MASTER OF SCIENCE
IN
APPLIED PHYSICS

A STUDY OF THE DESIGN AND ANALYSIS PROCESS OF A PROPOSED HYPERSONIC TACTICAL MISSILE
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The design and analysis process used in the design of a typical tactical missile is shown. The discussion primarily emphasizes the design of the airframe and propulsion system, but other components such as the guidance and control system and warhead are also addressed. A basic mission objective was identified, which was to develop an air-launched missile capable of striking a ground target at ranges of 400 to 600 NM, with a hypersonic tactical cruise missile. A range of payload weights were traded off against the amount of fuel that could be carried. The airframe was developed primarily by using the Missile DATCOM code to develop the aerodynamics, but the Aero-Prediction (AP) 98 code was also used. It is shown that results from the two codes agree well when the base drag correction is properly accounted for in both codes.

The flight performance was developed by using the TAME three-degrees-of-freedom missile performance analysis code. Performance data are shown for a total of thirty-five different missile configurations that were analyzed, and results are presented. This thesis suggests that the use of these computational codes is the way of future missile designs, shortening the design time length and greatly reducing the costs involved.

DoD KEY TECHNOLOGY AREAS: Air Vehicles, Computing and Software, Modeling and Simulation

KEYWORDS: Missiles, Design and Analysis, Computational Aerodynamics, Hypersonic Vehicles

CALIBRATION AND ALGORITHM DEVELOPMENT FOR SPLIT-FIELD POLARIMETER
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The NPS designed split-field polarimeter was previously constructed to exploit the elimination of polarized radiation reflected/emitted from the sea to improve target to background contrast in infrared images. This thesis investigates the development of a calibration algorithm for the split-field polarimeter to allow quantitative comparison of the orthogonally polarized images. Calibration requires knowledge of the effect of the additional optical elements along the path of radiance, which combine to form an optical transfer function. Laboratory measurement of the internal radiation sources within the polarimeter was accomplished through the introduction of external polarizing filters to isolate each optical element.

Numerical evaluation of a series of measurements made in the laboratory resulted in apparent radiance values for each optical element within the NPS split-field polarimeter. Analysis of these values to determine an algorithm for the absolute calibration of the split-field polarimeter yielded inconclusive results.

DoD KEY TECHNOLOGY AREAS: Electronics, Sensors

KEYWORDS: Thermal Imaging, Polarization, Infrared Radiation, Split-Field Polarimeter

ROOM DE-REVERBERATION USING TIME-REVERSAL ACOUSTICS

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This thesis probes the performance of one-channel time-reversal acoustics in a chamber in terms of the geometry of the cavity. In particular, a rectangular chamber is compared to an enclosure that has a stadium shape. The mode structure in the rectangular cavity is highly symmetric, while it is highly irregular in the stadium-shaped cavity. Time-reversal acoustic techniques produce an improved focus in the latter. The focusing quality is determined as a function of frequency, time-reversal window size, and spatial extent. A scheme for encrypted acoustic communication, both in air and underwater, that uses multiple broadband signals with identical bandwidth, Hanning window source spectra, and center frequencies separated by half the bandwidth, allowing for null detection between adjacent signals, is successfully investigated.

DoD KEY TECHNOLOGY AREAS: Sensors, Other (Signal Processing)

KEYWORDS: Time-Reversal Acoustics, Acoustic Communications, Acoustic Signal Processing, Reverberation, De-Reverberation