protection and projection challenge. CHAPTER I * INTRODUCTION * CHAPTER II * THE THREAT TO THE GLOBAL MOBILITY SYSTEM * Global Mobility System * Global Mobility Concept of Operations * Who is Responsible to Defend Against These Threats? * Who Has These Weapons? * Strategic and Operational Implications * Summary and Recommendations * CHAPTER III * MANPADS MISSILE AND COUNTERMEASURES TECHNOLOGIES * MANPADS at Work: Mechanics of the Kill * Missile Components: Present and Future * Current Countermeasure Technology Program and Investments * Mid-Term Countermeasure Technologies-MEDUSA * Future Programs: Hard-Kill Lasers * Radio Frequency Weapons * Summary and Recommendations * CHAPTER IV * TWO STRATEGIES TO DEFEAT MANPADS THREATS * Aircraft-Based Countermeasures System * Ground-Based Countermeasures System * Summary and Recommendations * CHAPTER V * CONCLUSIONS AND RECOMMENDATIONS * APPENDIX A * LIST OF NATIONS WITH MANPADS Man-portable air defense system threats are not a Middle-East phenomenon; mobility aircraft face increasing surface-to-air threats in all regions of the world. The Federal Bureau of Investigation (FBI) reports that there have been 29 instances in which civilian transport planes crashed after being hit by shoulder-fired missiles, causing up to 550 deaths. These include attacks on transports in Columbia, Angola, Congo, Chechnya, Sri Lanka, and Kosovo. Jane's Intelligence Review reported seven military transports were downed and another one struck by non-state use of man-portable air defense system (MANPADS) missiles from 1996 to 2001. The nature of the threat environment mobility assets face can be broadly categorized into three levels. The first includes the use of small to medium-caliber automatic weapons, up to 14.5-millimeter heavy machine guns, and infrared (IR) guided man-portable air defense systems. This level is characterized by the use of enemy-controlled agents, sympathizers, and terrorists. The next threat level includes more advanced, short to medium-range radar-guided anti-aircraft artillery and surface-to-air missiles. These systems are associated with regular combat units and more traditional nation-states. The final threat level, consisting of a sophisticated enemy air defense system with integrated high performance surface-to-air missiles and air interceptors, represents a major theater war scenario with a near-peer competitor. Currently only a few nation-states could present this most advanced level of threat.

The U.S. military is one of the largest and most complex organizations in the world. How it spends its money, chooses tactics, and allocates its resources have enormous implications for national defense and the economy. The Science of War is the only comprehensive textbook on how to analyze and understand these and other essential problems in modern defense policy. Michael O'Hanlon provides undergraduate and graduate students with an accessible yet rigorous introduction to the subject. Drawing on a broad range of sources and his own considerable expertise as a defense analyst and teacher, he describes the analytic techniques the military uses in every crucial area of military science. O'Hanlon explains how the military budget works, how the military assesses and deploys new technology, develops strategy and fights wars, handles the logistics of stationing and moving troops and equipment around the world, and models and evaluates battlefield outcomes. His modeling techniques have been tested in Iraq and Afghanistan, including the methods he used to predict higher-than-anticipated troop fatalities in Iraq--controversial predictions that have since been vindicated. The Science of War is the definitive resource on warfare in the twenty-first century. Gives the best introduction to defense analysis available Covers defense budgeting Shows how to model and predict outcomes in war Explains military logistics, including overseas basing Examines key issues in military technology, including missile defense, space warfare, and nuclear-weapons testing Based on the author's graduate-level courses at Princeton, Columbia, and Georgetown universities

Recent advances in ultra-high-power lasers, including the free-electron laser, and impressive airborne demonstrations of laser weapons systems, such as the airborne laser, have shown the enormous potential of laser technology to revolutionize 21st century warfare. Military Laser Technology for Defense, includes only unclassified or declassified information. The book focuses on military applications that involve propagation of light through the atmosphere and provides basic relevant background technology. It describes high-power lasers and masers, including the free-electron laser. Further, Military Laser Technology for Defense addresses how laser technology can effectively mitigate six of the most pressing military threats of the 21st century: attack by missiles, terrorists, chemical and biological weapons, as well as difficulty in imaging in bad weather and threats from directed beam weapons and future nuclear weapons. The author believes that laser technology will revolutionize warfare in the 21st century.

Proceedings of SPIE present the original research papers presented at SPIE conferences and other high-quality conferences in the broad-ranging fields of optics and photonics. These books provide prompt access to the latest innovations in research and technology in their respective fields. Proceedings of SPIE are among the most cited references in patent literature.

This authoritative new resource provides an overview of the deployment of various devices in systems in actual field conditions and efficacy established in warfare. The book covers laser and optronic technologies that have evolved over the years to build practical devices and systems for use in Homeland Security and low-intensity conflict scenarios. Readers will be able to assess combat and battle-worthiness of various available devices and systems. This book covers state-of-the-art and emerging trends in various optoelectronics technologies having applications in Homeland Security. It provides information on operational aspects, deployment scenarios, and actual usage of laser and optoelectronics based technologies for low intensity conflicts, offering insight into the utility of each technology/device for a given operational requirement. This book evaluates the merits of various laser and optoelectronic sensor based technologies intended for low intensity conflict operations, including counter-insurgency and anti-terrorist operations. It is a useful reference for those specializing in defense electronics and optronics and professionals in the defence industry involved in operation and maintenance of laser based security equipment. Packed with tables, photographs, and a comprehensive list of references in every chapter, this is the only book that covers all topics related to Laser and Optoelectronics devices intended for low intensity conflict operations in a single volume.

Some vols. include supplemental journals of "such proceedings of the sessions, as, during the time they were depending, were ordered to be kept secret, and respecting which the injunction of secrecy was afterwards taken off by the order of the House".

This book examines emerging defense technologies such as directed energy weapons, nanotech devices, and bioscience applications that have the potential to dominate international relations in the future, just as nuclear weapons and space infrastructure-assisted conventional weapons do now.

It is imperative the United States (US) accelerate its development within the field of directed energy weapons and guard against the emergence of hypersonic threats. Hypersonic weaponry shifts the strategic calculus of U.S. decision makers, increases stand-off capabilities and alters the deterrence equation of international actors. Directed energy weapons offer a feasible approach countering the proliferation of hypersonic threats to the homeland, safeguards the decision space of our nation's leaders and potentially strengthens military, diplomatic and economic instruments of power simultaneously.This compilation includes a reproduction of the 2019 Worldwide Threat Assessment of the U.S. Intelligence Community.Speed and agility are key components in hypersonic weapons and the proliferation of such a capability will drastically alter warfare; therefore, an agile and integrated defense posture provides a feasible response to emerging hypersonic threats. As an alternative to counter hypersonic weapons, directed energy weapons have increased in capability recently and offer a valid response these weapons. Directed energy weapons range from various types of lasers to microwave weapons. R&D breakthroughs with free electron and fiber lasers have increased laser power while reducing size for military applications. The military has begun to realize the potential advantages directed energy weapons offer combat systems and increased R&D into directed energy defense systems like the U.S. Navy exemplify the possibility of a feasible offset strategy against hypersonic missiles.The U.S. Navy has deployed a directed energy weapon onboard the U.S.S. Ponce in 2014 and intends to increase future laser defense systems to 150 kilowatts (kW).10 The Laser Weapons System (LaWS) is currently capable of targeting drones with a power output of 30 kW. The U.S. Navy plans to increase LaWS's power and could potentially boost its capabilities to an anti-ship weapon. Innovations in laser technology enable the military capability to target, track and concentrate intense energy on aircraft and flying weapons today. Hypersonic missiles construct a difficult problem for any defensive system and if they are required to intercept an ICBM; they may need to be forward deployed in order to target the vehicle in the boost phase of flight. The U.S. military will need a defensive system adaptive enough to intercept ICBMs and other hypersonic vehicles like cruise missiles in the near future. A collaborative effort of commercial and public funded R&D will produce the best opportunity for a game changing technological breakthrough in directed energy weapons like the latest laser innovations over the past decade.

A number of experiments carried out in the last two decades, have led to the development of lasers as the next generation weapon system. A number of defense companies are carrying out research in this field and have achieved varying degrees of progress in constructing a high energy weapon. Laser technology has observed great scientific developments and engineering improvements that make it usable for various commercial, industrial, medical and scientific applications. There is variety of lasers available in the market today with different wavelengths, spectral bandwidth, power levels, operating efficiencies and temporal characteristics. This increasing maturity of lasers and compact optical systems has enhanced their capabilities for military operations. Military officials have indubitably always been interested in laser technology, even before the first laser was invented. Especially, since these devices can bring technological revolution in warfare, when used as range- finders, target designation, sensors, active illumination, data relay devices, directed energy weapons, weather modifier and much more.This book will be of valuable to students and practicing engineers providing with practical study of laser applications, used by the military, to carry out tactical operations on the ground or space-based platforms.

This STAR proposes an innovative program in laser technology, one that will bring optical manufacturing closer to the automated processes characteristic of the electronics industry. The basic goals will be to obtain higher efficiency, lower cost, and more reliable lasers. If this effort is successful, it should be possible to make well integrated, monolithic, inexpensive laser systems that are also rugged, stable and long-lived. Many current Department of Defense (DoD) mission areas require battlespace sensors and directed energy solutions. Vital military laser applications include range finders, illuminators, beam riders, and designators, and laser radar. Recent DoD studies (such as LASSOS: Lasers and Space Optical Systems and DE-ATAC: Directed Energy Advanced Tactical Airborne Combat) describe the key enabling laser technologies needed in the future as a) agile multi-wavelength lasers and b) high efficiency electric lasers. Important mission areas include countermeasures, chemical warfare agent detection and identification, nighttime imaging, tunnel and underground structure detection, and tactical directed energy weapons. These laser systems need to be efficient, compact, lightweight, inexpensive, easily transportable and maintainable, rugged, reliable, and capable of operation in widely diverse environments. Unfortunately, current lasers often do not meet many of these requirements. To meet these requirements, a new generation of solid-state laser technology is necessary. The basic goal of a successful program in military solid-state lasers should be the improvement, over the next five years, of a factor of three or more in many of the parameters that define the operational capability of these systems.

The papers included in this volume comprise research from participants in the 2018 Nuclear Scholars Initiative and the Project on Nuclear Issues (PONI) Conference Series. PONI sponsors this research to provide a forum for facilitating new and innovative thinking and to provide a platform for emerging thought leaders across the nuclear enterprise.

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HELSTF is the most comprehensive site in the United States capable of supporting directed energy technologies for the DoD, other government agencies, industry, and academia. HELSTF represents a national investment of approximately $800 million in high energy laser technology. As a result of the existing laser technologies and supporting infrastructure, which have an established record of successful and innovative laser testing, research, and development, HELSTF is an important national asset to support continued laser technologies. It is imperative that our nation's military and scientific communities have access to up-to-date facilities for increasingly complex research, development, testing, and evaluation of new and existing laser technologies. National defense also requires that foreign laser technologies be evaluated to counter threats to U.S. and Allied deployed forces. The purpose of the Proposed Action is to enhance the capability of HELSTF in order to better accommodate a more comprehensive suite of lasers, beam directors, sensors, associated equipment, meteorological equipment, multiple test areas, and pointing and tracking systems. The Proposed Action is needed for HELSTF to remain technologically competitive in directed energy development and to provide a comprehensive test facility for all aspects of military laser technology.

The United States Army is looking for ways to defend against missile and mortar attacks. In this book, the National Research Council assesses a plan to create a 100 kW mobile, solid-state, laser weapon that could defend an area several kilometers in diameter. The NRC provides several recommendations: A 100 kW Laser is of limited value, so the program's goal should be a 400 kW weapon. The Army should proceed with the program in stages, focusing first on a rugged transportable platform for the weapon using existing 25 kW laser technology, then directing resources toward 100kW and 400 kW weapons. The Army should perform a detailed, quantitative study of the effectiveness of a high energy, solid-state laser weapon against future threats. The Army should continue to participate in U.S.-based and

international research on high-energy lasers and related equipment. The committee found substantial benefits for the Army's solid-state laser program from other programs outside the Army. The Army should conduct risk-assessments that investigate the effects that a high energy laser may have on other airborne platforms in the vicinity of the target. The Army should study eye safety for both the operators of the laser and for civilians. The results of these studies should be integrated into the development of the weapon.

This paper describes the achievements in research and development of laser military equipment technology at North China Research Institute of Photoelectric Technology (NCRIEO) in recent years.

In a rapidly changing world, there needs to be a critical reappraisal of traditional military/industry relationships. This book, packed with data, industry-specific case studies, and sophisticated analysis, is such an appraisal. It will be required reading for technology managers and policymakers in industry and government, as well as those concerned with technological and economic competitiveness.

Military laser systems are significantly different from commercial ones. The Department of Defense (DoD) has supported a large laser research-and-development budget, which has resulted in a rich diversity of military laser systems, ranging from the latest nonlinear technology to eye-safe, low-cost, laser-ranging binoculars. This paper reviews the military interests that created the diversity of laser systems, describes some of the more significant developments, and discusses some of the military lasers that can be expected in the future. Military interest in laser systems has been concentrated in four general areas: laser rangefinders and target designators, directed-energy weapons, laser radar, and laser communications. Although the nature of this interest is different from that in the commercial world, DoD funding has enabled significant laser systems to be advanced from laboratory curiosities to reliable and relatively inexpensive commercial successes.

A catalog of dental research projects sponsored by federal and non-federal organizations.

This new resource provides an insight into the physical principles of the device technology that underpins many laser-based military systems in one form or another. From this knowledge a deeper understanding of the fundamental requirements and the potential performance, as well as limitations of such systems may be assessed, given the appropriate operational parameters. Engineers and students are provided with practical advice on how to evaluate laser devices and systems, operate them safely, and train with them.

Infrared and laser technology is widely used in aviation and space, in reconnaissance, remote sensing and remote metering, missile warning, aircraft night vision and night navigation, and plays an important role in target detection, identification and tracking, aiming and precision guidance as well as communications. Their application can greatly increase the precision of weapons systems, increase ECM capabilities, counter stealth capabilities, counter surface object interference capabilities, greatly reduce costs, and increase the effectiveness of weapons systems. Therefore, they are recognized as power multipliers for the weapons with which the military is equipped. The military of all countries are playing serious attention to developments in infrared and laser technology, especially the development of elements, components and their basic technology. For example, of the 11 different key technologies of the United States Defense Science and Technology, 1.162 billion dollars was invested in optics and electronics (primarily composed of infrared and laser technologies) durirg the years 1992, 1993 and 1994 (not including SDI). This constituted 13 percent of all investments in key technologies during these three years.

United States Statutes at Large, Containing the Laws and Concurrent Resolutions Enacted During the First Session of the One Hundred Sixth Congress of the United States of America, 1999, and Proclamations, V. 113 in Three Parts. Spine title reads: United States Statutes at Large, 106th Congress, 1st Session, 1999, V. 113, Pt. 1-3, Public Laws. Includes Public Laws 106-1 through 106-170. 106th Congress, 1st Session.

This paper presents high-energy CW HF/DF chemical lasers developed under the U.S. Navy Sealite program and the Alpha program of the DARPA Triad program, and a brief account of Soviet chemical lasers. Continuous wave HF/DF chemical lasers were developed starting in the late sixties as high-power lasers of consistent interest to military circles. These are lasers that have the most matured technology among present-day high-energy lasers. It is hoped that in the near future CW HF/DF chemical lasers can be developed into a space laser weapon to deal with ICBMs. CW HF/DF chemical lasers are an integration of technologies in gas dynamics, chemistry, fluid chemistry, optics, and lasers. By using the branching chain reaction of heat liberation, inversion of the population ratio is generated to obtain lasers.

"The introduction of directed energy weapons into twenty-first century naval forces has the potential to change naval tactics as fundamentally as the transition from sail to steam. Recent advances in directed energy technologies have made the development of both high-energy laser and high-power microwave weapons technically feasible. This study examines the potential adaptation of such weapons for the defense of naval forces. This study considers options for using directed energy systems on naval vessels in the context of the U.S. maritime strategy and emerging threats in international politics. The framework for this study is an integrated system of microwave devices, high-energy lasers, and surfact-to-air missiles which are evaluated in terms of their ability to enhance anti-ship cruise missile defense, tactical air defense, and fast patrol boat defense. This study also examines collateral capabilities, such as non-lethal defensive measures and counter-surveillance operations. The global proliferation of increasingly sophisticated weapons and the expanding demands placed on its ever-smaller navy require the United States to reassess its current approach to fleet operations. This study concludes that directed energy technology has made sufficient progress to warrant the development of sea-based weapons systems for deployment in the first two decades of the next century. For operational and technical reasons, a Nimitz class aircraft carrier may be the preferred platform for the initial implementation of directed energy weapons. If successful, the robust self-defense capability provided by directed energy weapons will permit a fundamental shift in carrier battle group operations from a massed, attrition-oriented defense to a more dynamic, dispersed offense."--Page iv.

Navy officials announced in April 2013 that a solid-state laser would be deployed onboard the U.S.S. Ponce, providing the first at-sea demonstration of a revolutionary directed energy weapon. The demonstration is part of a wider portfolio of near-term Navy directed energy programs that promise rapid fielding, demonstration and prototyping efforts for shipboard, airborne and ground systems. The Office of Naval Research (ONR) and Naval Sea Systems Command recently performed demonstrations of high-energy lasers aboard a moving surface combatant ship, as well as against remotely piloted aircraft. Through careful planning of such demonstrations and by leveraging investments made through other DoD agencies, researchers have been able to increase the ruggedness, power and beam quality of lasers, more than doubling the range of the weapons. This book includes a detailed report on the laser program, Navy Shipboard Lasers for Surface, Air, and Missile Defense: Background and Issues for Congress. Contents include: Scope, Sources, and Terminology * Background * Shipboard Lasers in General * Potential Advantages and Limitations of Shipboard Lasers * Potential Targets for Shipboard Lasers * Required Laser Power Levels for Countering Targets * Types of Lasers Being Developed for Potential Shipboard Use * Fiber Solid State Lasers (Fiber SSLs). * Slab Solid State Lasers (Slab SSLs) *

Free Electron Lasers (FELs) * Navy Surface Fleet's Generalized Vision for Shipboard Lasers * Remaining Technical Challenges * ONR Solid-State Laser Technology Maturation Effort * Naval Directed Energy Steering Group * Directed Energy Vision for U.S. Naval Forces * Destroyers and LCSs Reportedly Leading Candidate Platforms * FY2012 Congressional Report Language * FY2012 National Defense Authorization Act (H.R. 1540/P.L. 112-81) * FY2012 Military Construction and Veterans Affairs and Related Agencies * Appropriations Act (H.R. 2055/P.L. 112-74) * FY2013 Funding Request * Issues for Congress * Program of Record and Roadmap * Arguments Against Developing a Roadmap or Program of Record. * Arguments Supporting Developing a Roadmap or Program of Record * Number of Laser Types to Continue Developing * Potential Strategies * Relative Merits of Laser Types * Implications for Ship Design and Acquisition * Options for Congress * Legislative Activity for FY2013 * FY2013 Funding Request. "The future is here," said Peter A. Morrision, program officer for ONR's Sold-State Laser Technology Maturation Program. "The solid-state laser is a big step forward to revolutionizing modern warfare with directed energy, just as gunpowder did in the era of knives and swords." Officials consider the solid-state laser a revolutionary technology that gives the Navy an extremely affordable, multi-mission weapon with a deep magazine and unmatched precision, targeting and control functions. Because lasers run on electricity, they can be fired as long as there is power and provide a measure of safety as they don't require carrying propellants and explosives aboard ships.