Regierung gibt Flache Erde zu!

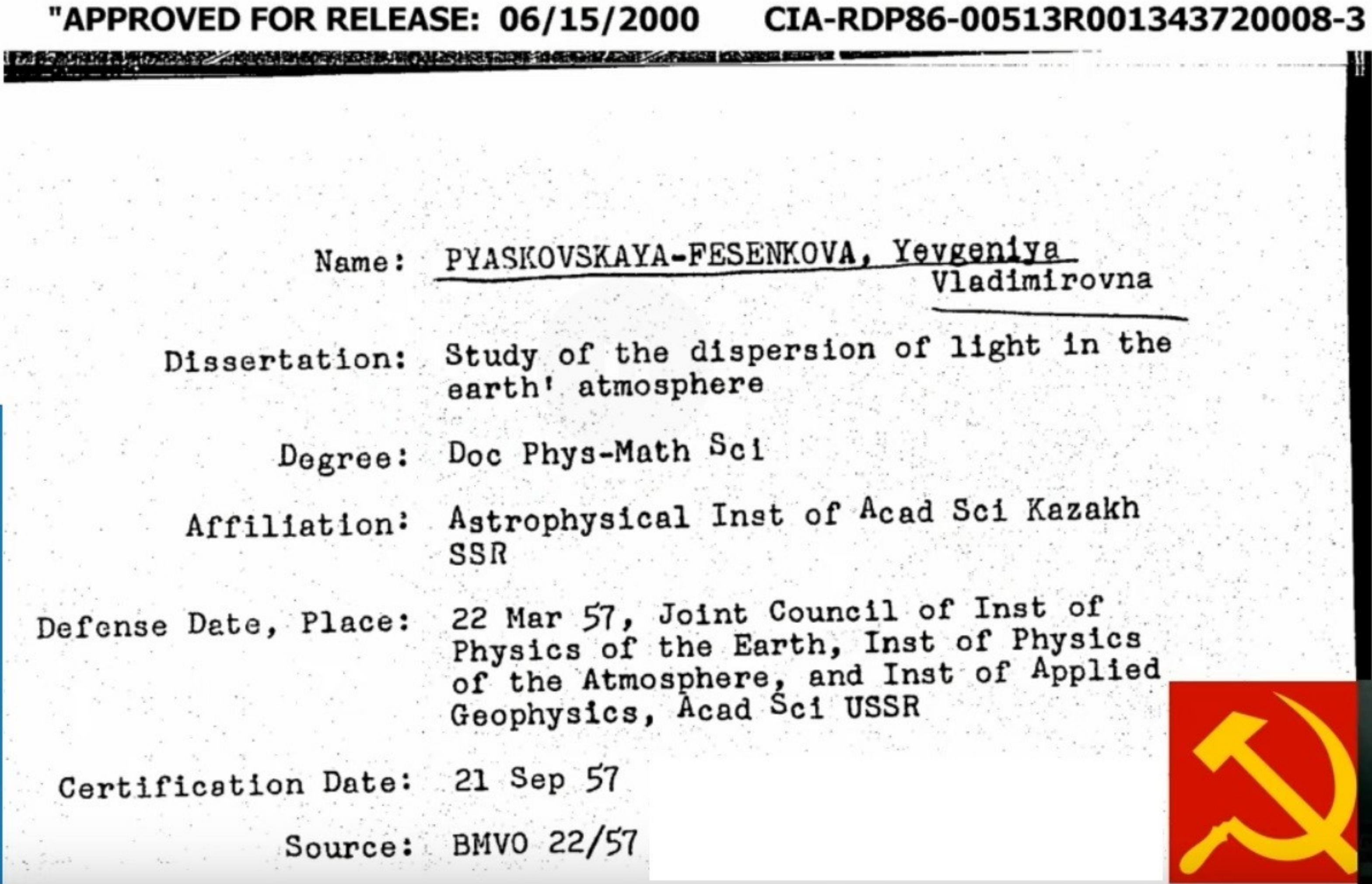
In vielen Regierungsdokumenten sind
Unzählige Hinweise das die
Erde Flach ist .

Regierung gibt Flache Erde zu: Dok #1

Title: Dissertations Defended in the Scientific Council of the Institute of Physics of the Earth

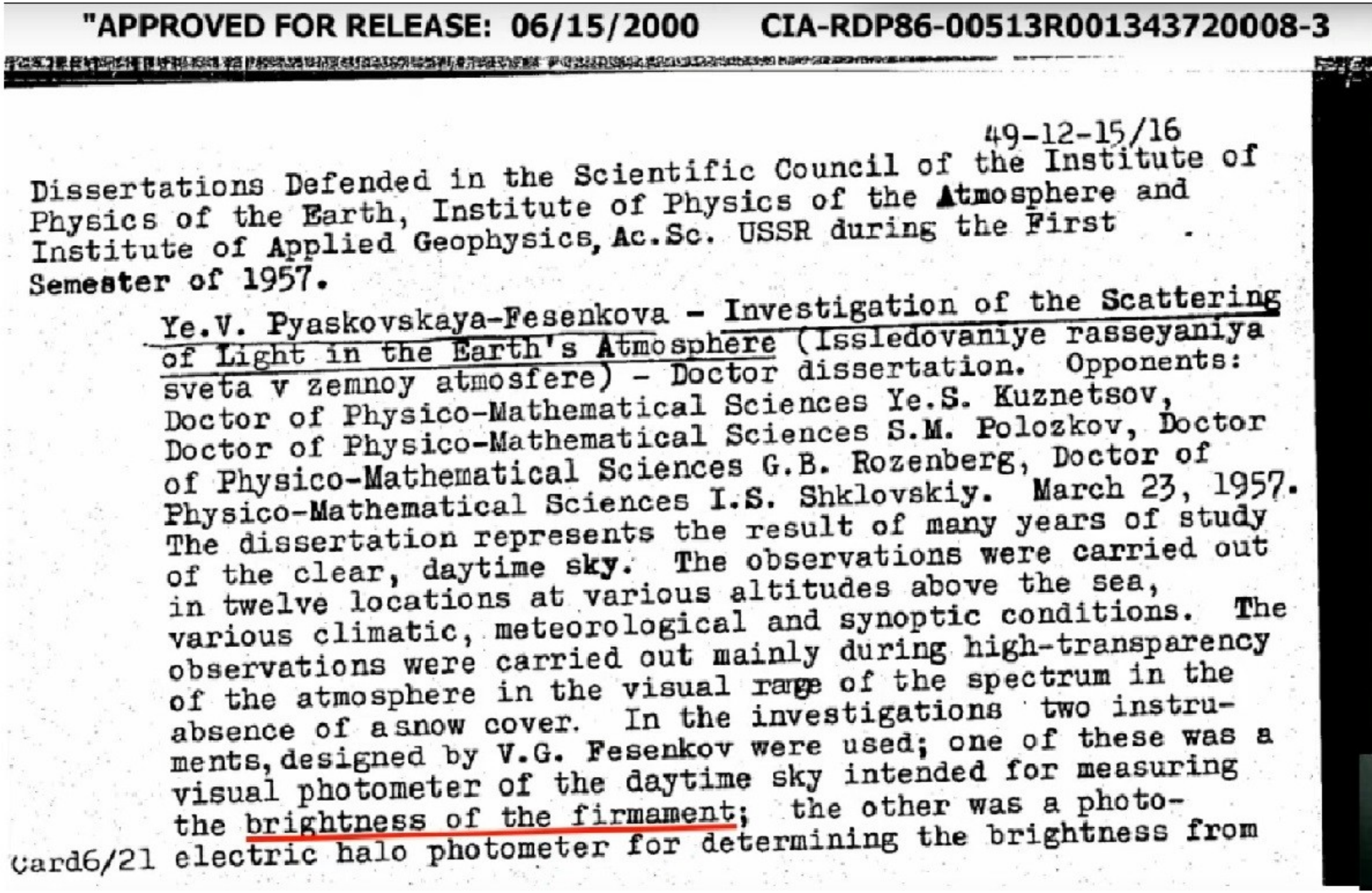
Author: Kirillov, F.A.

URL: https://www.cia.gov/library/readingroom/docs/CIA-RDP86-00513R001343720008-3.pdf



"APPROVED FOR RELEASE: 06/15/2000 CIA-RDP86-00513R001343720008-3

Name:	PYASKOVSKAYA-FESENKOVA, Yevgeniya Vladimirovna
Dissertation:	Study of the dispersion of light in the earth' atmosphere
Degree:	Doc Phys-Math Sci
Affiliation:	Astrophysical Inst of Acad Sci Kazakh SSR
Defense Date, Place:	22 Mar 57, Joint Council of Inst of Physics of the Earth, Inst of Physics of the Atmosphere, and Inst of Applied Geophysics, Acad Sci USSR
Certification Date:	21 Sep 57
Source:	BMVO 22/57

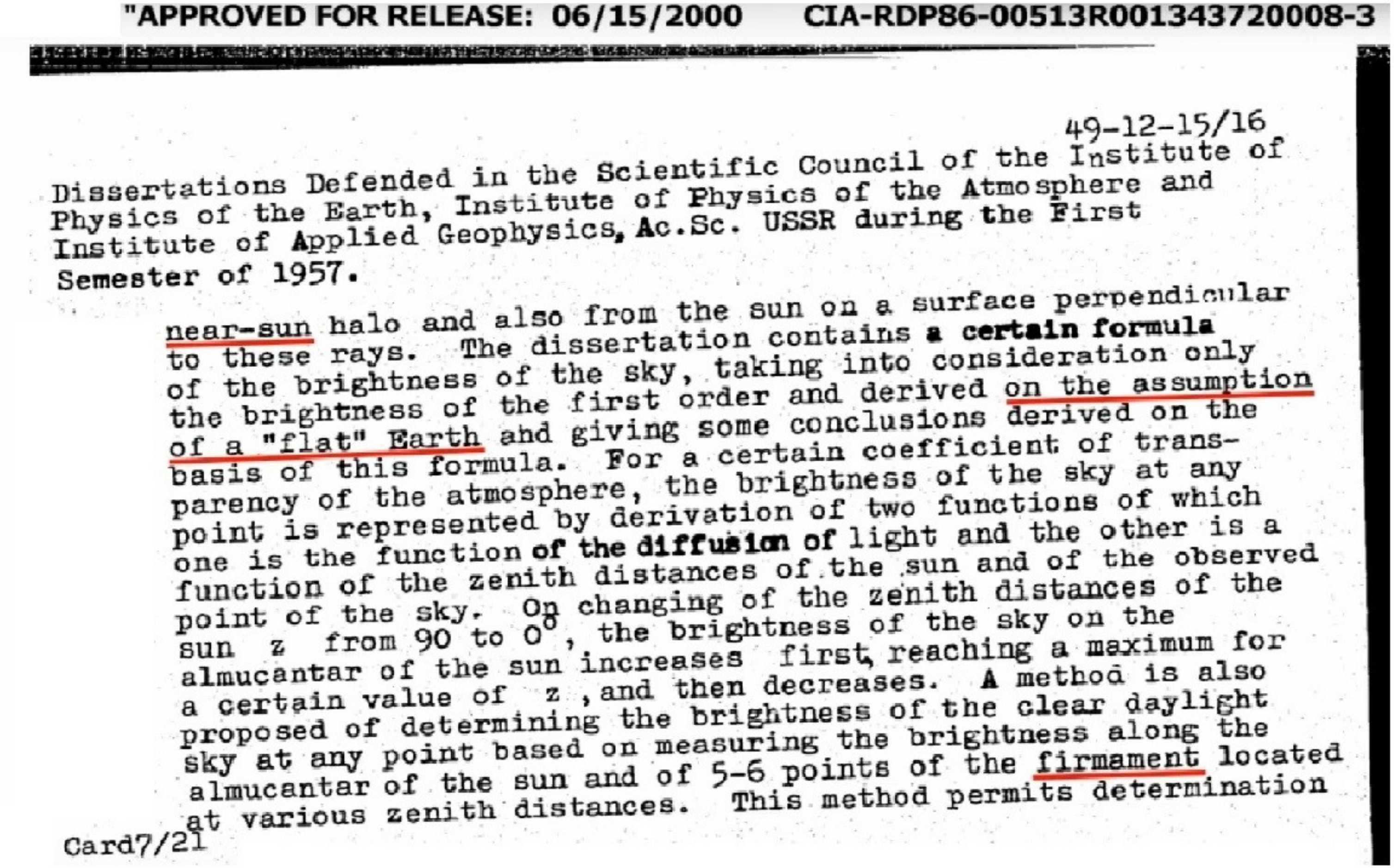


49-12-15/16

Dissertations Defended in the Scientific Council of the Institute of Physics of the Earth, Institute of Physics of the Atmosphere and Institute of Applied Geophysics, Ac.Sc. USSR during the First Semester of 1957.

Ye.V. Pyaskovskaya-Fesenkova - Investigation of the Scattering of Light in the Earth's Atmosphere (Issledovaniye rasseyaniya sveta v zemnoy atmosfere) - Doctor dissertation. Opponents: Doctor of Physico-Mathematical Sciences Ye.S. Kuznetsov, Doctor of Physico-Mathematical Sciences S.M. Polozkov, Doctor of Physico-Mathematical Sciences G.B. Rozenberg, Doctor of Physico-Mathematical Sciences I.S. Shklovskiy. March 23, 1957. The dissertation represents the result of many years of study of the clear, daytime sky. The observations were carried out in twelve locations at various altitudes above the sea, various climatic, meteorological and synoptic conditions. The observations were carried out mainly during high-transparency of the atmosphere in the visual range of the spectrum in the absence of a snow cover. In the investigations two instruments, designed by V.G. Fesenkov were used; one of these was a visual photometer of the daytime sky intended for measuring the brightness of the firmament; the other was a photoelectric halo photometer for determining the brightness from

Card6/21



49-12-15/16

Dissertations Defended in the Scientific Council of the Institute of
Physics of the Earth, Institute of Physics of the Atmosphere and
Institute of Applied Geophysics, Ac.Sc. USSR during the First
Semester of 1957.

near-sun halo and also from the sun on a surface perpendicular
to these rays. The dissertation contains **a certain formula**
of the brightness of the sky, taking into consideration only
the brightness of the first order and derived on the assumption
of a "flat" Earth and giving some conclusions derived on the
basis of this formula. For a certain coefficient of trans-
parency of the atmosphere, the brightness of the sky at any
point is represented by derivation of two functions of which
one is the function **of the diffusion of** light and the other is a
function of the zenith distances of the sun and of the observed
point of the sky. On changing of the zenith distances of the
sun z from 90 to 0°, the brightness of the sky on the
almucantar of the sun increases first, reaching a maximum for
a certain value of z , and then decreases. A method is also
proposed of determining the brightness of the clear daylight
sky at any point based on measuring the brightness along the
almucantar of the sun and of 5-6 points of the firmament located
at various zenith distances. This method permits determination

Card7/21

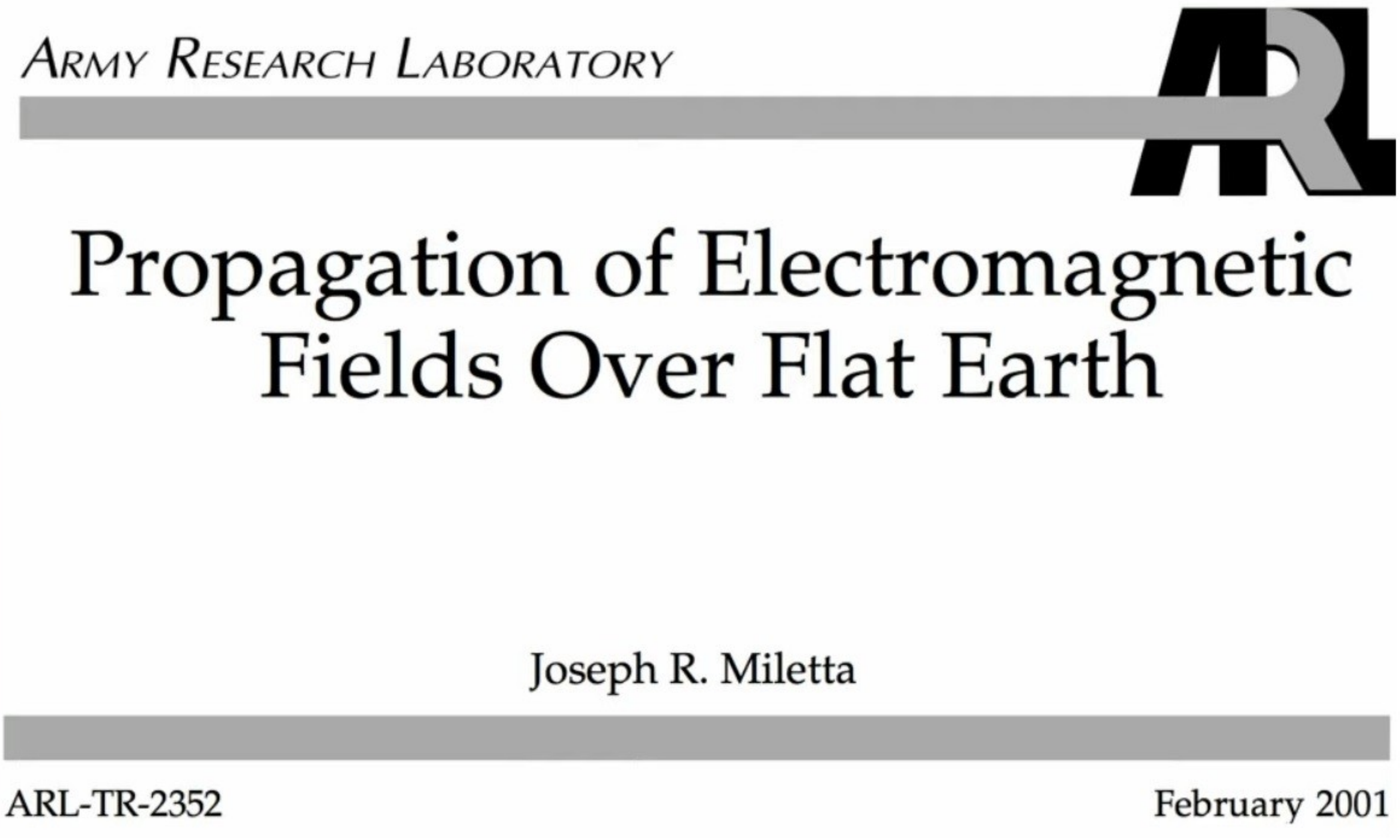
Regierung gibt Flache Erde zu: Dok #2

UNITED STATES ARMY

Title: Propagation of Electromagnetic Fields Over Flat Earth

Author: Joseph R. Miletta

URL:
https://www.arl.army.mil/arlreports/2001/ARL-TR-2352.pdf



ARMY RESEARCH LABORATORY

ARL

Propagation of Electromagnetic Fields Over Flat Earth

Joseph R. Miletta

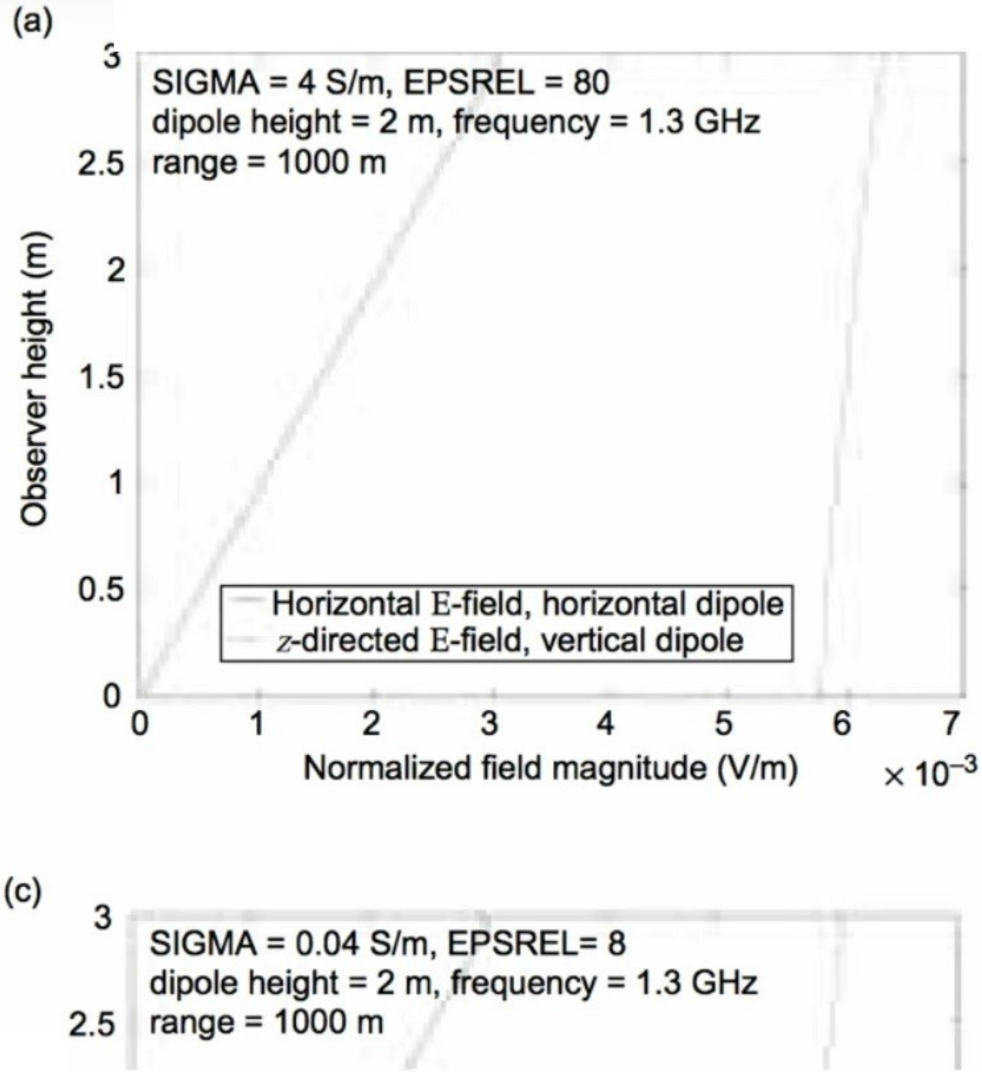
ARL-TR-2352

February 2001

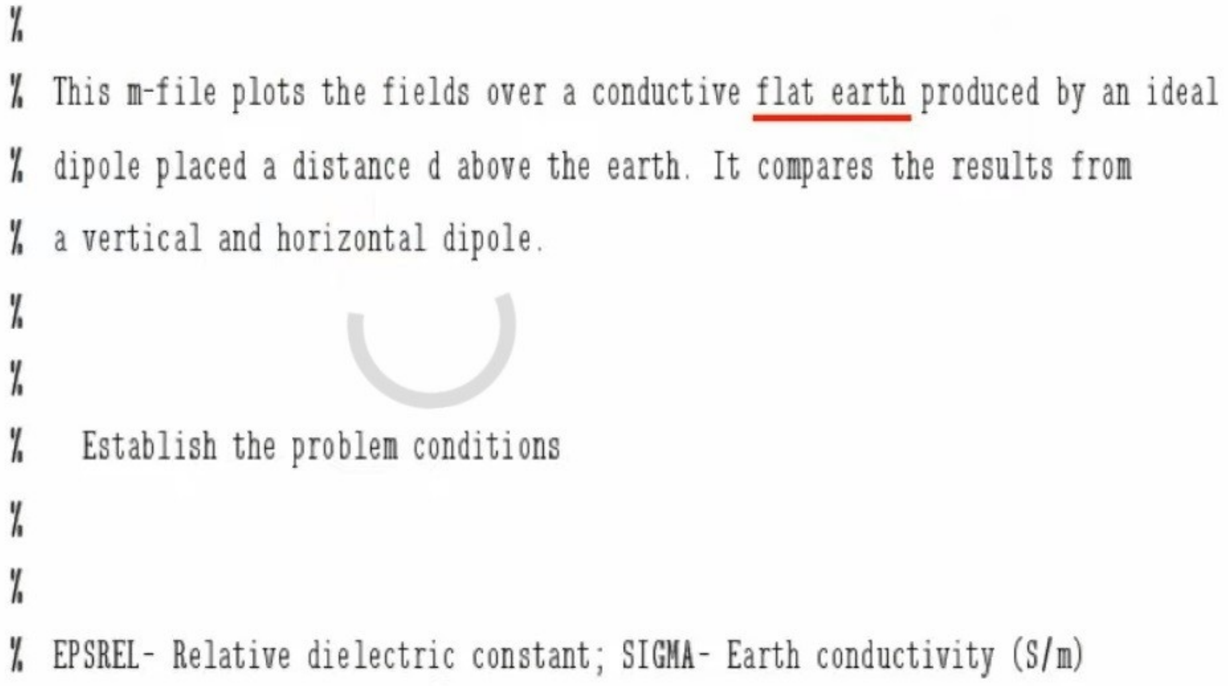
1. Introduction

Effective military or law-enforcement applications of high-power microwave (HPM) systems in which the HPM system and the target system are on or near the ground or water require that the microwave power density on target be maximized. The power density at the target for a given source will depend on the destructive and constructive scattering of the fields as they propagate to the target. Antenna design for an HPM system includes addressing the following questions about field polarization: Should the fields the transmitting antenna produces be vertically, horizontally, or circularly polarized? Which polarization maximizes the power density on target? (The question of which polarization best couples to the target is beyond the scope of this report.) While this report does not completely answer these questions, it addresses the interaction of the radiated electromagnetic fields with earth ground. It is assumed that the transmitting antenna and the target (or receiver) are located above, but near the surface of a flat idealized earth (constant permittivity, ε, and conductivity, σ) ground. First an ideal vertical dipole (oriented along the z-axis perpendicular to the ground plane) is addressed. The horizontal dipole (parallel to the ground plane) follows.

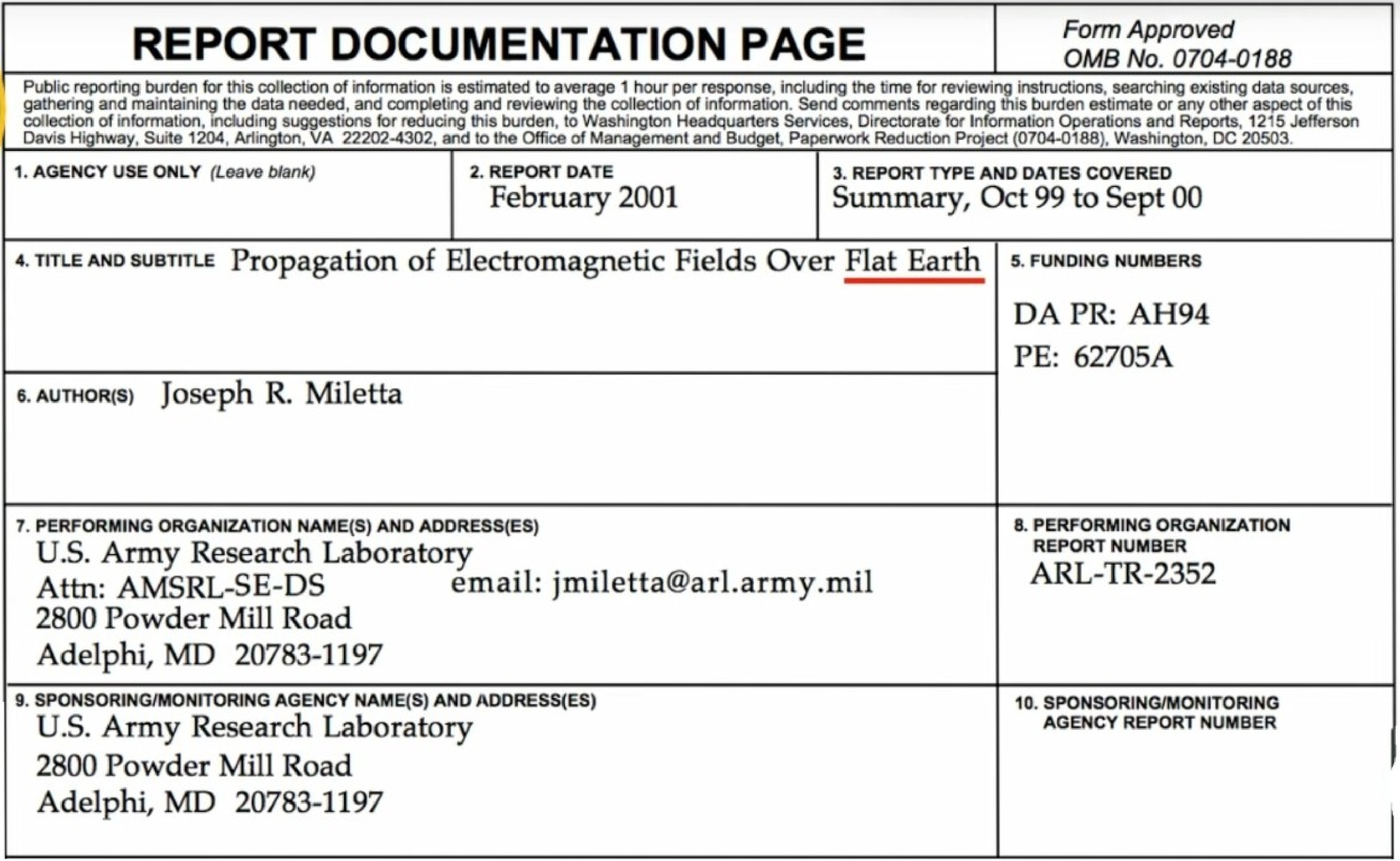
Figure 6. Comparison of principal fields from an ideal dipole oriented perpendicular and horizontal to a homogeneous flat earth. In each case, dipole is placed 2 m above ground plane and observer or target is 1000 m down range: (a) sea water, (b) wet earth, (c) dry earth, (d) lake water, and (e) dry sand.



Plot m-File for Fields



```
%
% This m-file plots the fields over a conductive flat earth produced by an ideal
% dipole placed a distance d above the earth. It compares the results from
% a vertical and horizontal dipole.
%
%
%  Establish the problem conditions
%
%
% EPSREL- Relative dielectric constant; SIGMA- Earth conductivity (S/m)
```



REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY *(Leave blank)*

2. REPORT DATE February 2001

3. REPORT TYPE AND DATES COVERED Summary, Oct 99 to Sept 00

4. TITLE AND SUBTITLE Propagation of Electromagnetic Fields Over Flat Earth

5. FUNDING NUMBERS
DA PR: AH94
PE: 62705A

6. AUTHOR(S) Joseph R. Miletta

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Research Laboratory
Attn: AMSRL-SE-DS
2800 Powder Mill Road
Adelphi, MD 20783-1197
email: jmiletta@arl.army.mil

8. PERFORMING ORGANIZATION REPORT NUMBER
ARL-TR-2352

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Research Laboratory
2800 Powder Mill Road
Adelphi, MD 20783-1197

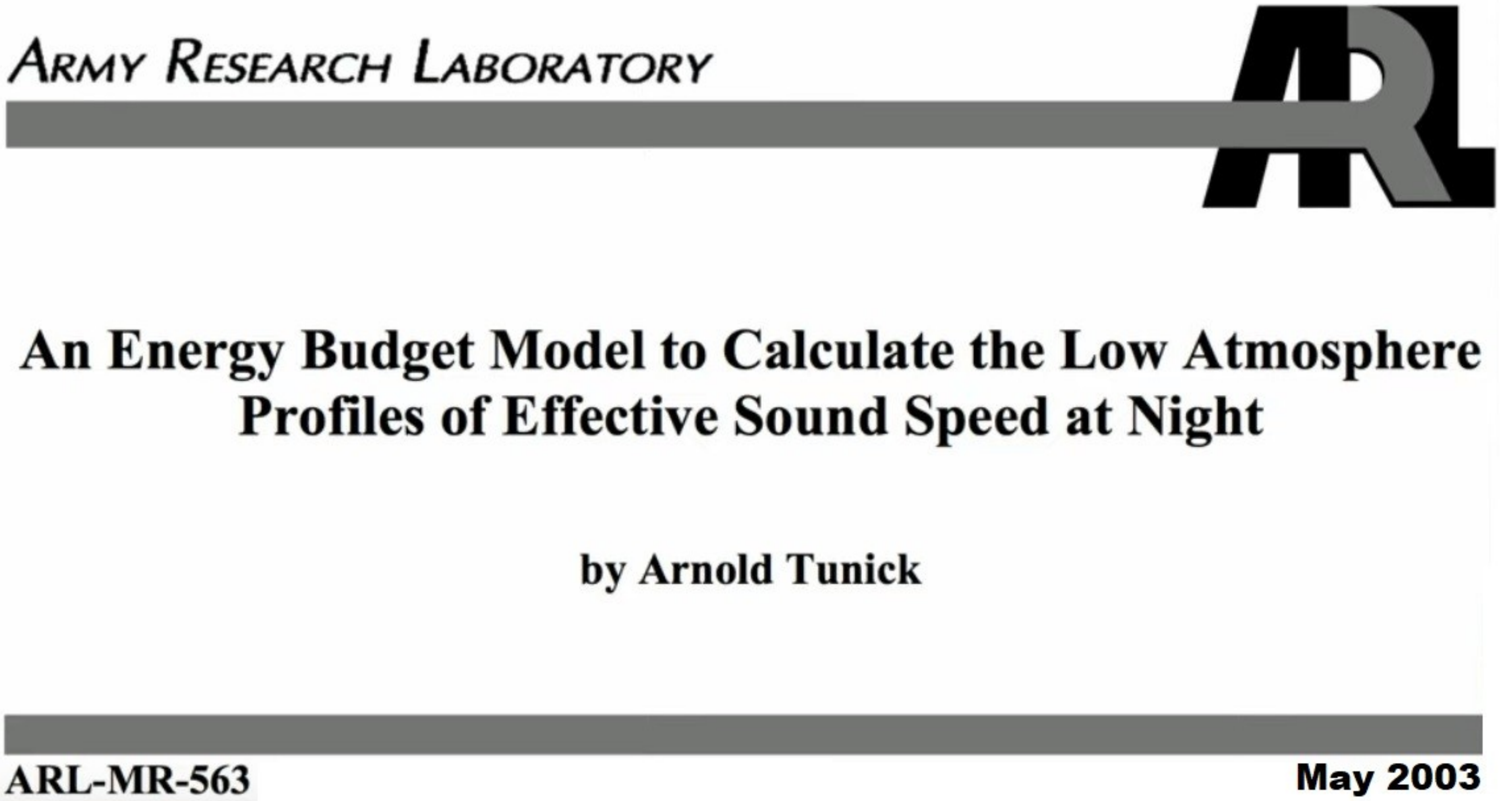
10. SPONSORING/MONITORING AGENCY REPORT NUMBER

Regierung gibt Flache Erde zu: Dok #3

Title: An Energy Budget Model to Calculate the Low Atmosphere Profiles of Effective Sound Speed at Night

Author: Arnold Tunick

URL:
https://www.arl.army.mil/arlreports/2003/ARL-MR-563.pdf



ARMY RESEARCH LABORATORY

ARL

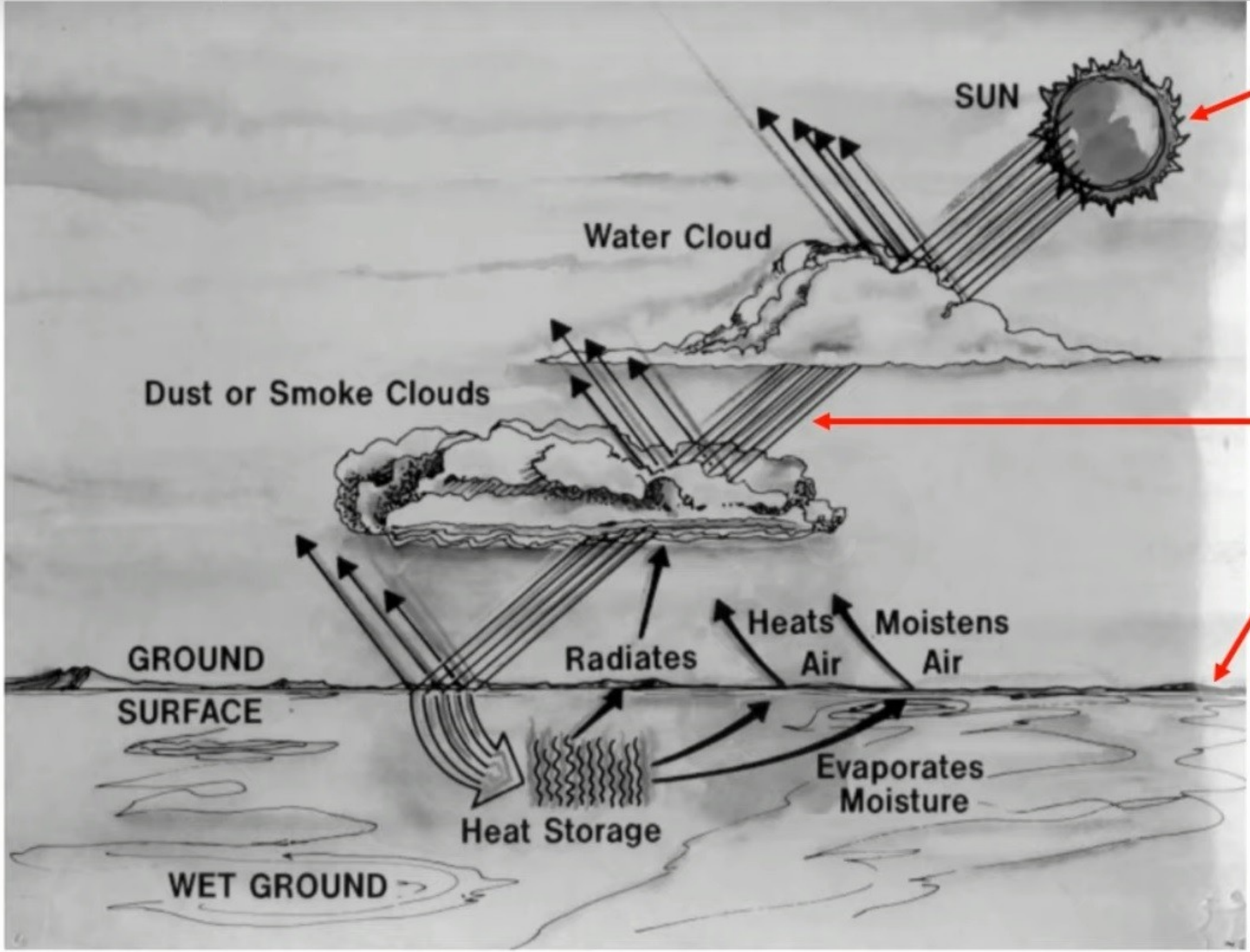
An Energy Budget Model to Calculate the Low Atmosphere Profiles of Effective Sound Speed at Night

by Arnold Tunick

ARL-MR-563

May 2003

UNITED STATES ARMY

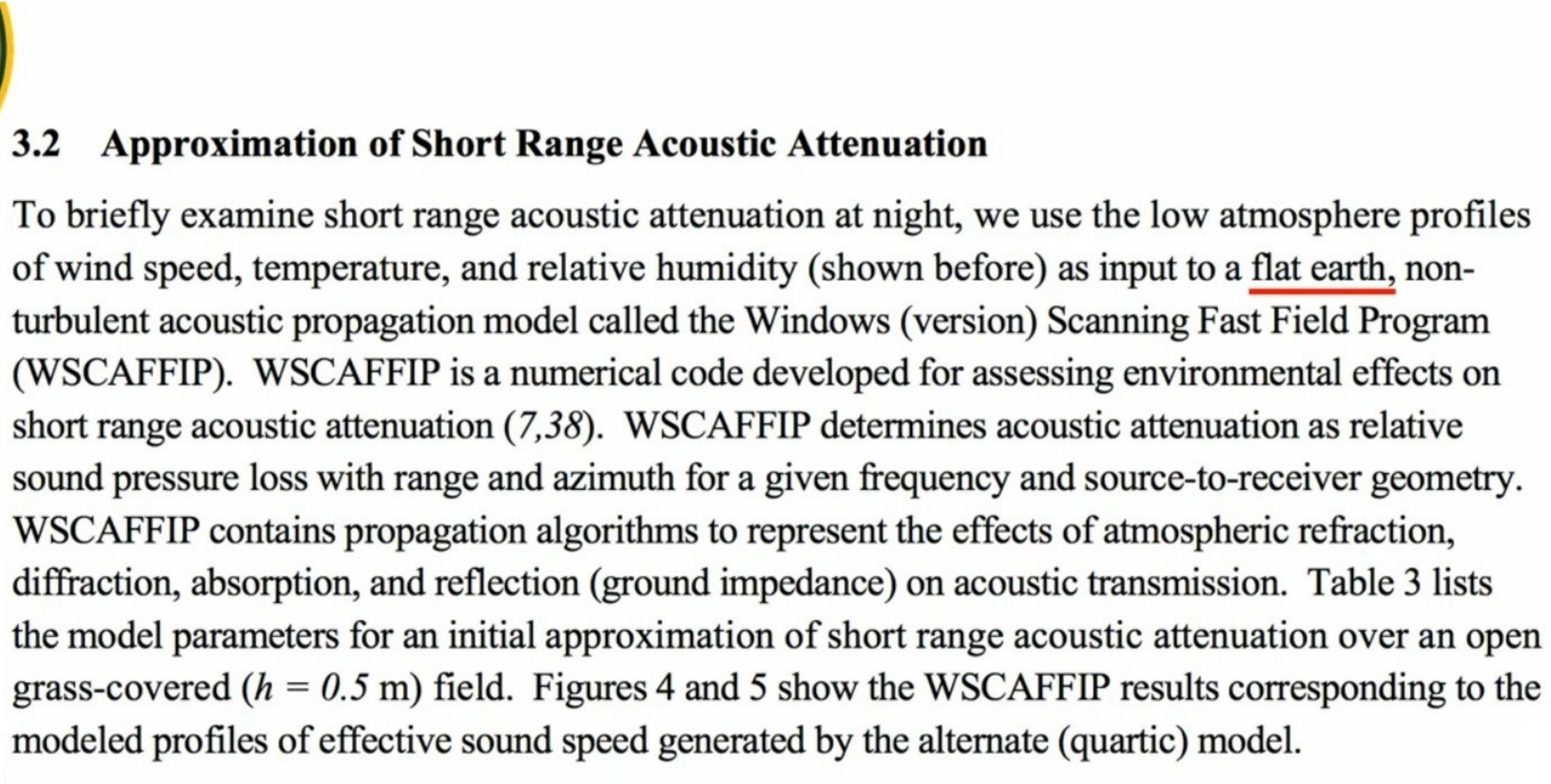


Near/Localized Sun

Crepuscular Rays

FLAT EARTH

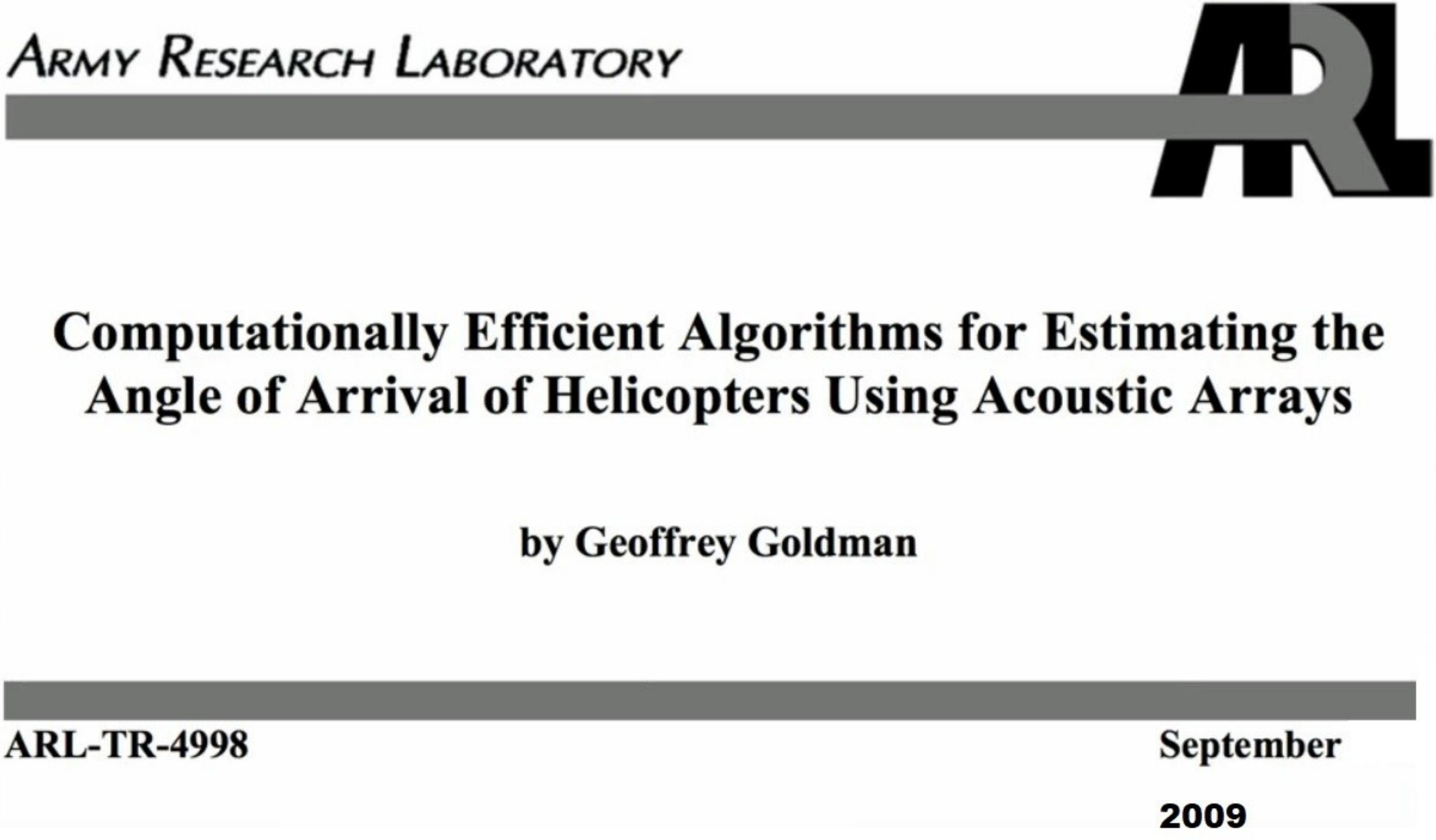
Figure 1. The radiation and energy budget close to the ground (illustrated by F.V. Hansen, 1993).



3.2 Approximation of Short Range Acoustic Attenuation

To briefly examine short range acoustic attenuation at night, we use the low atmosphere profiles of wind speed, temperature, and relative humidity (shown before) as input to a flat earth, non-turbulent acoustic propagation model called the Windows (version) Scanning Fast Field Program (WSCAFFIP). WSCAFFIP is a numerical code developed for assessing environmental effects on short range acoustic attenuation (*7,38*). WSCAFFIP determines acoustic attenuation as relative sound pressure loss with range and azimuth for a given frequency and source-to-receiver geometry. WSCAFFIP contains propagation algorithms to represent the effects of atmospheric refraction, diffraction, absorption, and reflection (ground impedance) on acoustic transmission. Table 3 lists the model parameters for an initial approximation of short range acoustic attenuation over an open grass-covered ($h = 0.5$ m) field. Figures 4 and 5 show the WSCAFFIP results corresponding to the modeled profiles of effective sound speed generated by the alternate (quartic) model.

Regierung gibt Flache Erde zu: Dok #4



ARMY RESEARCH LABORATORY

Computationally Efficient Algorithms for Estimating the Angle of Arrival of Helicopters Using Acoustic Arrays

by Geoffrey Goldman

ARL-TR-4998

September

2009

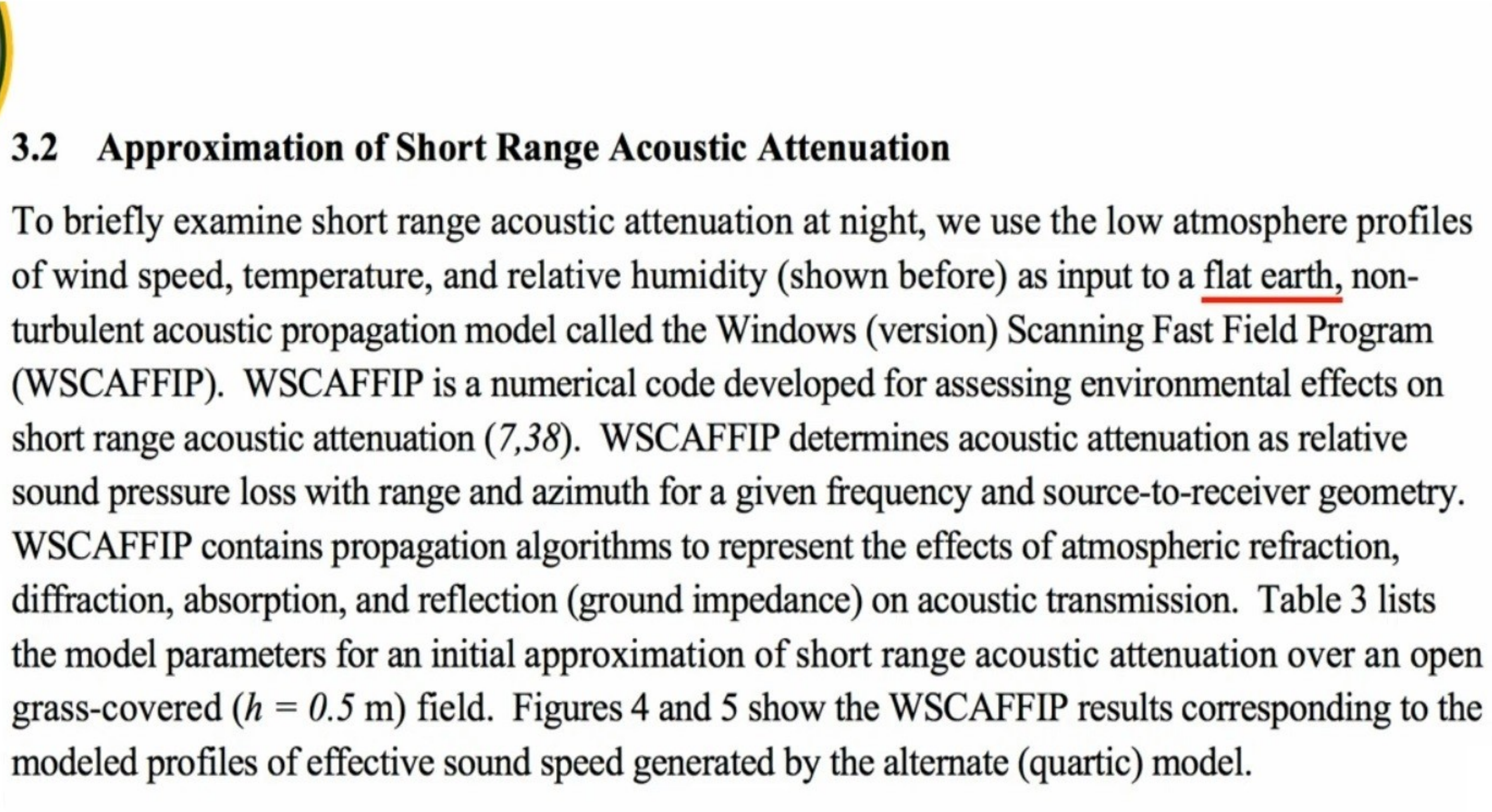
Title: Computationally Efficient Algorithms for Estimating the Angle of Arrival of Helicopters Using Acoustic Arrays

Author: Geoffrey Goldman

URL: https://www.arl.army.mil/arlreports/2009/ARL-TR-4998.pdf

3.3 Multipath Model

Figure 6 illustrates a simple model for multipath, which is a based upon the signal having a single bounce on a flat Earth with propagation that is described by ray tracing for signals in the far-field. The microphone is at a height H above the ground, and a complex reflection coefficient that is potentially frequency dependent is given by $\rho(\omega)$, which can be approximated using empirical data. The signal propagating along the direct and indirect path sum to generate the signal measured at the microphone.



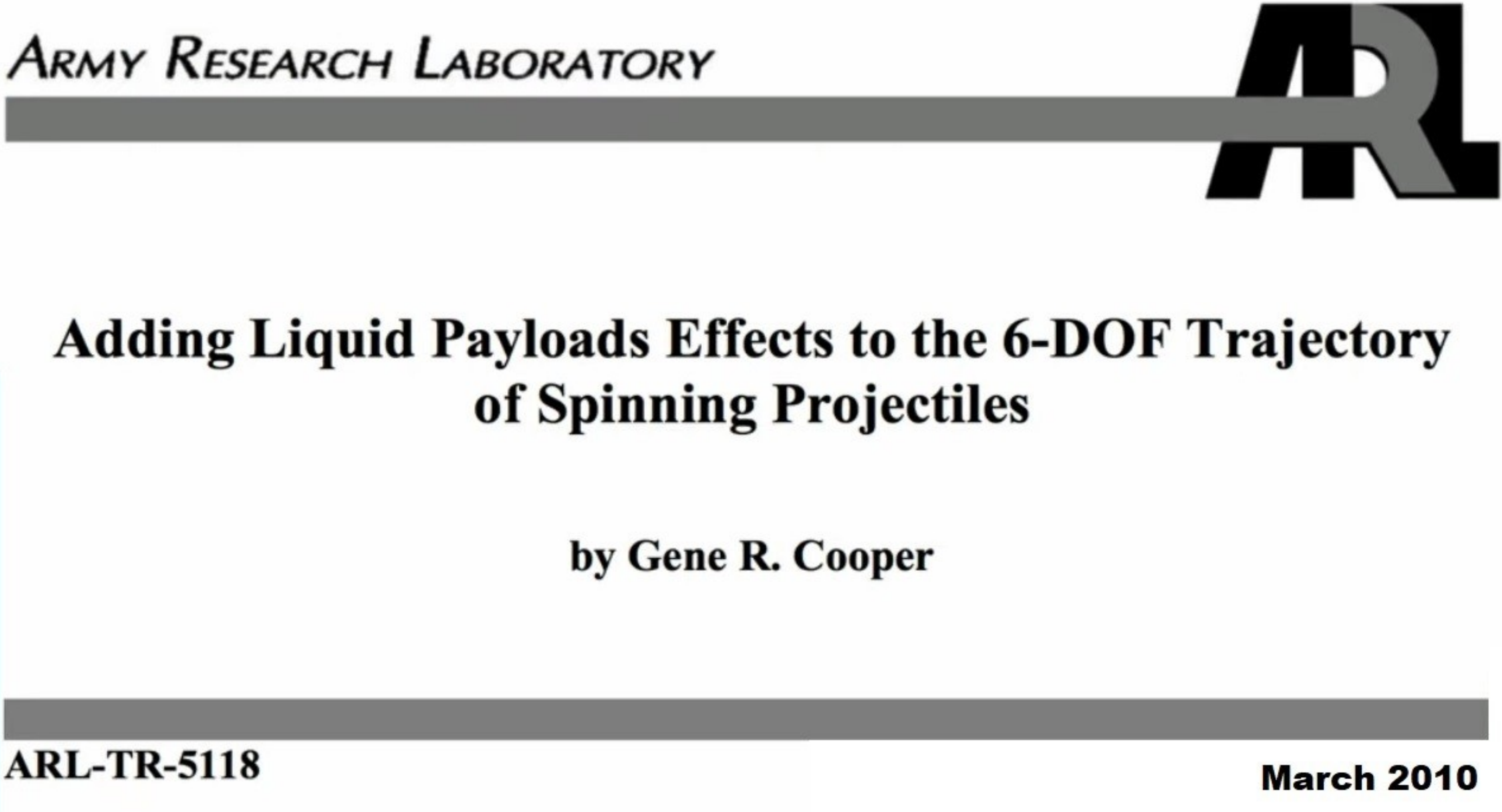
3.2 Approximation of Short Range Acoustic Attenuation

To briefly examine short range acoustic attenuation at night, we use the low atmosphere profiles of wind speed, temperature, and relative humidity (shown before) as input to a flat earth, non-turbulent acoustic propagation model called the Windows (version) Scanning Fast Field Program (WSCAFFIP). WSCAFFIP is a numerical code developed for assessing environmental effects on short range acoustic attenuation (*7,38*). WSCAFFIP determines acoustic attenuation as relative sound pressure loss with range and azimuth for a given frequency and source-to-receiver geometry. WSCAFFIP contains propagation algorithms to represent the effects of atmospheric refraction, diffraction, absorption, and reflection (ground impedance) on acoustic transmission. Table 3 lists the model parameters for an initial approximation of short range acoustic attenuation over an open grass-covered ($h = 0.5$ m) field. Figures 4 and 5 show the WSCAFFIP results corresponding to the modeled profiles of effective sound speed generated by the alternate (quartic) model.

microphone array. The characteristics of the data collected on the elevated microphone changed during the time interval from 0–250 to 250–420 s. The normalized power of the signal was smaller compared to the lower microphones and the propagation of the signal from the helicopter looked more dispersive during the 0–250 s time interval. The underlying phenomenology for this behavior is still being investigated.

To improve the elevation angle estimate, a multipath model was incorporated into the beamforming algorithm. The algorithm assumed multipath could be modeled with a single bounce, a constant reflection coefficient, straight line propagation, a flat Earth, and incident angles that were not near grazing. This algorithm did not work well. A more detailed analysis is needed to understand its deficiencies.

Regierung gibt Flache Erde zu: Dok #5



ARMY RESEARCH LABORATORY

ARL

Adding Liquid Payloads Effects to the 6-DOF Trajectory of Spinning Projectiles

by Gene R. Cooper

ARL-TR-5118

March 2010

Title: Adding Liquid Payloads Effects to the 6-DOF Trajectory of Spinning Projectiles

Author: Gene R. Cooper

URL:
https://www.arl.army.mil/arlreports/2010/ARL-TR-5118.pdf

UNITED STATES ARMY

2. Projectile Flight Dynamics

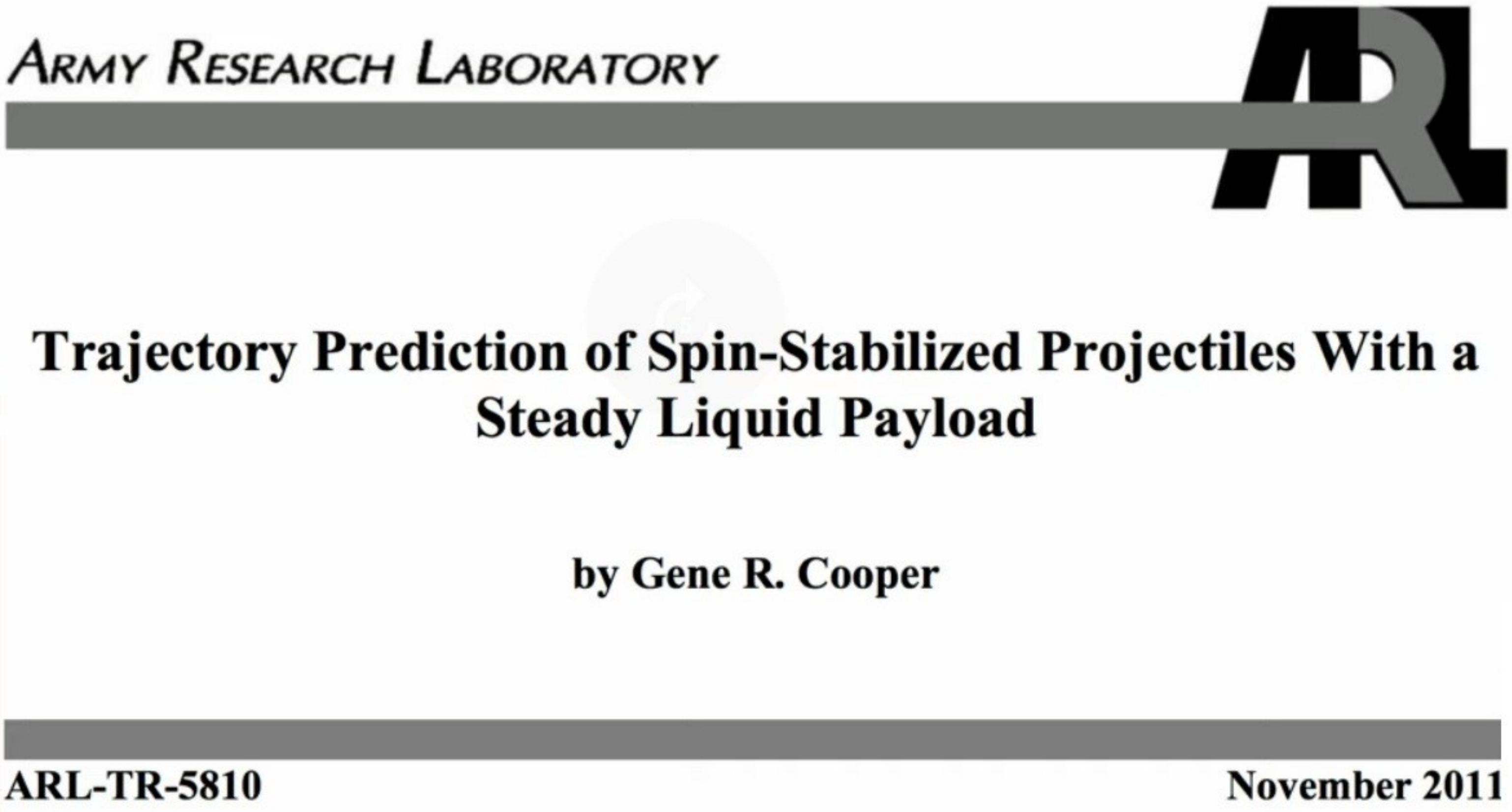
A 6-DOF rigid projectile model is employed to predict the dynamics of a projectile in flight. These equations assume a flat Earth. The 6-DOF comprises the three translational components describing the position of the projectile's center of mass and the three Euler angles describing the orientation of the projectile with respect to the Earth. Figures 1 and 2 provide a visualization of the degrees of freedom.

Regierung gibt Flache Erde zu: Dok #6

Title: Trajectory Prediction of Spin-Stabilized Projectiles With a Steady Liquid Payload

Author: Gene R. Cooper

URL:
https://www.arl.army.mil/arlreports/2011/ARL-TR-5810.pdf



ARMY RESEARCH LABORATORY

ARL

Trajectory Prediction of Spin-Stabilized Projectiles With a Steady Liquid Payload

by Gene R. Cooper

ARL-TR-5810 November 2011

2. Projectile Flight Dynamic Model With a Liquid Payload

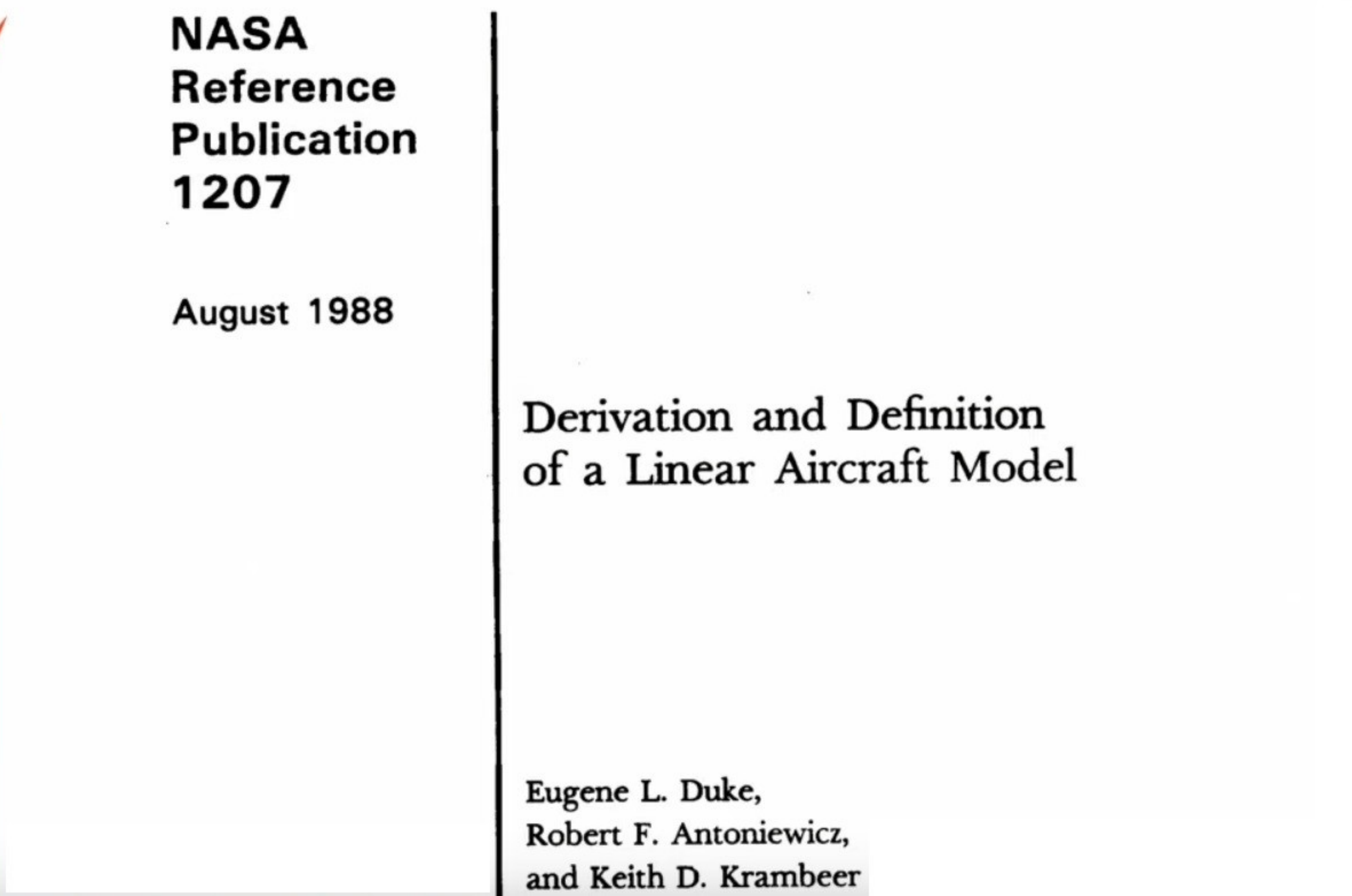
A typical 6-DOF rigid projectile model is employed to predict the dynamics of a projectile in flight. These equations assume a flat Earth. The well-known 6-DOF states comprise the three translational components describing the position of the projectile's center of mass and the three Euler angles describing the orientation of the projectile with respect to the Earth. Figures 1 and 2 provide a visualization of the degrees of freedom.

Regierung gibt Flache Erde zu: Dok #7

Title: Derivation and Definition of a Linear Aircraft Model

Author: Eugene L. Duke, Robert F. Antoniewicz, and Keith D. Krambeer

URL:
https://www.nasa.gov/centers/dryden/pdf/88104main_H-1391.pdf



NASA
Reference
Publication
1207

August 1988

Derivation and Definition of a Linear Aircraft Model

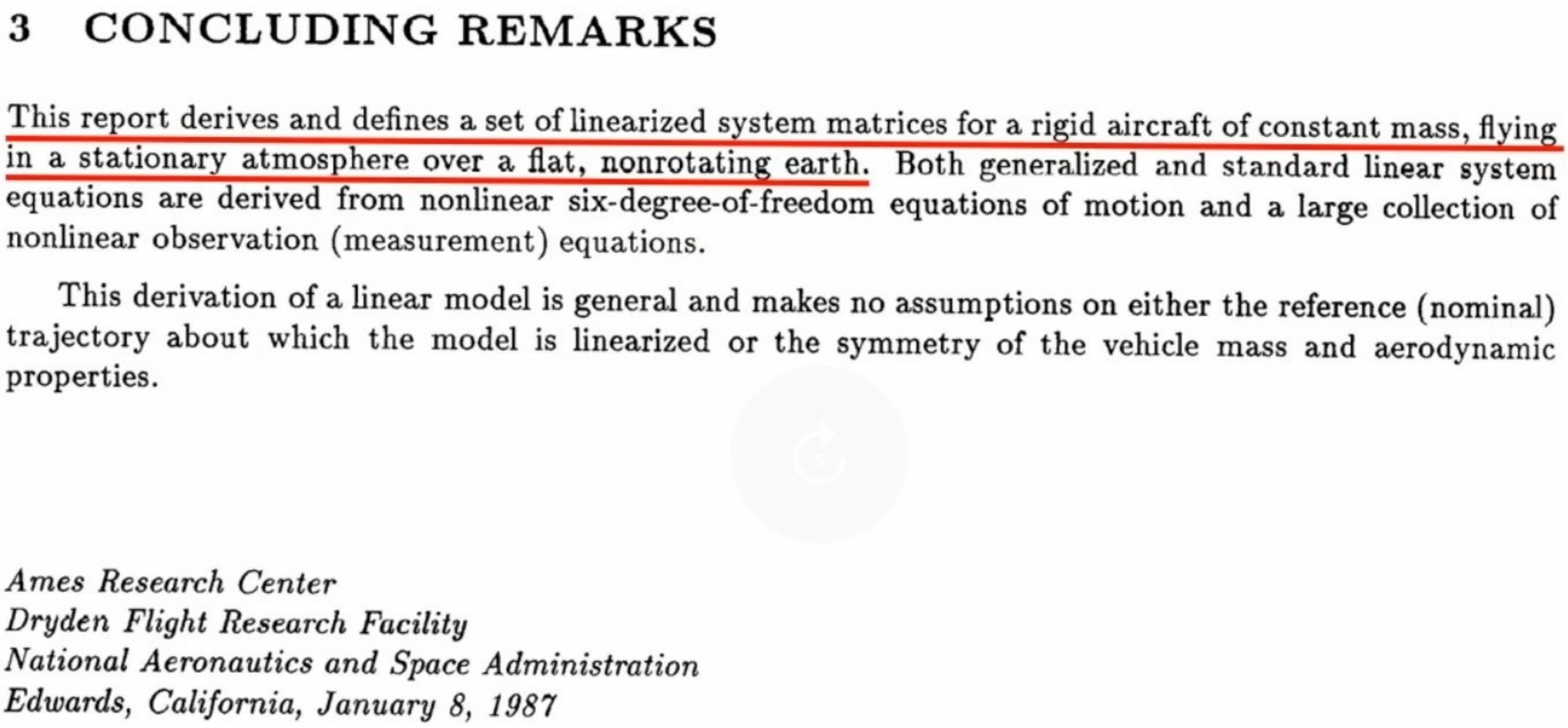
Eugene L. Duke,
Robert F. Antoniewicz,
and Keith D. Krambeer

INTRODUCTION

The need for linear models of aircraft for the analysis of vehicle dynamics and control law design is well known. These models are widely used, not only for computer applications but also for quick approximations and desk calculations. Whereas the use of these models is well understood and well documented, their derivation is not. The lack of documentation and, occasionally, understanding of the derivation of linear models is a hindrance to communication, training, and application.

This report details the development of the linear model of a rigid aircraft of constant mass, flying over a flat, nonrotating earth. This model consists of a state equation and an observation (or measurement) equation. The system equations have been broadly formulated to accommodate a wide variety of applications. The linear state equation is derived from the nonlinear six-degree-of-freedom equations of motion. The linear observation equation is derived from a collection of nonlinear equations representing state variables, time derivatives of state variables, control inputs, and flightpath, air data, and other parameters. The linear model is developed about a nominal trajectory that is general.

Whereas it is common to assume symmetric aerodynamics and mass distribution, or a straight and level trajectory, or both (Clancy, 1975; Dommasch and others, 1967; Etkin, 1972; McRuer and others, 1973; Northrop Aircraft, 1952; Thelander, 1965), these assumptions limit the generality of the linear model. The principal contribution of this report is a solution of the general problem of deriving a linear model of a rigid aircraft without making these simplifying assumptions. By defining the initial conditions (of the nominal trajectory) for straight and level flight and setting the asymmetric aerodynamic and inertia terms to zero, one can easily obtain the more traditional linear models from the linear model derived in this report.

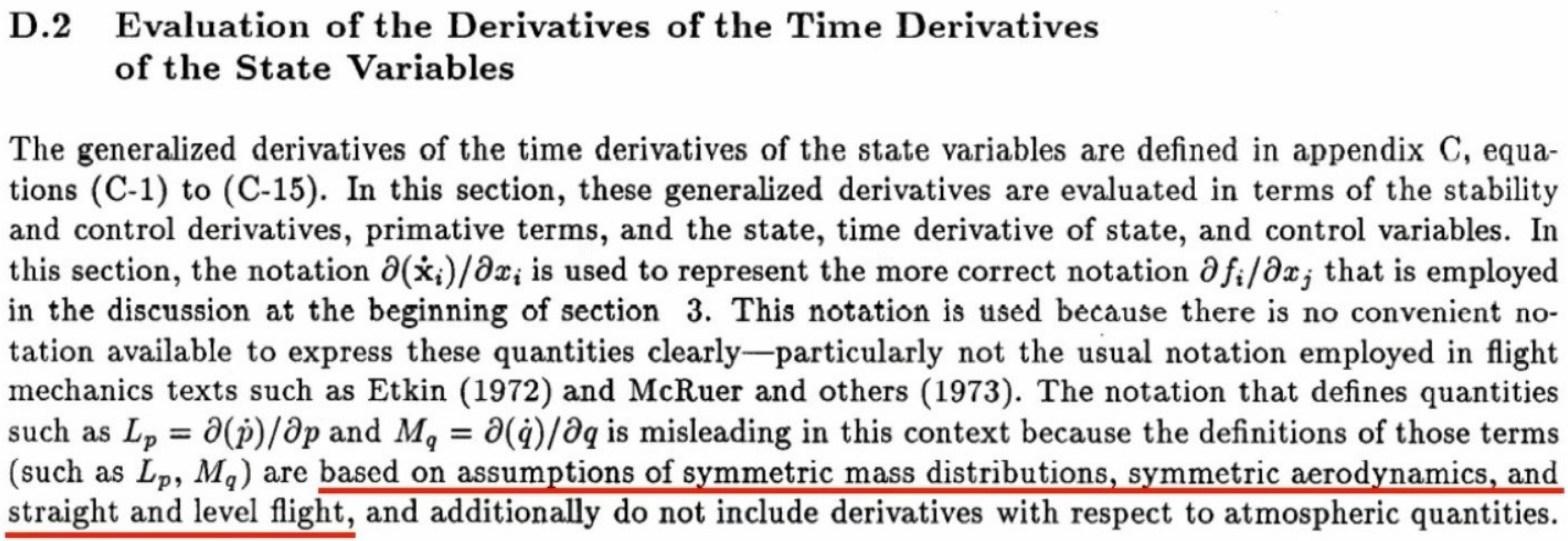


3 CONCLUDING REMARKS

This report derives and defines a set of linearized system matrices for a rigid aircraft of constant mass, flying in a stationary atmosphere over a flat, nonrotating earth. Both generalized and standard linear system equations are derived from nonlinear six-degree-of-freedom equations of motion and a large collection of nonlinear observation (measurement) equations.

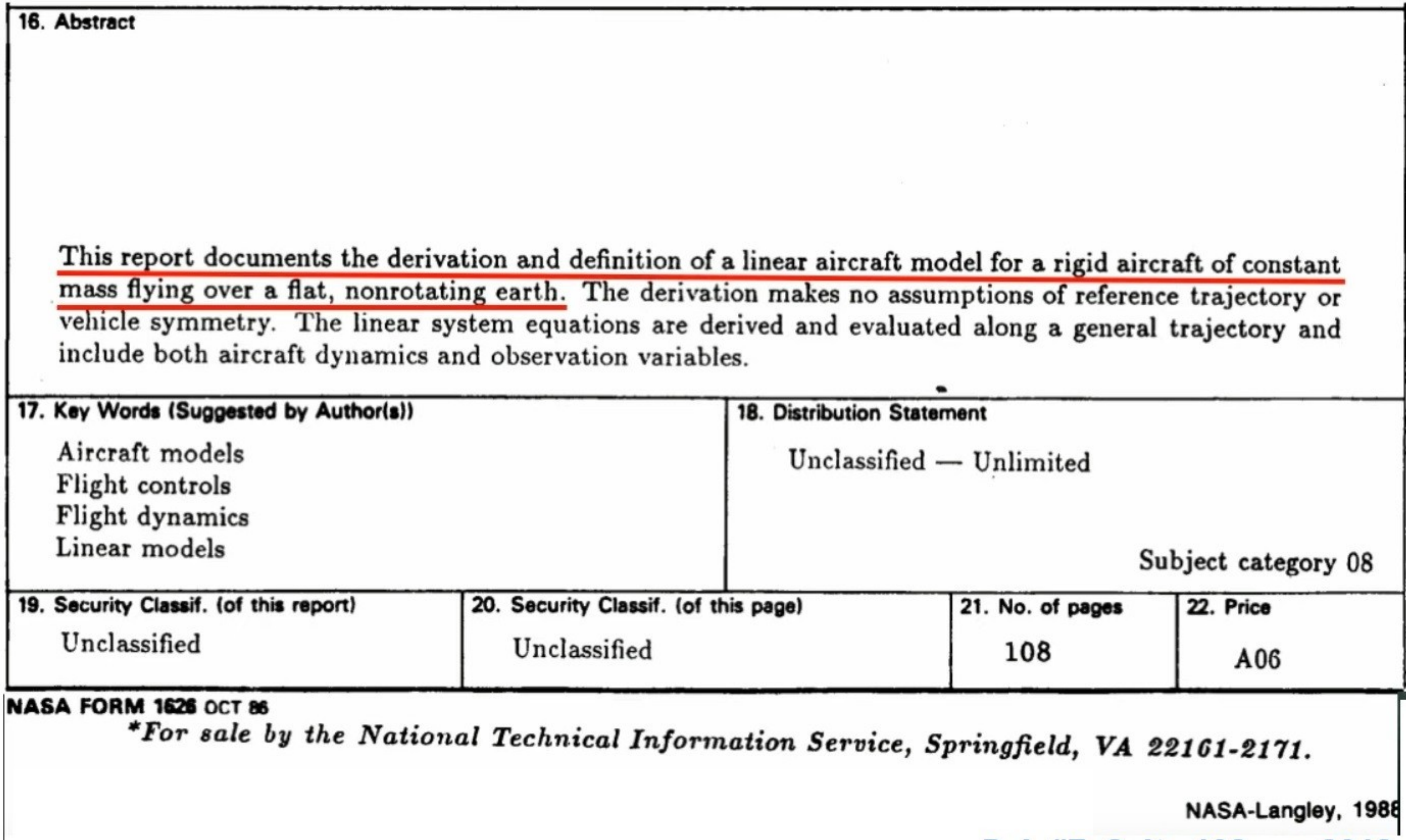
This derivation of a linear model is general and makes no assumptions on either the reference (nominal) trajectory about which the model is linearized or the symmetry of the vehicle mass and aerodynamic properties.

Ames Research Center
Dryden Flight Research Facility
National Aeronautics and Space Administration
Edwards, California, January 8, 1987



D.2 Evaluation of the Derivatives of the Time Derivatives of the State Variables

The generalized derivatives of the time derivatives of the state variables are defined in appendix C, equations (C-1) to (C-15). In this section, these generalized derivatives are evaluated in terms of the stability and control derivatives, primative terms, and the state, time derivative of state, and control variables. In this section, the notation $\partial(\dot{\mathbf{x}}_i)/\partial x_i$ is used to represent the more correct notation $\partial f_i/\partial x_j$ that is employed in the discussion at the beginning of section 3. This notation is used because there is no convenient notation available to express these quantities clearly—particularly not the usual notation employed in flight mechanics texts such as Etkin (1972) and McRuer and others (1973). The notation that defines quantities such as $L_p = \partial(\dot{p})/\partial p$ and $M_q = \partial(\dot{q})/\partial q$ is misleading in this context because the definitions of those terms (such as L_p, M_q) are based on assumptions of symmetric mass distributions, symmetric aerodynamics, and straight and level flight, and additionally do not include derivatives with respect to atmospheric quantities.



16. Abstract

This report documents the derivation and definition of a linear aircraft model for a rigid aircraft of constant mass flying over a flat, nonrotating earth. The derivation makes no assumptions of reference trajectory or vehicle symmetry. The linear system equations are derived and evaluated along a general trajectory and include both aircraft dynamics and observation variables.

17. Key Words (Suggested by Author(s)) Aircraft models Flight controls Flight dynamics Linear models	18. Distribution Statement Unclassified — Unlimited Subject category 08

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of pages 108	22. Price A06

NASA FORM 1626 OCT 86

*For sale by the National Technical Information Service, Springfield, VA 22161-2171.

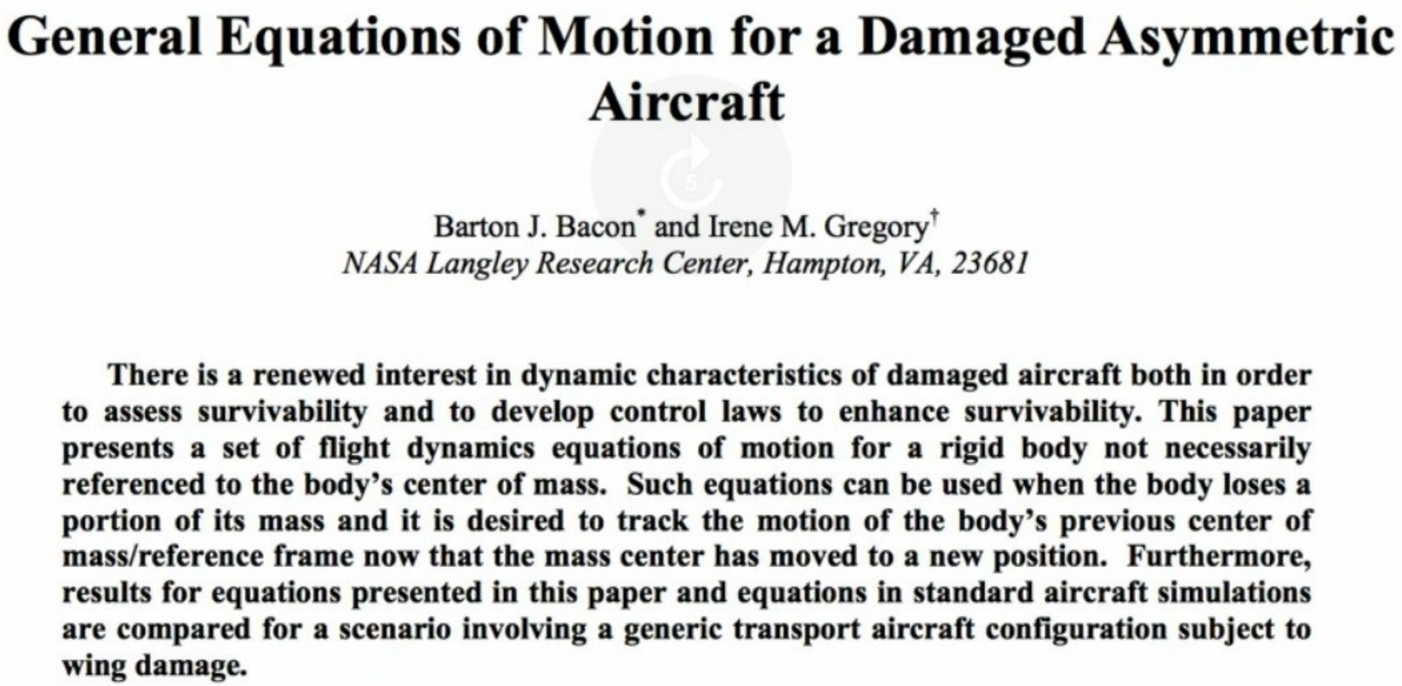
NASA-Langley, 198

Regierung gibt Flache Erde zu: Dok #8

Title: General Equations of
Motion for a Damaged
Asymmetric Aircraft

Author: Barton J. Bacon and
rene M. Gregory

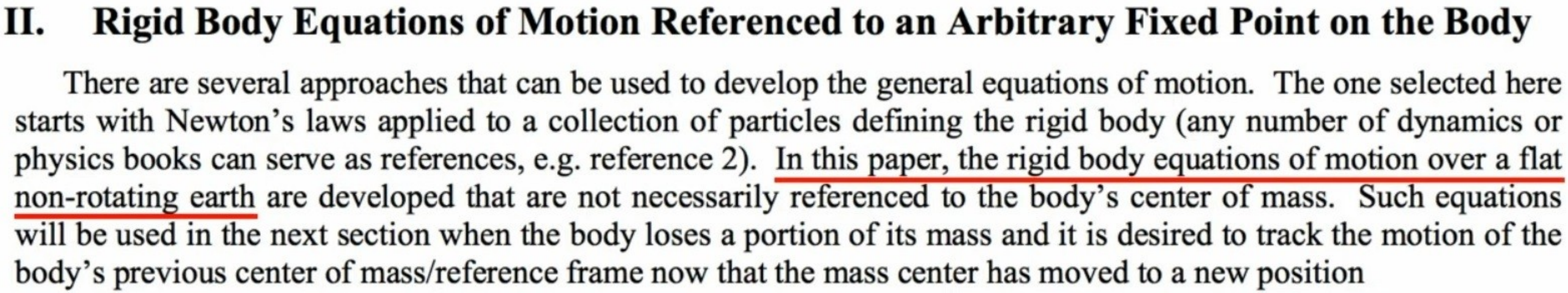
URL:
ttps://ntrs.nasa.gov/archive/n
asa/casi.ntrs.nasa.gov/2007003
0307.pdf



General Equations of Motion for a Damaged Asymmetric Aircraft

Barton J. Bacon[*] and Irene M. Gregory[†]
NASA Langley Research Center, Hampton, VA, 23681

There is a renewed interest in dynamic characteristics of damaged aircraft both in order to assess survivability and to develop control laws to enhance survivability. This paper presents a set of flight dynamics equations of motion for a rigid body not necessarily referenced to the body's center of mass. Such equations can be used when the body loses a portion of its mass and it is desired to track the motion of the body's previous center of mass/reference frame now that the mass center has moved to a new position. Furthermore, results for equations presented in this paper and equations in standard aircraft simulations are compared for a scenario involving a generic transport aircraft configuration subject to wing damage.



II. Rigid Body Equations of Motion Referenced to an Arbitrary Fixed Point on the Body

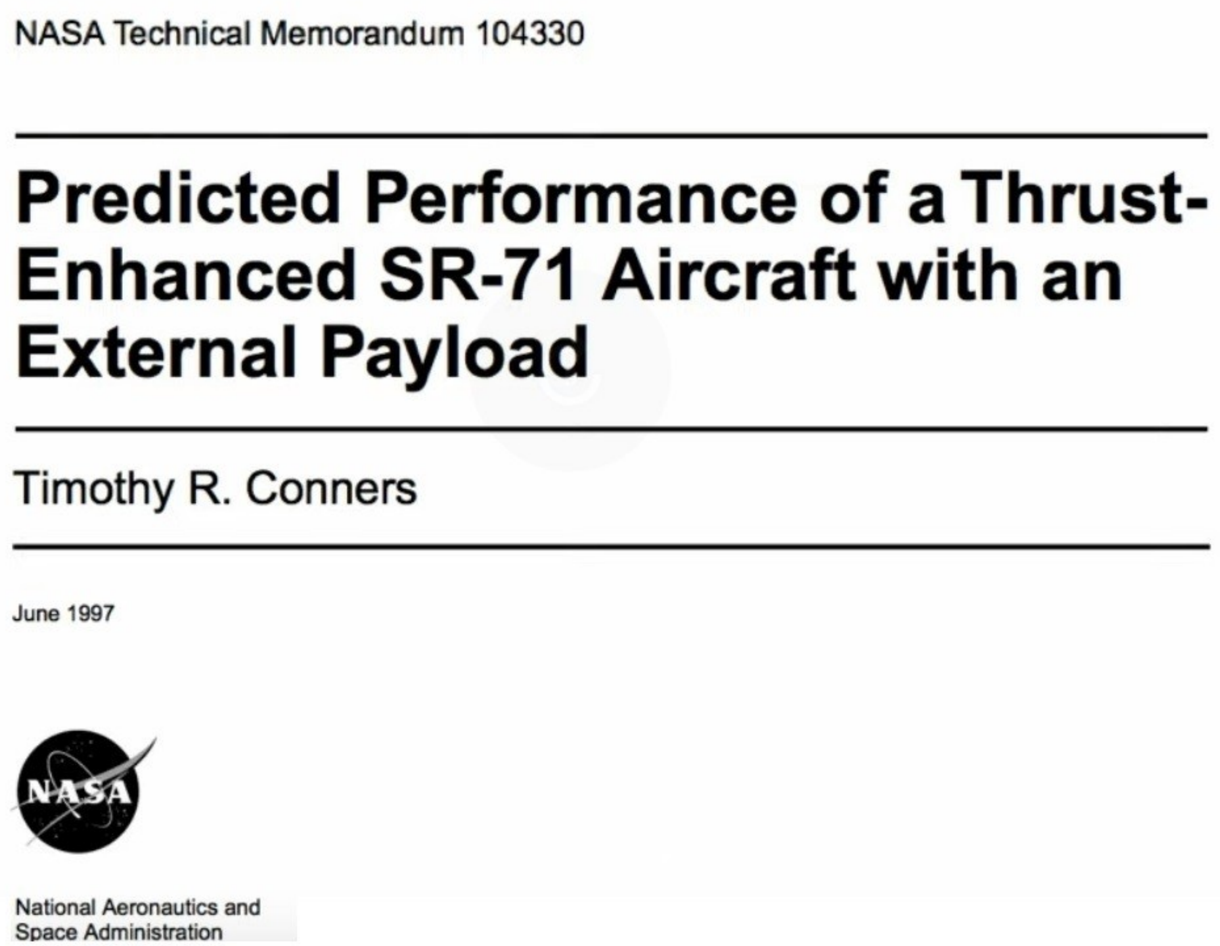
There are several approaches that can be used to develop the general equations of motion. The one selected here starts with Newton's laws applied to a collection of particles defining the rigid body (any number of dynamics or physics books can serve as references, e.g. reference 2). In this paper, the rigid body equations of motion over a flat non-rotating earth are developed that are not necessarily referenced to the body's center of mass. Such equations will be used in the next section when the body loses a portion of its mass and it is desired to track the motion of the body's previous center of mass/reference frame now that the mass center has moved to a new position

Regierung gibt Flache Erde zu: Dok #9

Title: Predicted Performance of a ThrustEnhanced SR-71 Aircraft with an External Payload

Author: Timothy R. Conners

URL:
https://www.nasa.gov/centers/dryden/pdf/88507main_H-2179.pdf



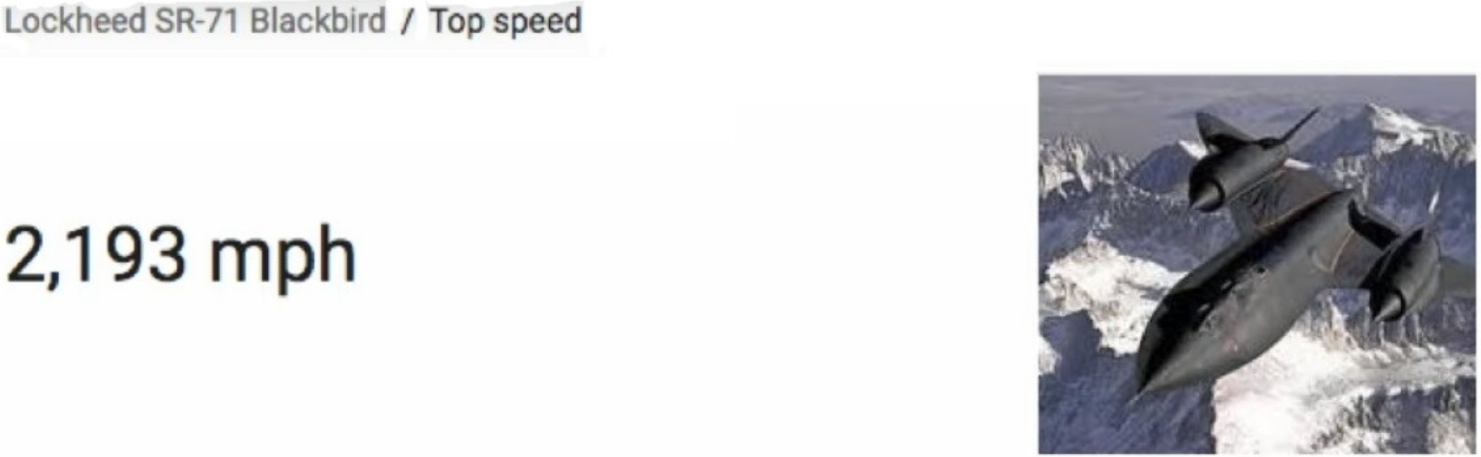
NASA Technical Memorandum 104330

Predicted Performance of a Thrust-Enhanced SR-71 Aircraft with an External Payload

Timothy R. Conners

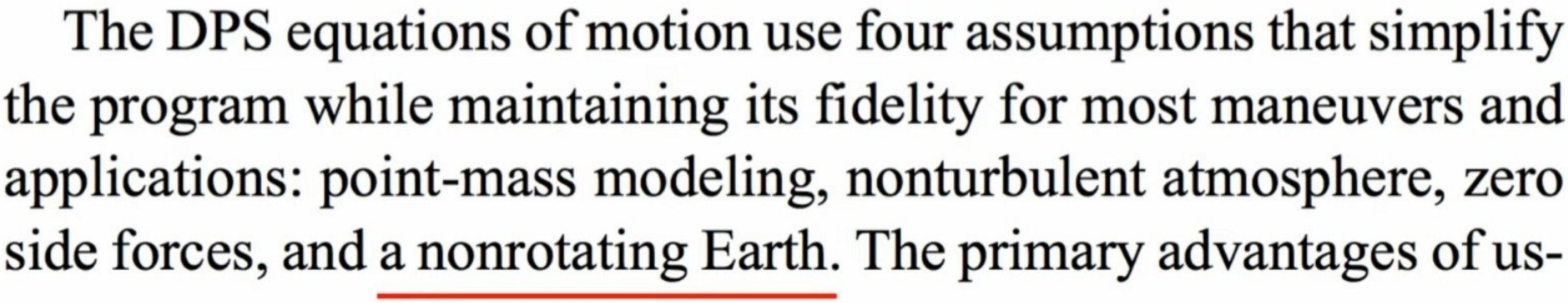
June 1997

National Aeronautics and
Space Administration



Lockheed SR-71 Blackbird / Top speed

2,193 mph



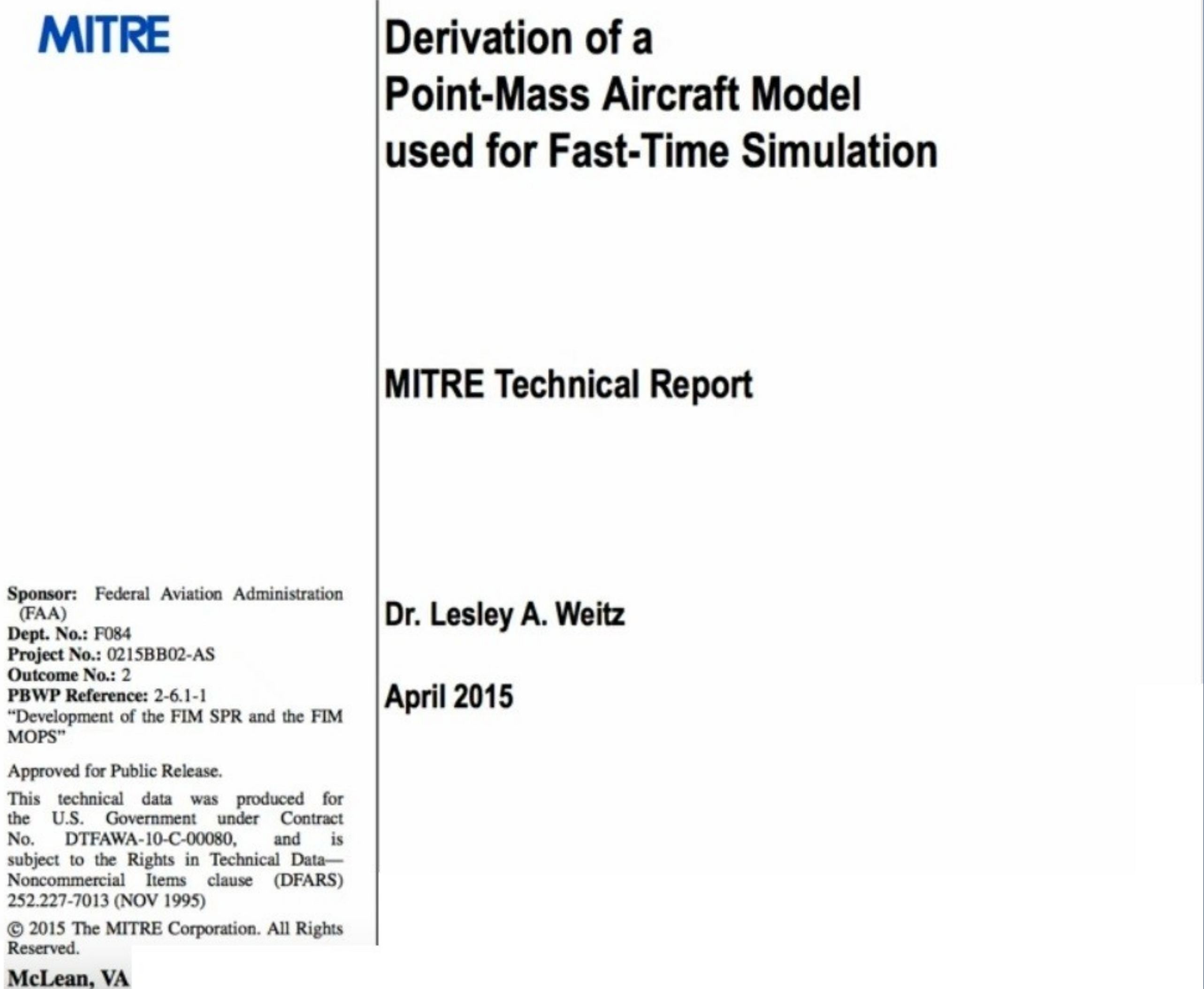
The DPS equations of motion use four assumptions that simplify the program while maintaining its fidelity for most maneuvers and applications: point-mass modeling, nonturbulent atmosphere, zero side forces, and a nonrotating Earth. The primary advantages of us-

Regierung gibt Flache Erde zu: Dok #10

Title: Derivation of a Point-Mass Aircraft Model used for Fast-Time Simulation

Author: Dr. Lesley A. Weitz

URL:
https://www.mitre.org/sites/default/files/publications/pr_15-1318-derivation-of-point-mass-aircraft-model-used-for-fast-time-simulation.pdf



MITRE

Sponsor: Federal Aviation Administration (FAA)
Dept. No.: F084
Project No.: 0215BB02-AS
Outcome No.: 2
PBWP Reference: 2-6.1-1
"Development of the FIM SPR and the FIM MOPS"

Approved for Public Release.

This technical data was produced for the U.S. Government under Contract No. DTFAWA-10-C-00080, and is subject to the Rights in Technical Data—Noncommercial Items clause (DFARS) 252.227-7013 (NOV 1995)

McLean, VA

Derivation of a Point-Mass Aircraft Model used for Fast-Time Simulation

MITRE Technical Report

Dr. Lesley A. Weitz

April 2015

FEDERAL AVIATION ADMINISTRATION

2 Equations of Motion

2.1 Reference Frames

Assuming a flat, non-rotating Earth, an inertial reference frame N is defined with the $\hat{\boldsymbol{n}}_1$ axis aligned with east, the $\hat{\boldsymbol{n}}_2$ axis aligned with north, and the $\hat{\boldsymbol{n}}_3$ axis pointing up from the Earth.

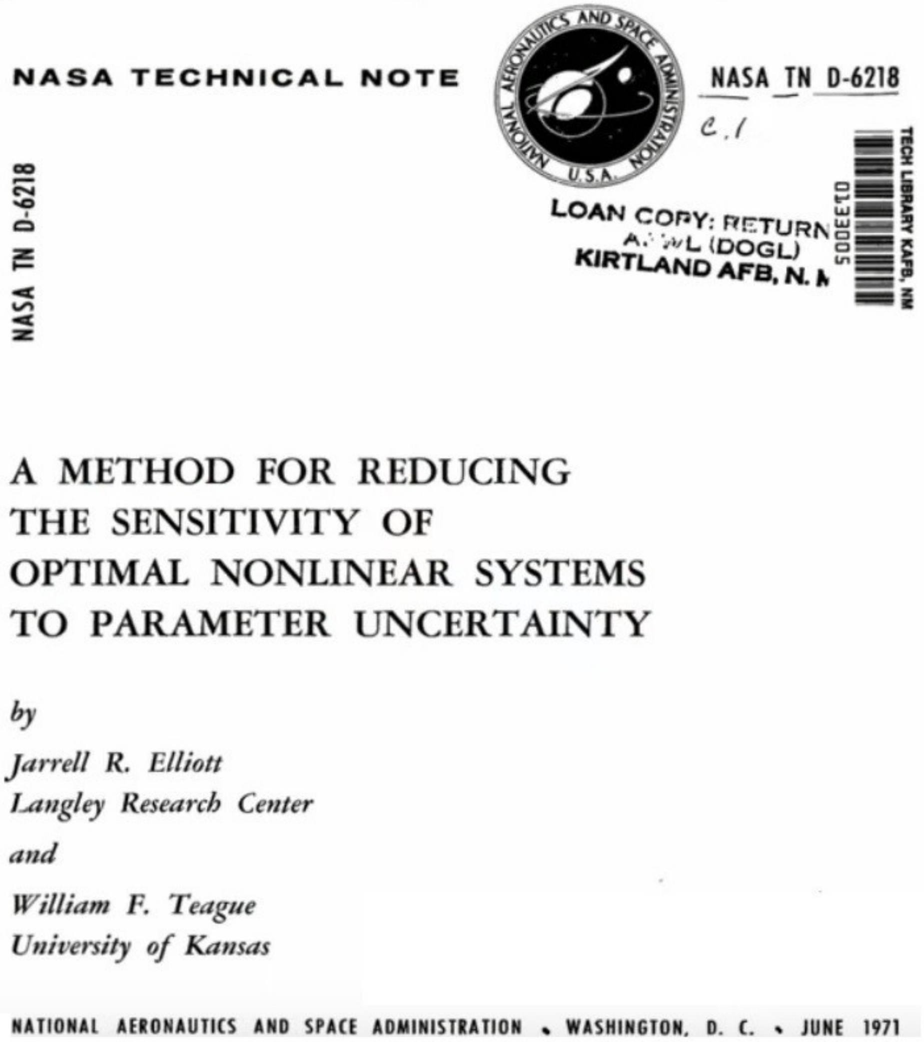
Regierung gibt Flache Erde zu: Dok #11

THE UNIVERSITY OF KANSAS

Title: A Method for Reducing The Sensitivity of Optimal Nonlinear Systems to Parameter Uncertainty

Author: Jarrell R. Elliott (Langley Research Center) and William F. Teague (University of Kansas)

URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19710018599.pdf



NASA TECHNICAL NOTE

NASA TN D-6218

c.1

NASA TN D-6218

A METHOD FOR REDUCING THE SENSITIVITY OF OPTIMAL NONLINEAR SYSTEMS TO PARAMETER UNCERTAINTY

by

Jarrell R. Elliott
Langley Research Center

and

William F. Teague
University of Kansas

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • JUNE 1971

Problem Statement

The example problem is a fixed-time problem in which it is required to determine the thrust-attitude program of a single-stage rocket vehicle starting from rest and going to specified terminal conditions of altitude and vertical velocity which will maximize the final horizontal velocity. The idealizing assumptions made are the following:

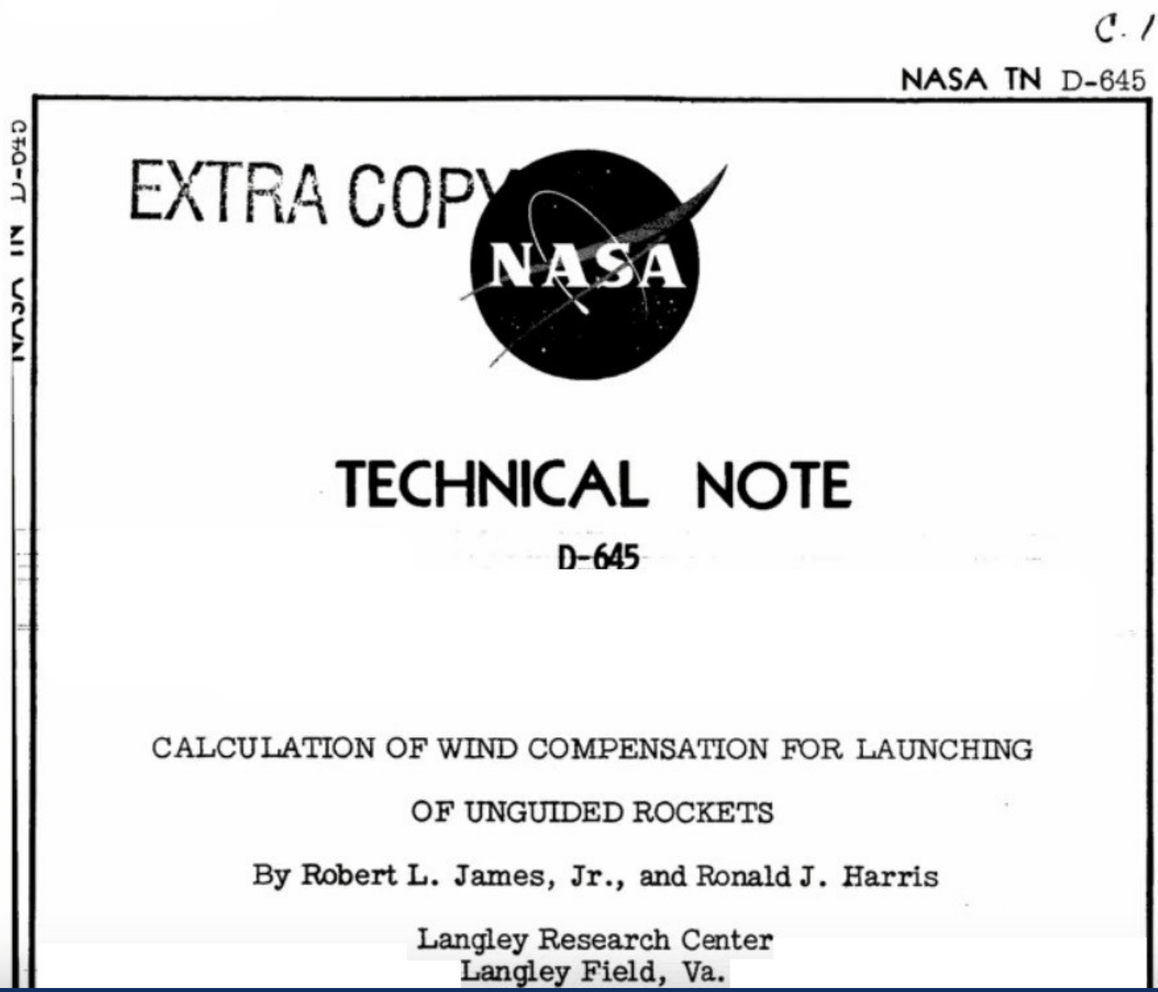
(1) A point-mass vehicle
(2) A flat, nonrotating earth
(3) A constant-gravity field, $g = 9.8\ \text{m/sec}^2$ $(32.2\ \text{ft/sec}^2)$
(4) Constant thrust and mass-loss rate
(5) A nonlifting body in a nonvarying atmosphere with a constant drag parameter $K_D = \frac{1}{2}\rho C_D S$, where S is the frontal surface area.

Regierung gibt Flache Erde zu: Dok #12

Title: Calculation of Wind Compensation for Launching of Unguided Rockets

Author: Robert L. James, Jr., and Ronald J. Harris

URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20040008097.pdf



C. 1

NASA TN D-645

NASA TN D-645

EXTRA COPY

TECHNICAL NOTE

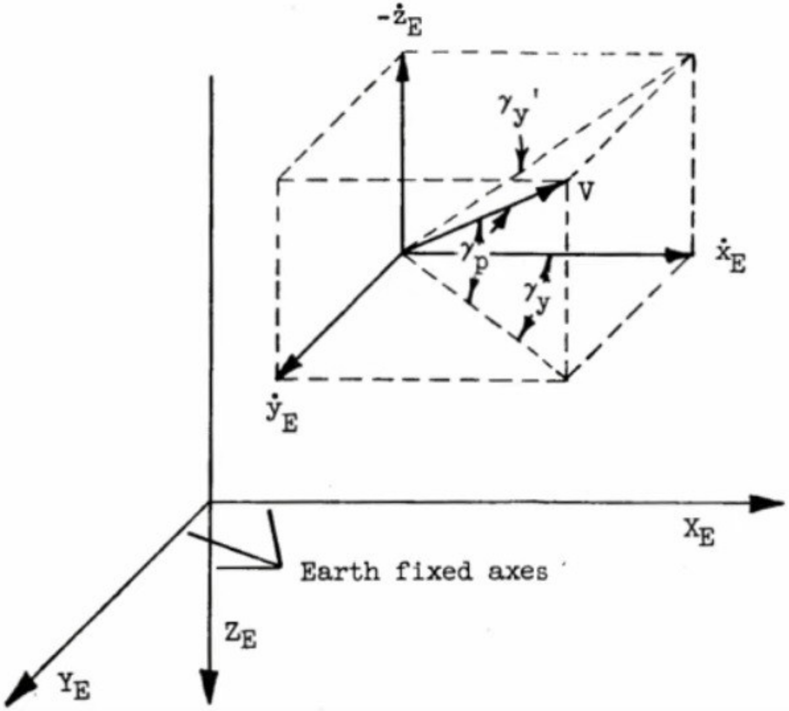
D-645

CALCULATION OF WIND COMPENSATION FOR LAUNCHING OF UNGUIDED ROCKETS

By Robert L. James, Jr., and Ronald J. Harris

Langley Research Center
Langley Field, Va.

A trajectory simulation incorporating the above requirements is presented in reference 8. In addition to the above requirements, this simulation assumes a vehicle with six degrees of freedom and aerodynamic symmetry in roll and the missile position in space is computed relative to a flat nonrotating earth. This trajectory simulation was programmed on the IBM 704 electronic data processing machine and is the basis for all trajectory computations made in this paper.

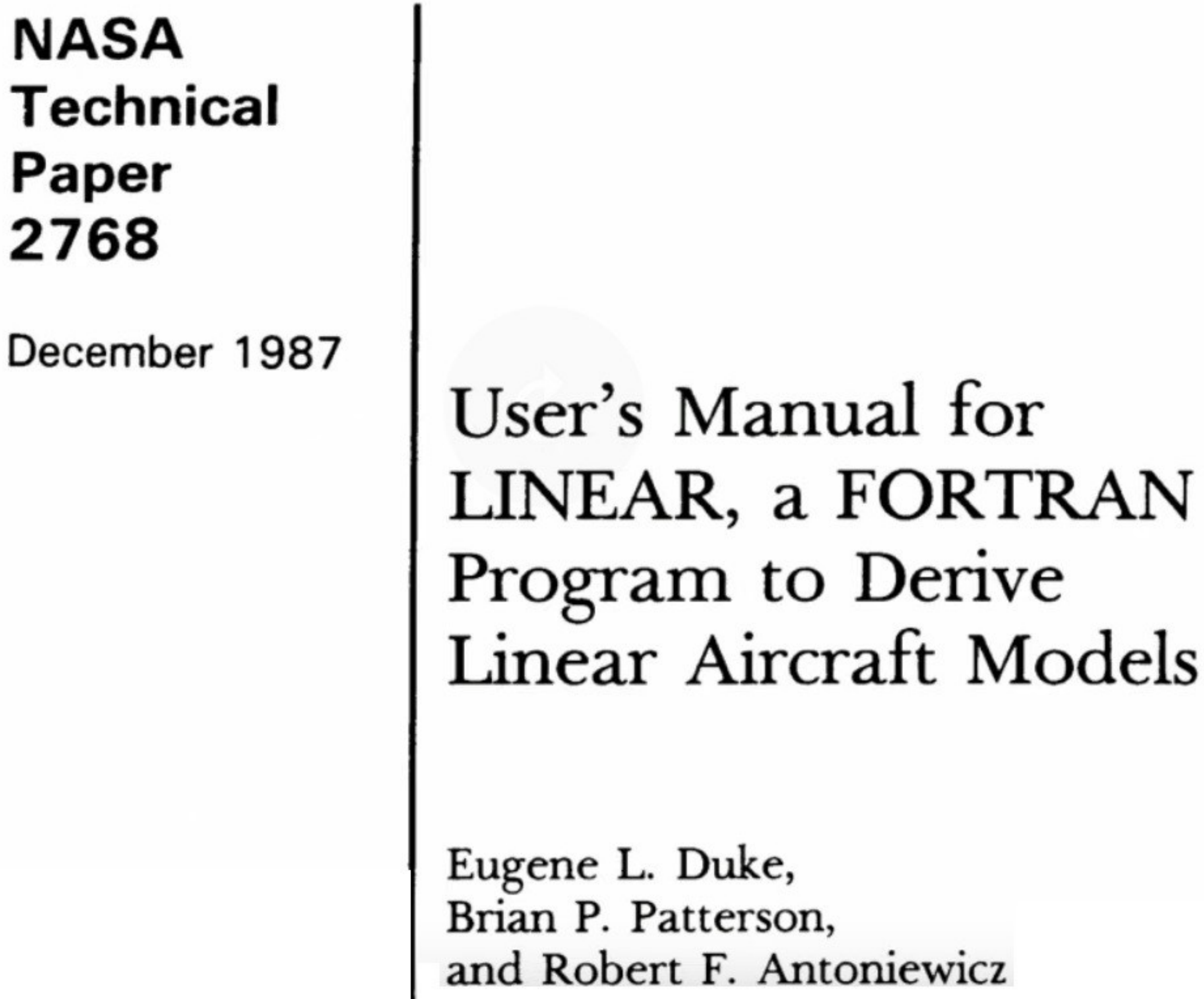


Regierung gibt Flache Erde zu: Dok #13

Title: User's Manual for LINEAR, a FORTRAN Program to Derive Linear Aircraft Models (2768)

Author: Eugene L. Duke, Brian P. Patterson, and Robert F. Antoniewicz

URL:
https://www.nasa.gov/centers/dryden/pdf/88072main_H-1259.pdf



NASA
Technical
Paper
2768

December 1987

User's Manual for LINEAR, a FORTRAN Program to Derive Linear Aircraft Models

Eugene L. Duke,
Brian P. Patterson,
and Robert F. Antoniewicz

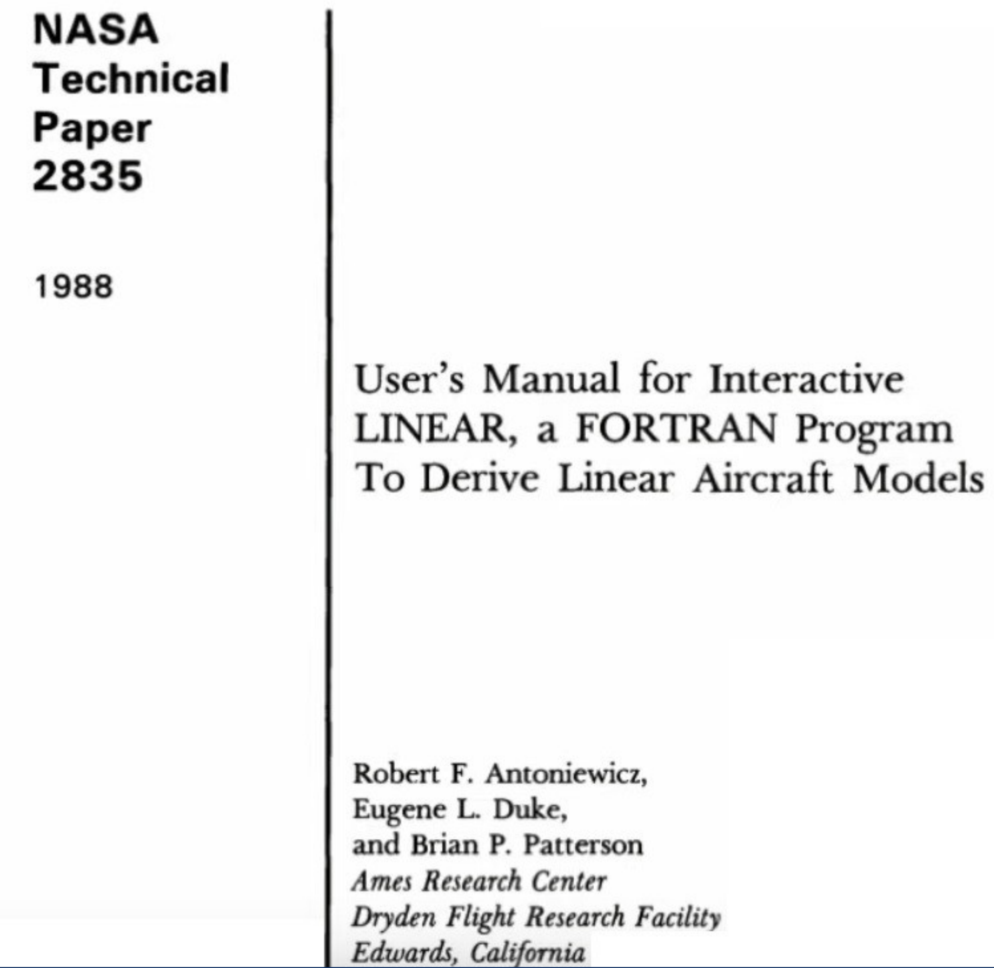
Within the program, the nonlinear equations of motion include 12 states representing a rigid aircraft flying in a stationary atmosphere over a flat nonrotating earth. Thus, the state vector **x** is computed internally as

Regierung gibt Flache Erde zu: Dok #14

Title: User's Manual for LINEAR,
a FORTRAN Program to Derive
Linear Aircraft Models (2835)

Author: Eugene L. Duke, Brian P.
Patterson, and Robert F.
Antoniewicz

URL:
https://ntrs.nasa.gov/archive/na
sa/casi.ntrs.nasa.gov/19890007
066.pdf



NASA
Technical
Paper
2835

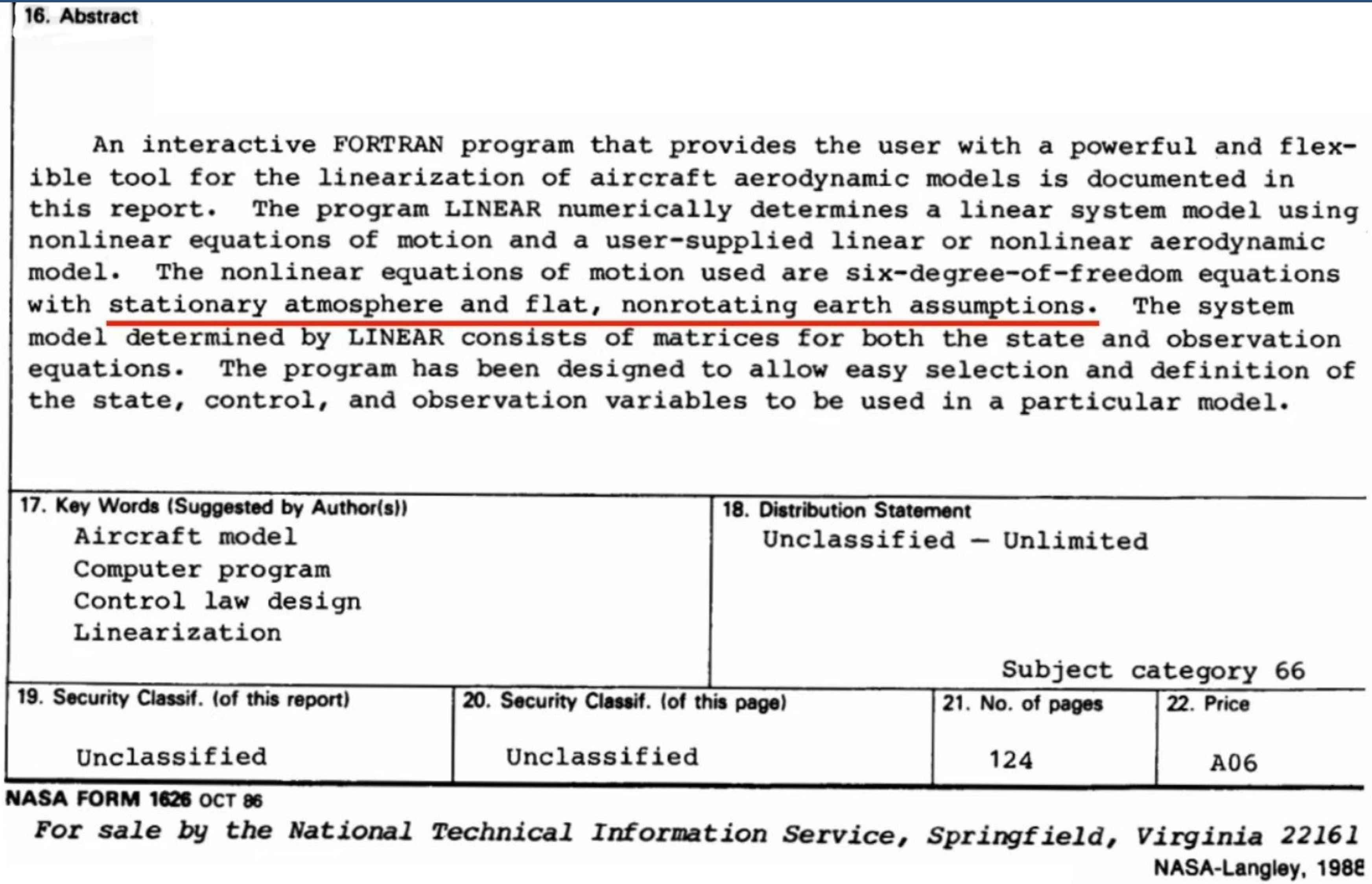
1988

User's Manual for Interactive
LINEAR, a FORTRAN Program
To Derive Linear Aircraft Models

Robert F. Antoniewicz,
Eugene L. Duke,
and Brian P. Patterson
Ames Research Center
Dryden Flight Research Facility
Edwards, California

SUMMARY

An interactive FORTRAN program that provides the user with a powerful and flexible tool for the linearization of aircraft aerodynamic models is documented in this report. The program LINEAR numerically determines a linear system model using nonlinear equations of motion and a user-supplied linear or nonlinear aerodynamic model. The nonlinear equations of motion used are six-degree-of-freedom equations with stationary atmosphere and flat, nonrotating earth assumptions. The system model determined by LINEAR consists of matrices for both the state and observation equations. The program has been designed to allow easy selection and definition of the state, control, and observation variables to be used in a particular model.



16. Abstract

An interactive FORTRAN program that provides the user with a powerful and flexible tool for the linearization of aircraft aerodynamic models is documented in this report. The program LINEAR numerically determines a linear system model using nonlinear equations of motion and a user-supplied linear or nonlinear aerodynamic model. The nonlinear equations of motion used are six-degree-of-freedom equations with stationary atmosphere and flat, nonrotating earth assumptions. The system model determined by LINEAR consists of matrices for both the state and observation equations. The program has been designed to allow easy selection and definition of the state, control, and observation variables to be used in a particular model.

17. Key Words (Suggested by Author(s)) Aircraft model Computer program Control law design Linearization	**18. Distribution Statement** Unclassified — Unlimited Subject category 66

19. Security Classif. (of this report)	**20. Security Classif. (of this page)**	**21. No. of pages**	**22. Price**
Unclassified	Unclassified	124	A06

NASA FORM 1626 OCT 86

For sale by the National Technical Information Service, Springfield, Virginia 22161

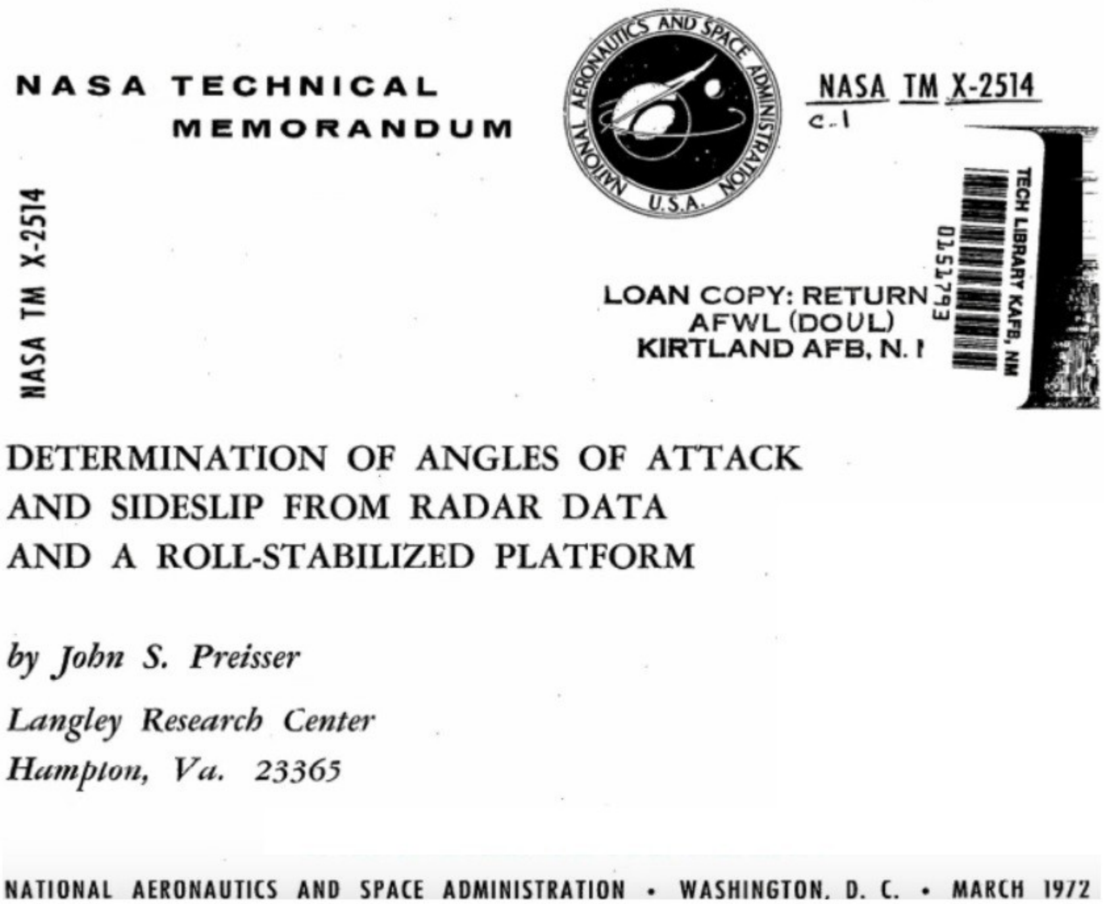
NASA-Langley, 198

Regierung gibt Flache Erde zu: Dok #15

Title: Determination of Angles of Attack and Sideslip from Radar Data and a Roll-Stabilized Platform

Author: John S. Preisser

URL:
https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19720012071.pdf



NASA TECHNICAL MEMORANDUM

NASA TM X-2514

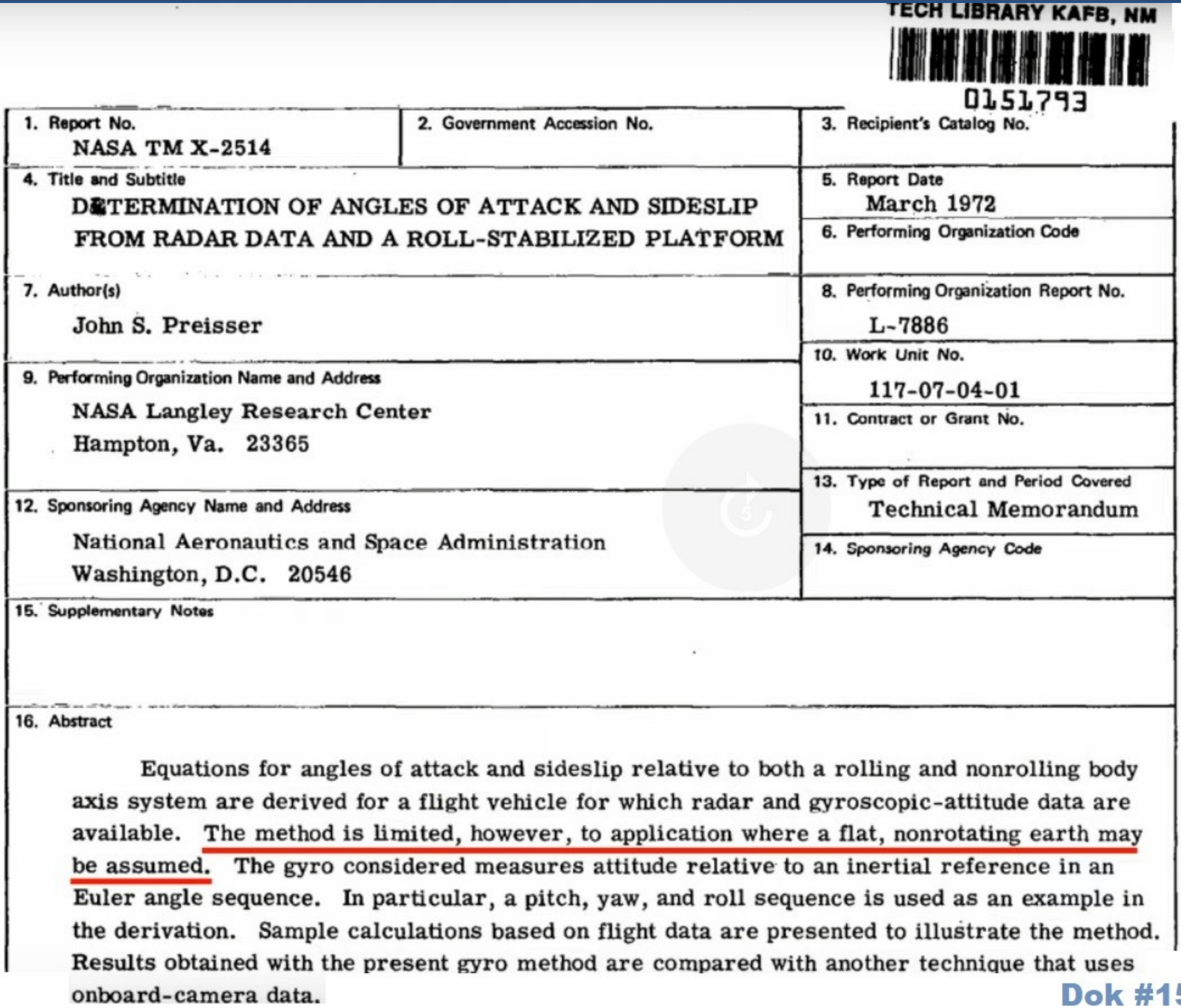
NASA TM X-2514
c.1

DETERMINATION OF ANGLES OF ATTACK AND SIDESLIP FROM RADAR DATA AND A ROLL-STABILIZED PLATFORM

by John S. Preisser

Langley Research Center
Hampton, Va. 23365

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • MARCH 1972



1. Report No. NASA TM X-2514	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle DETERMINATION OF ANGLES OF ATTACK AND SIDESLIP FROM RADAR DATA AND A ROLL-STABILIZED PLATFORM		5. Report Date March 1972
		6. Performing Organization Code
7. Author(s) John S. Preisser		8. Performing Organization Report No. L-7886
9. Performing Organization Name and Address NASA Langley Research Center Hampton, Va. 23365		10. Work Unit No. 117-07-04-01
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		13. Type of Report and Period Covered Technical Memorandum
		14. Sponsoring Agency Code
15. Supplementary Notes		

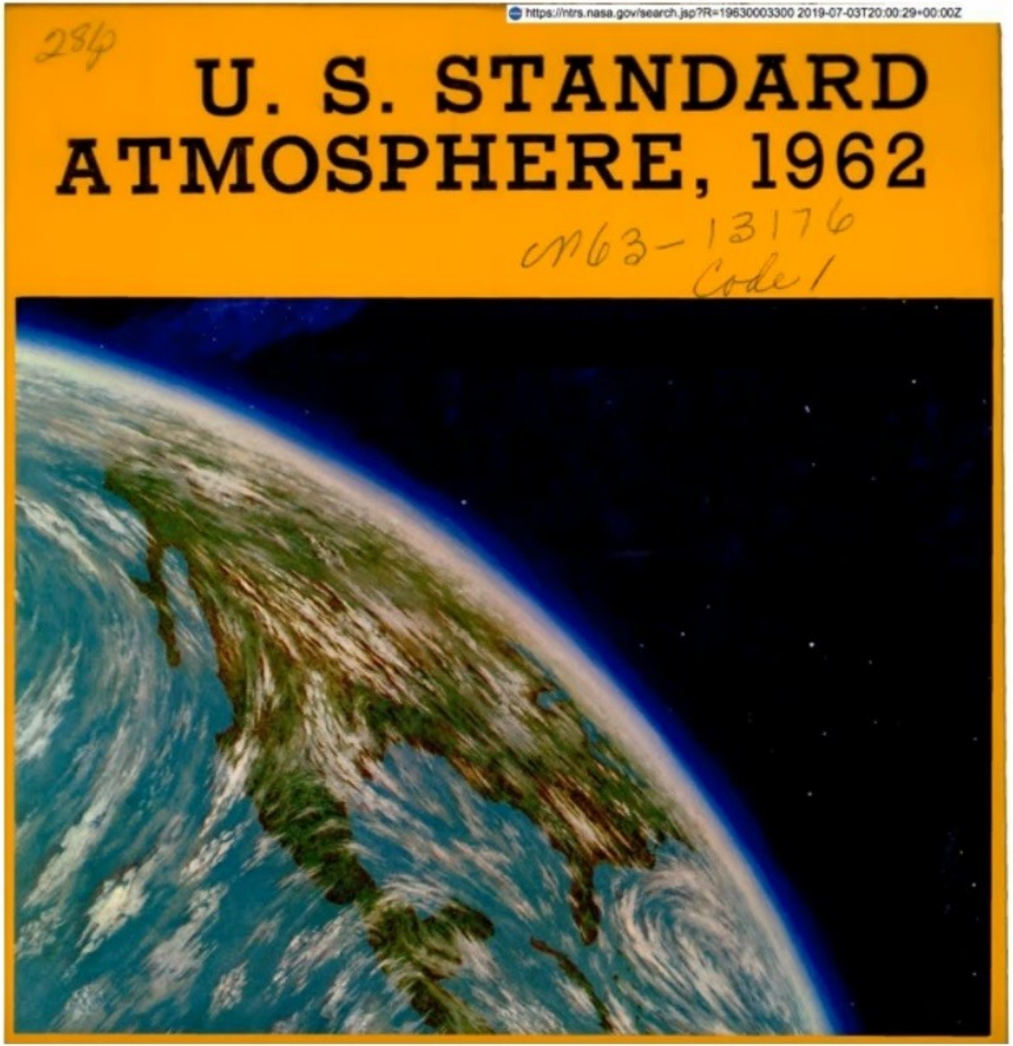
16. Abstract

Equations for angles of attack and sideslip relative to both a rolling and nonrolling body axis system are derived for a flight vehicle for which radar and gyroscopic-attitude data are available. The method is limited, however, to application where a flat, nonrotating earth may be assumed. The gyro considered measures attitude relative to an inertial reference in an Euler angle sequence. In particular, a pitch, yaw, and roll sequence is used as an example in the derivation. Sample calculations based on flight data are presented to illustrate the method. Results obtained with the present gyro method are compared with another technique that uses onboard-camera data.

Regierung gibt Flache Erde zu: Dok #16

Title: U.S. Standard Atmosphere (1962)

URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19630003300.pdf

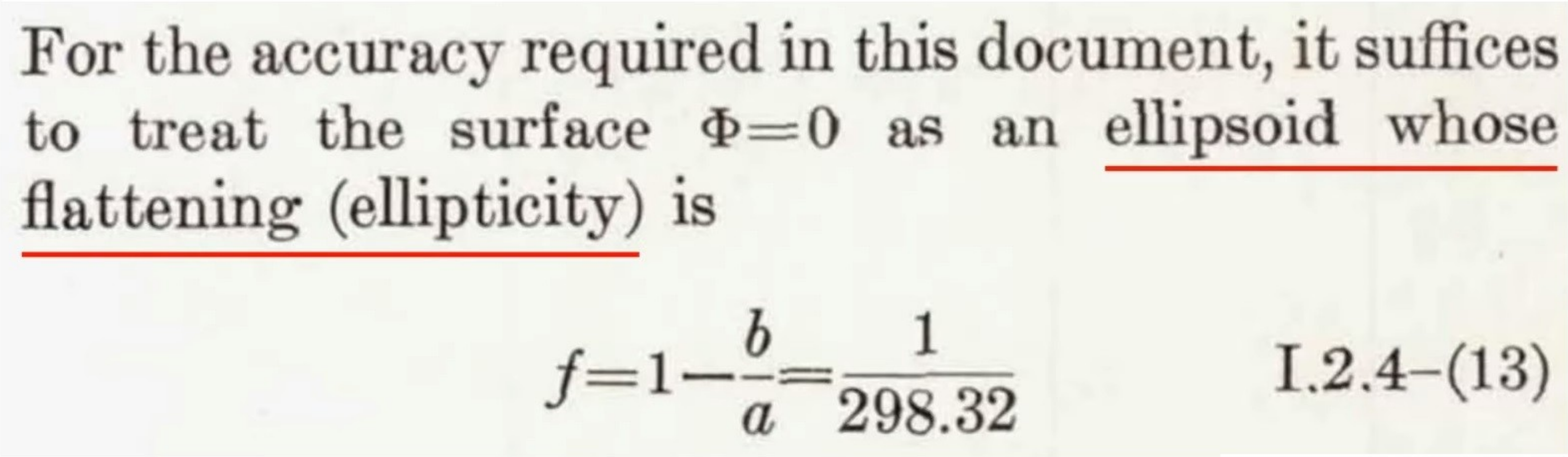


https://ntrs.nasa.gov/search.jsp?R=19630003300 2019-07-03T20:00:29+00:00Z

284

U. S. STANDARD
ATMOSPHERE, 1962

N63-13176
Code 1



For the accuracy required in this document, it suffices to treat the surface $\Phi = 0$ as an ellipsoid whose flattening (ellipticity) is

$$f = 1 - \frac{b}{a} = \frac{1}{298.32} \tag{I.2.4–(13)}$$

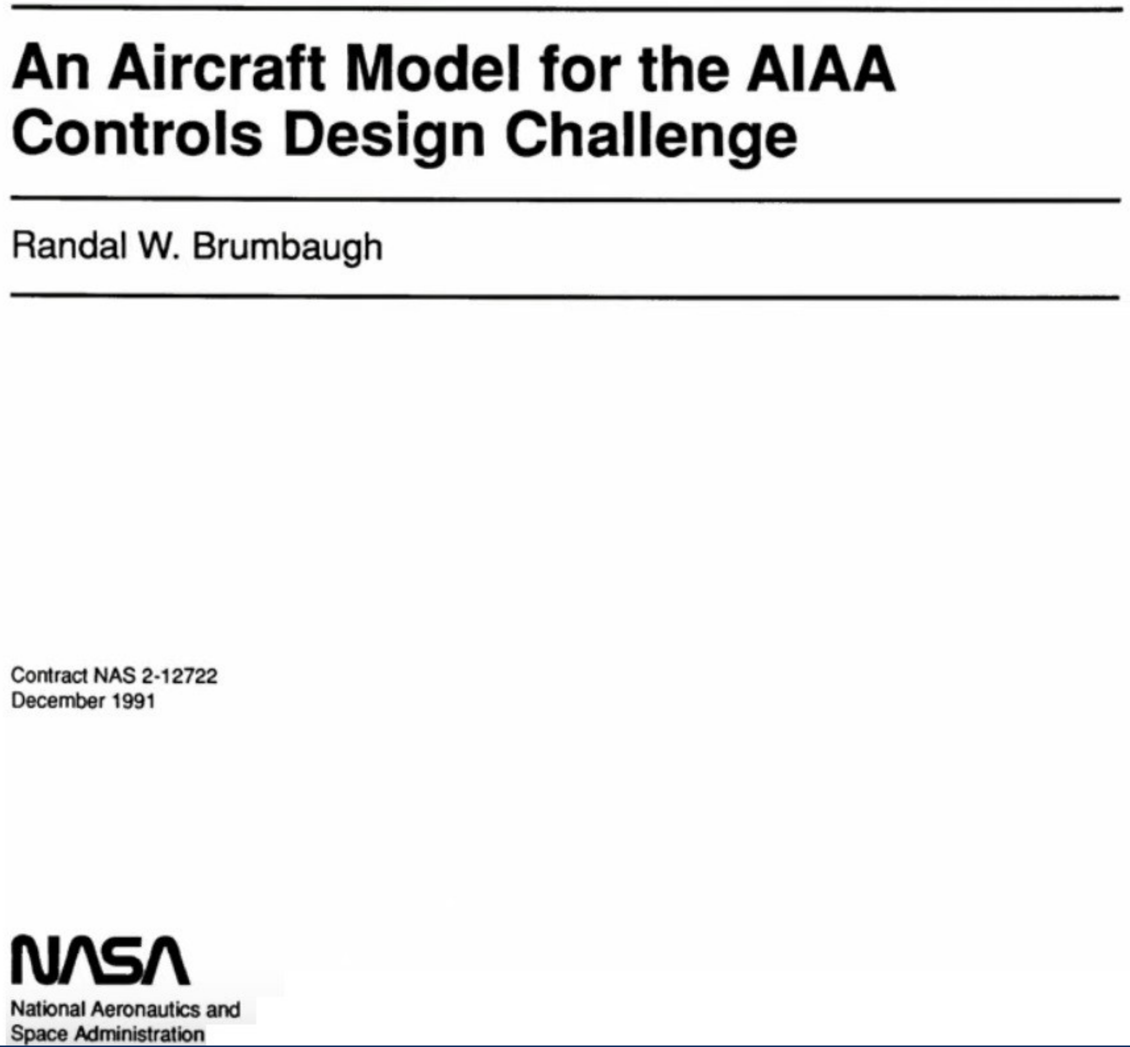
Dok #16: Seite 22 von 296

Regierung gibt Flache Erde zu: Dok #17

Title: An Aircraft Model for the AIAA Controls Design Challenge

Author: Randal W. Brumbaugh

URL:
https://www.nasa.gov/centers/dryden/pdf/88248main_H-1777.pdf

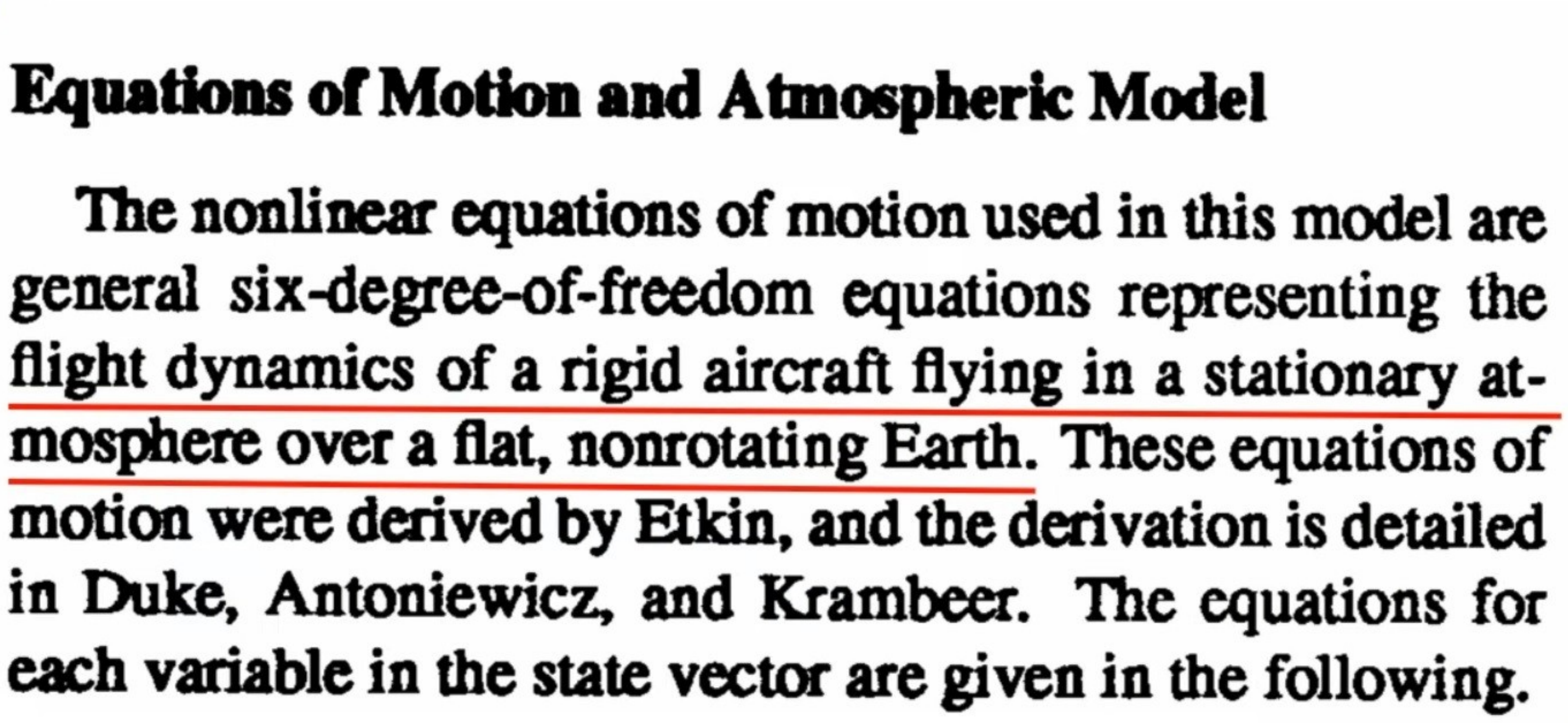


An Aircraft Model for the AIAA Controls Design Challenge

Randal W. Brumbaugh

Contract NAS 2-12722
December 1991

NASA
National Aeronautics and
Space Administration



Equations of Motion and Atmospheric Model

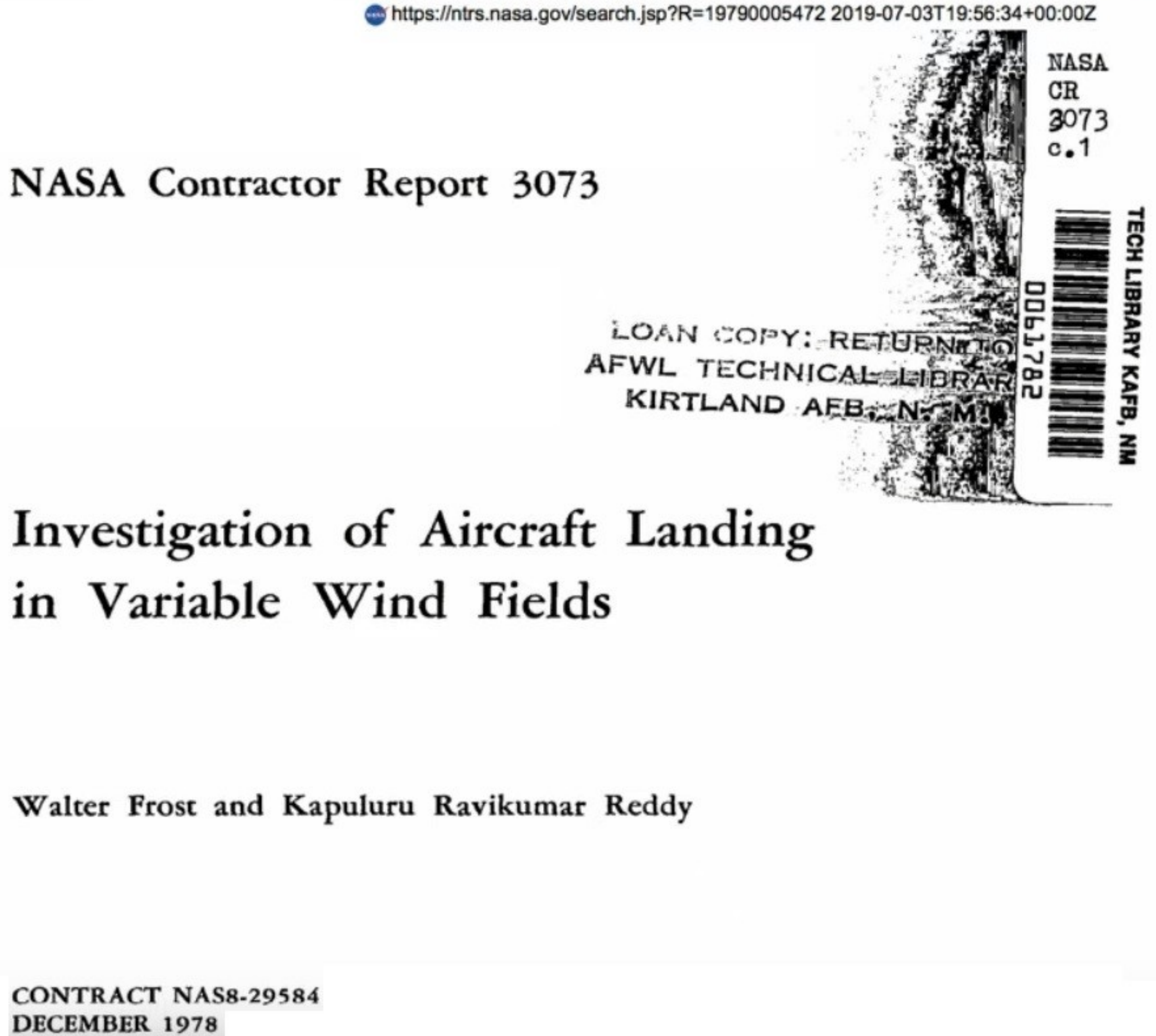
The nonlinear equations of motion used in this model are general six-degree-of-freedom equations representing the flight dynamics of a rigid aircraft flying in a stationary atmosphere over a flat, nonrotating Earth. These equations of motion were derived by Etkin, and the derivation is detailed in Duke, Antoniewicz, and Krambeer. The equations for each variable in the state vector are given in the following.

Regierung gibt Flache Erde zu: Dok #18

Title: Investigation of Aircraft Landing in Variable Wind Fields

Author: Walter Frost and Kapuluru Ravikumar Reddy

URL:
https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19790005472.pdf



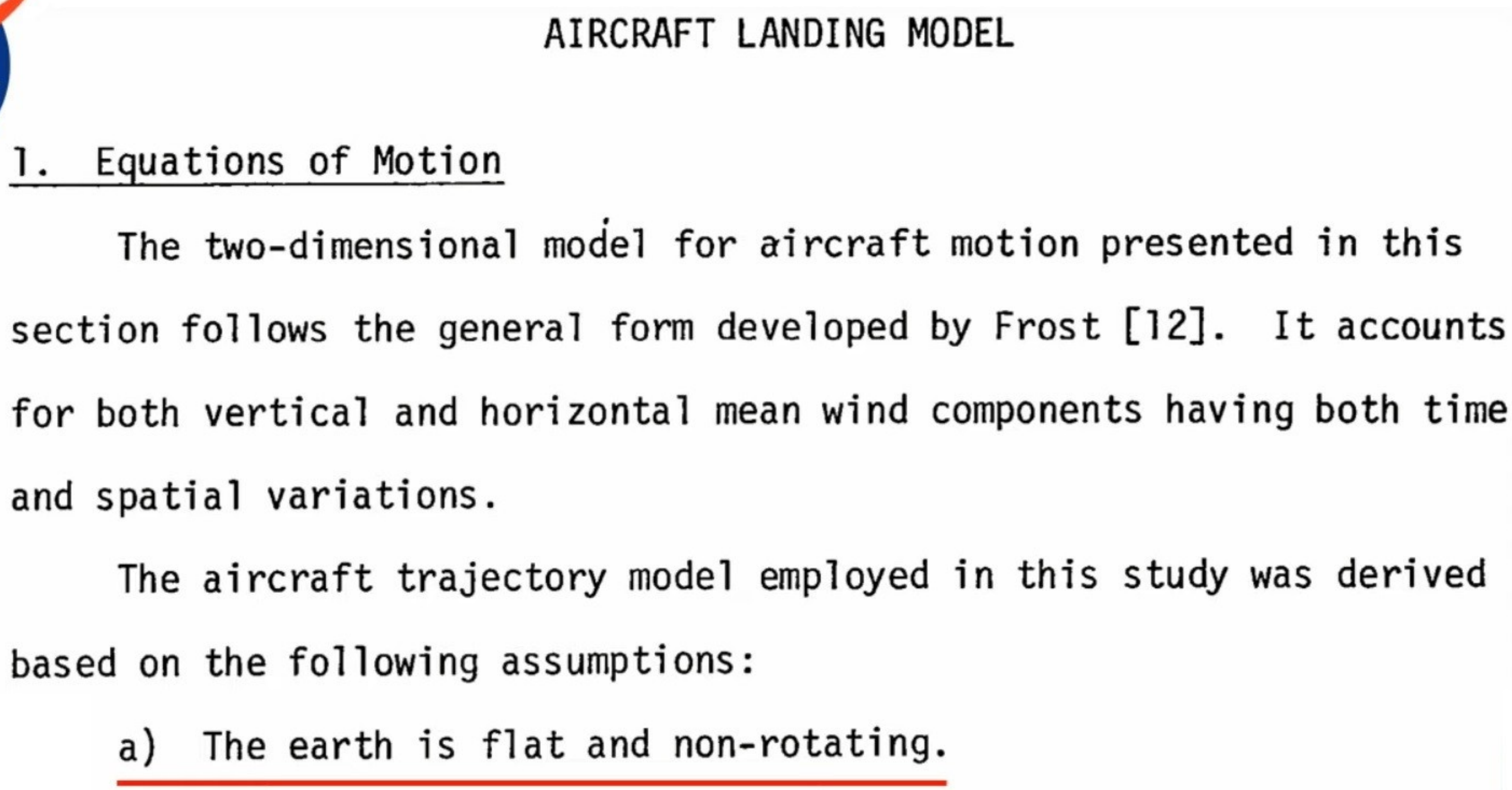
https://ntrs.nasa.gov/search.jsp?R=19790005472 2019-07-03T19:56:34+00:00Z

NASA Contractor Report 3073

Investigation of Aircraft Landing in Variable Wind Fields

Walter Frost and Kapuluru Ravikumar Reddy

CONTRACT NAS8-29584
DECEMBER 1978



AIRCRAFT LANDING MODEL

1. Equations of Motion

The two-dimensional model for aircraft motion presented in this section follows the general form developed by Frost [12]. It accounts for both vertical and horizontal mean wind components having both time and spatial variations.

The aircraft trajectory model employed in this study was derived based on the following assumptions:

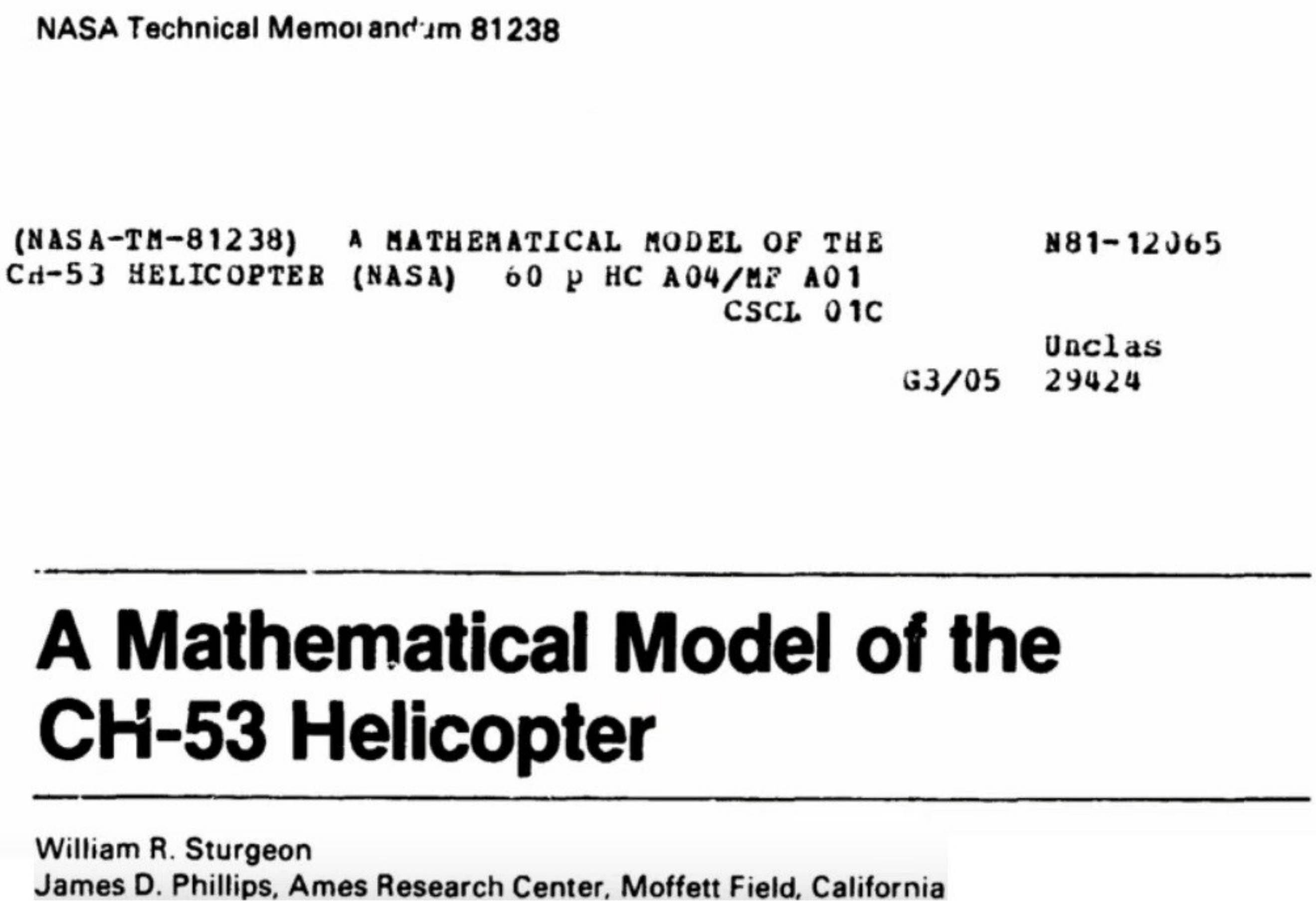
a) The earth is flat and non-rotating.

Regierung gibt Flache Erde zu: Dok #19

Title: A Mathematical Model of the CH-53 Helicopter

Author: William R. Sturgeon, James D. Phillips, Ames Research Center, Moffett Field, California

URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19810003557.pdf

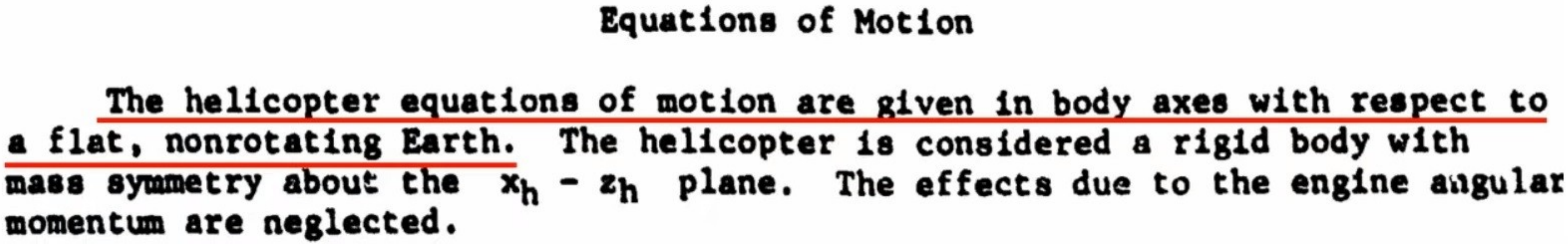


NASA Technical Memorandum 81238

```
(NASA-TM-81238)   A MATHEMATICAL MODEL OF THE         N81-12065
CH-53 HELICOPTER  (NASA)   60 p HC A04/MF A01
                                          CSCL 01C
                                                      Unclas
                                             G3/05    29424
```

A Mathematical Model of the CH-53 Helicopter

William R. Sturgeon
James D. Phillips, Ames Research Center, Moffett Field, California



Equations of Motion

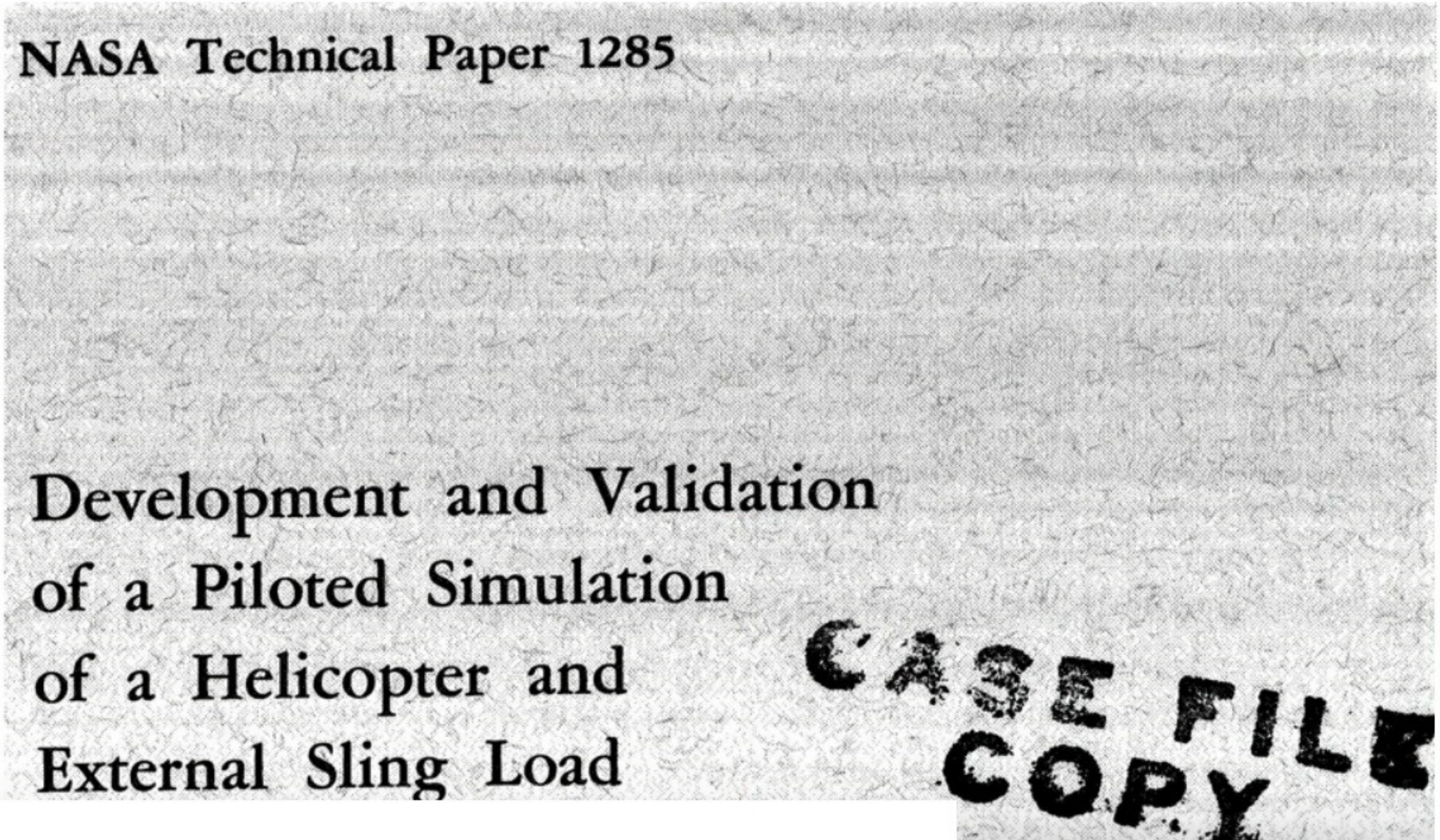
The helicopter equations of motion are given in body axes with respect to a flat, nonrotating Earth. The helicopter is considered a rigid body with mass symmetry about the $x_h - z_h$ plane. The effects due to the engine angular momentum are neglected.

Regierung gibt Flache Erde zu: Dok #20

Title: The Development and Validation of a Piloted Simulation of a Helicopter and External Sling Load

Author: J. D. Shaughnessy, Thomas N. Deaux, and Kenneth R. Yenni

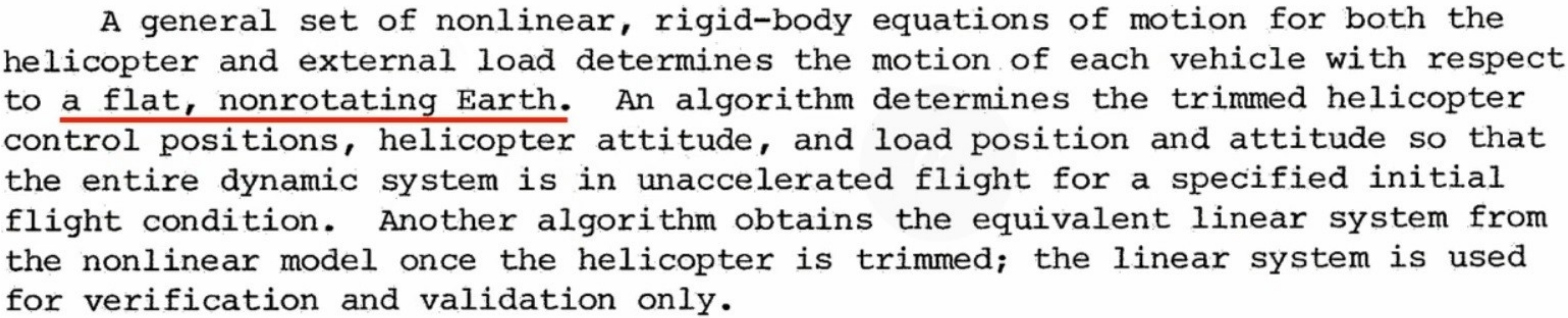
URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19790005912.pdf



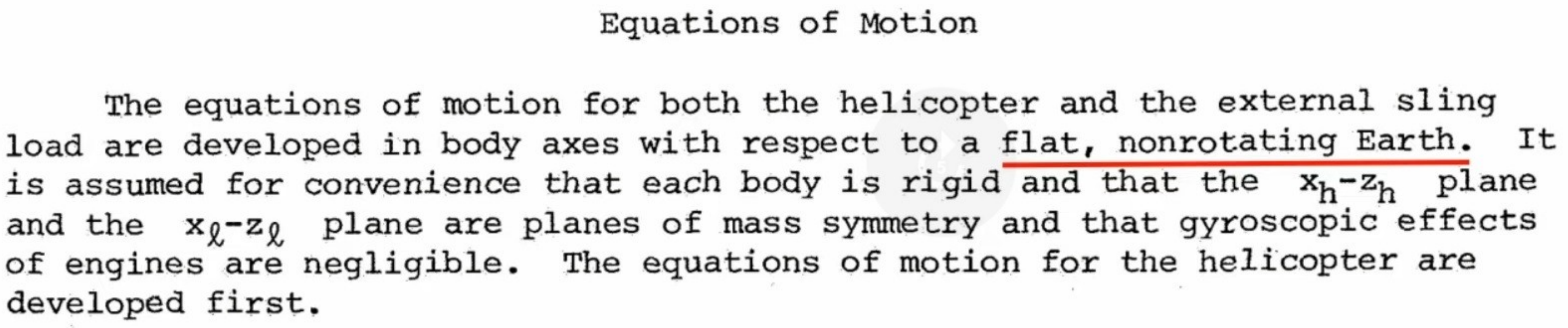
NASA Technical Paper 1285

Development and Validation of a Piloted Simulation of a Helicopter and External Sling Load

CASE FILE COPY

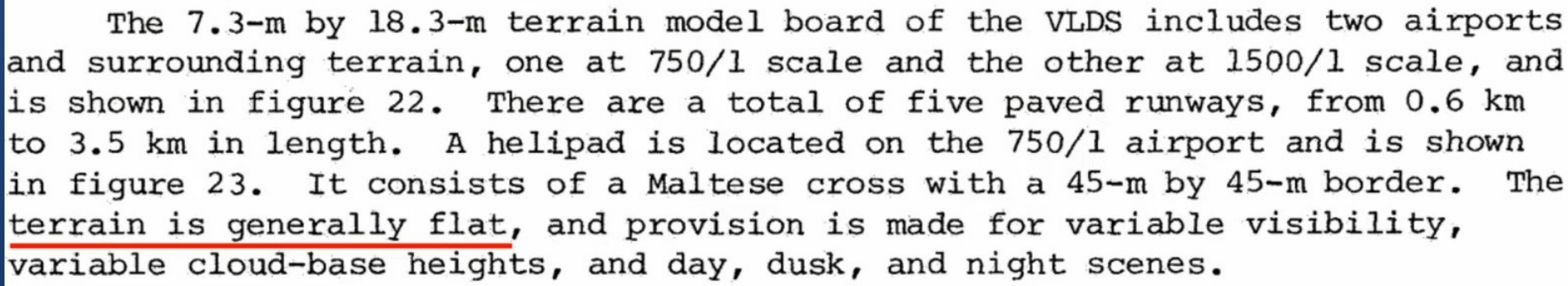


A general set of nonlinear, rigid-body equations of motion for both the helicopter and external load determines the motion of each vehicle with respect to a flat, nonrotating Earth. An algorithm determines the trimmed helicopter control positions, helicopter attitude, and load position and attitude so that the entire dynamic system is in unaccelerated flight for a specified initial flight condition. Another algorithm obtains the equivalent linear system from the nonlinear model once the helicopter is trimmed; the linear system is used for verification and validation only.



Equations of Motion

The equations of motion for both the helicopter and the external sling load are developed in body axes with respect to a flat, nonrotating Earth. It is assumed for convenience that each body is rigid and that the x_h-z_h plane and the x_ℓ-z_ℓ plane are planes of mass symmetry and that gyroscopic effects of engines are negligible. The equations of motion for the helicopter are developed first.



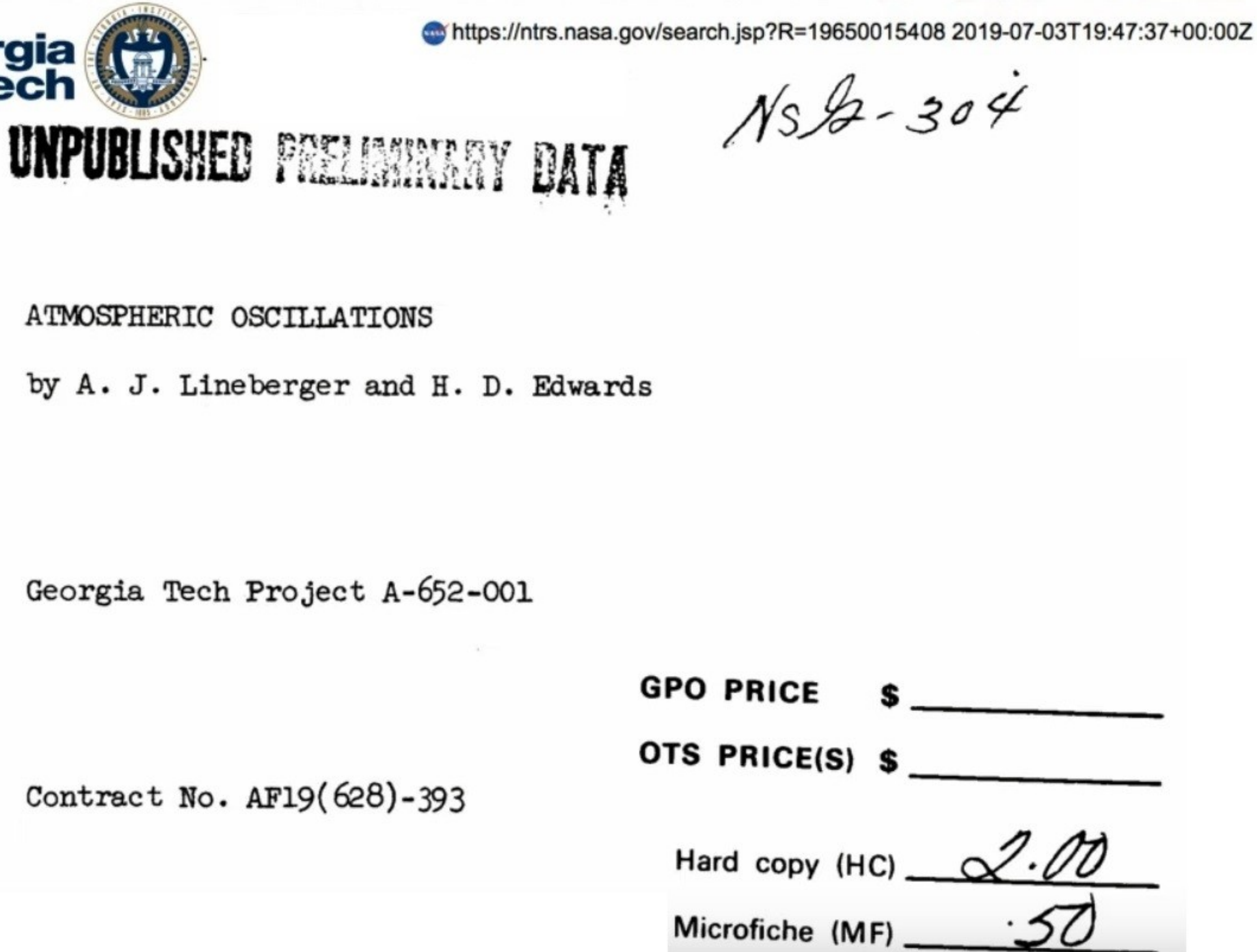
The 7.3-m by 18.3-m terrain model board of the VLDS includes two airports and surrounding terrain, one at 750/1 scale and the other at 1500/1 scale, and is shown in figure 22. There are a total of five paved runways, from 0.6 km to 3.5 km in length. A helipad is located on the 750/1 airport and is shown in figure 23. It consists of a Maltese cross with a 45-m by 45-m border. The terrain is generally flat, and provision is made for variable visibility, variable cloud-base heights, and day, dusk, and night scenes.

Regierung gibt Flache Erde zu: Dok #21

Title: Atmospheric Oscillations

Author: A. J. Lineberger and H. D. Edwards

URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19650015408.pdf



https://ntrs.nasa.gov/search.jsp?R=19650015408 2019-07-03T19:47:37+00:00Z

NsG-304

UNPUBLISHED PRELIMINARY DATA

ATMOSPHERIC OSCILLATIONS

by A. J. Lineberger and H. D. Edwards

Georgia Tech Project A-652-001

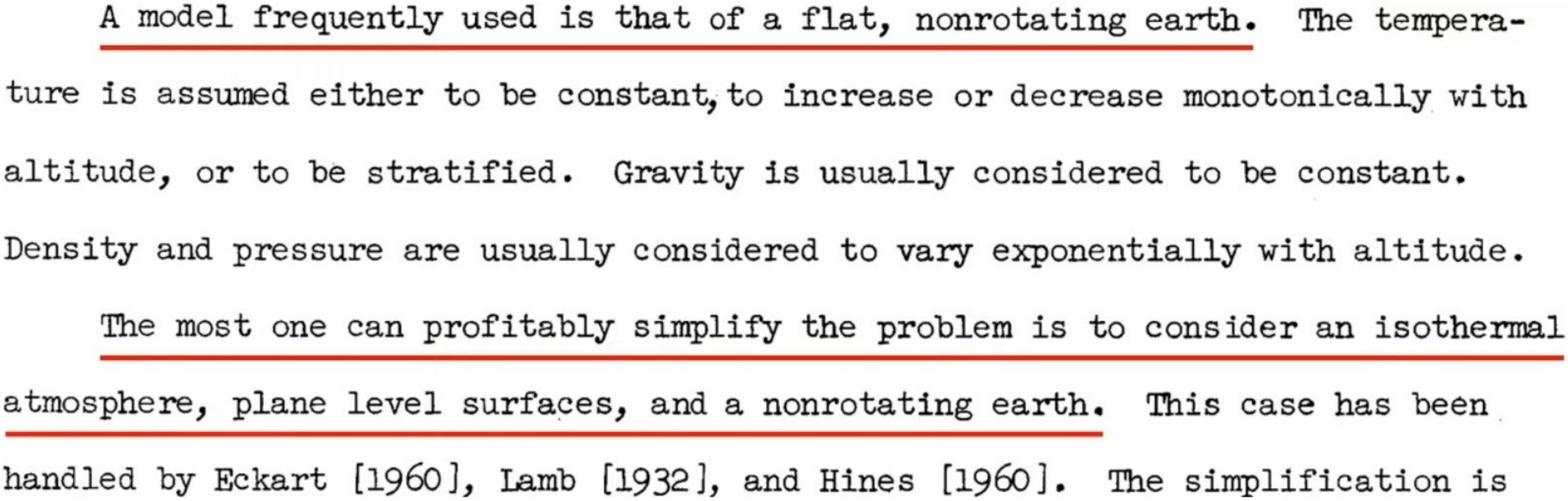
Contract No. AF19(628)-393

GPO PRICE $ ______

OTS PRICE(S) $ ______

Hard copy (HC) 2.00

Microfiche (MF) .50



A model frequently used is that of a flat, nonrotating earth. The temperature is assumed either to be constant, to increase or decrease monotonically with altitude, or to be stratified. Gravity is usually considered to be constant. Density and pressure are usually considered to vary exponentially with altitude.

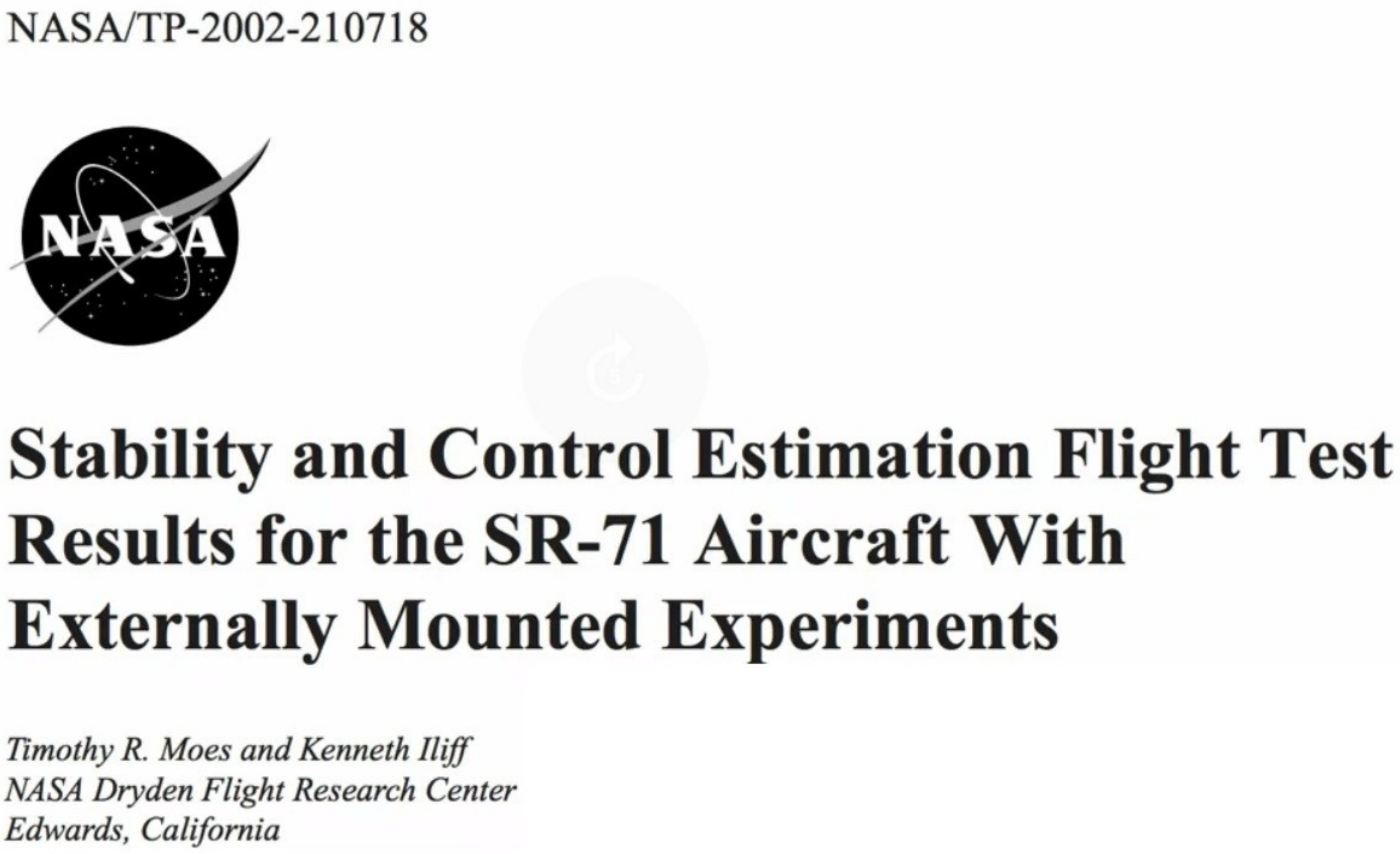
The most one can profitably simplify the problem is to consider an isothermal atmosphere, plane level surfaces, and a nonrotating earth. This case has been handled by Eckart [1960], Lamb [1932], and Hines [1960]. The simplification is

Regierung gibt Flache Erde zu: Dok #22

Title: Stability and Control Estimation Flight Test Results for the SR-71 Aircraft With Externally Mounted Experiments

Author: Timothy R. Moes and Kenneth Iliff

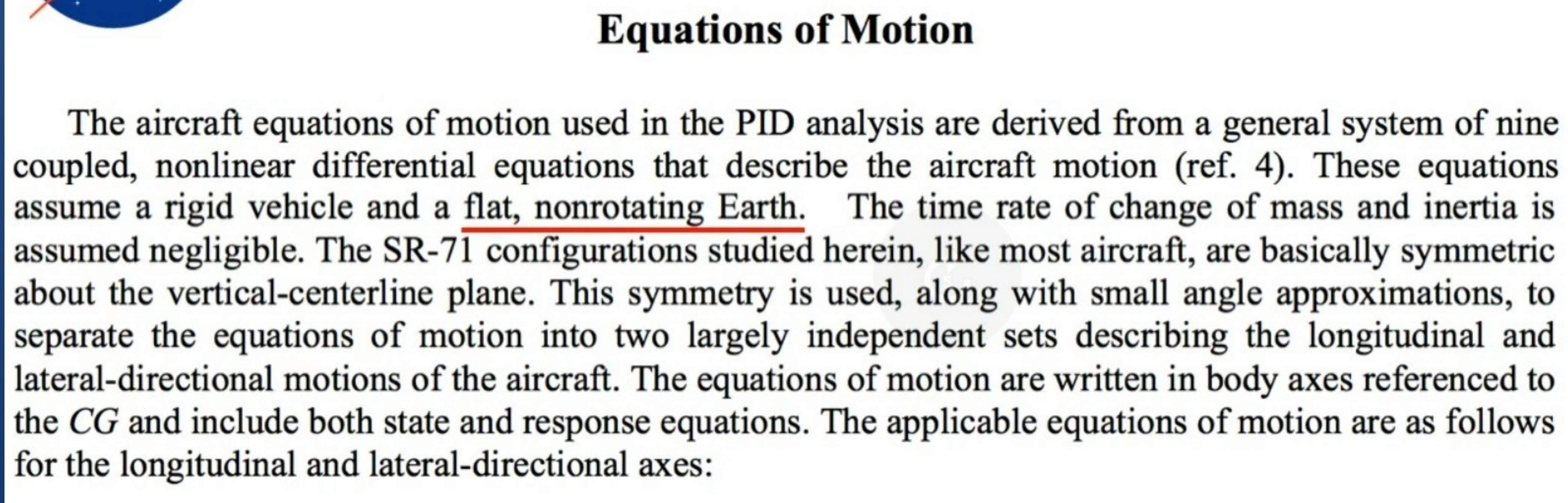
URL:
https://www.nasa.gov/centers/dryden/pdf/88733main_H-2465.pdf



NASA/TP-2002-210718

Stability and Control Estimation Flight Test Results for the SR-71 Aircraft With Externally Mounted Experiments

Timothy R. Moes and Kenneth Iliff
NASA Dryden Flight Research Center
Edwards, California



Equations of Motion

The aircraft equations of motion used in the PID analysis are derived from a general system of nine coupled, nonlinear differential equations that describe the aircraft motion (ref. 4). These equations assume a rigid vehicle and a flat, nonrotating Earth. The time rate of change of mass and inertia is assumed negligible. The SR-71 configurations studied herein, like most aircraft, are basically symmetric about the vertical-centerline plane. This symmetry is used, along with small angle approximations, to separate the equations of motion into two largely independent sets describing the longitudinal and lateral-directional motions of the aircraft. The equations of motion are written in body axes referenced to the *CG* and include both state and response equations. The applicable equations of motion are as follows for the longitudinal and lateral-directional axes:

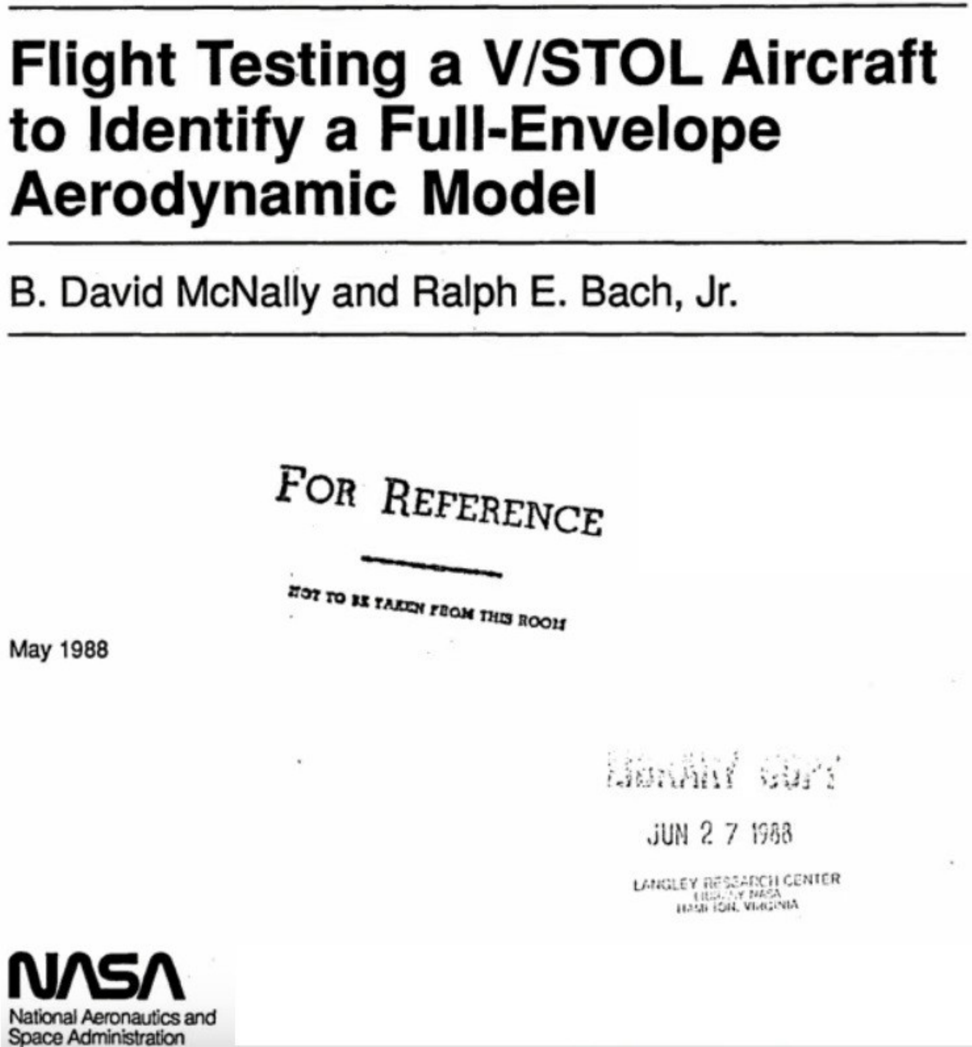
Dok #22: Seite 18&19 von 96

Regierung gibt Flache Erde zu: Dok #23

Title: Flight Testing a V/STOL Aircraft to Identify a Full-Envelope Aerodynamic Model

Author: B. David McNally and Ralph E. Back, Jr.

URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19880014378.pdf

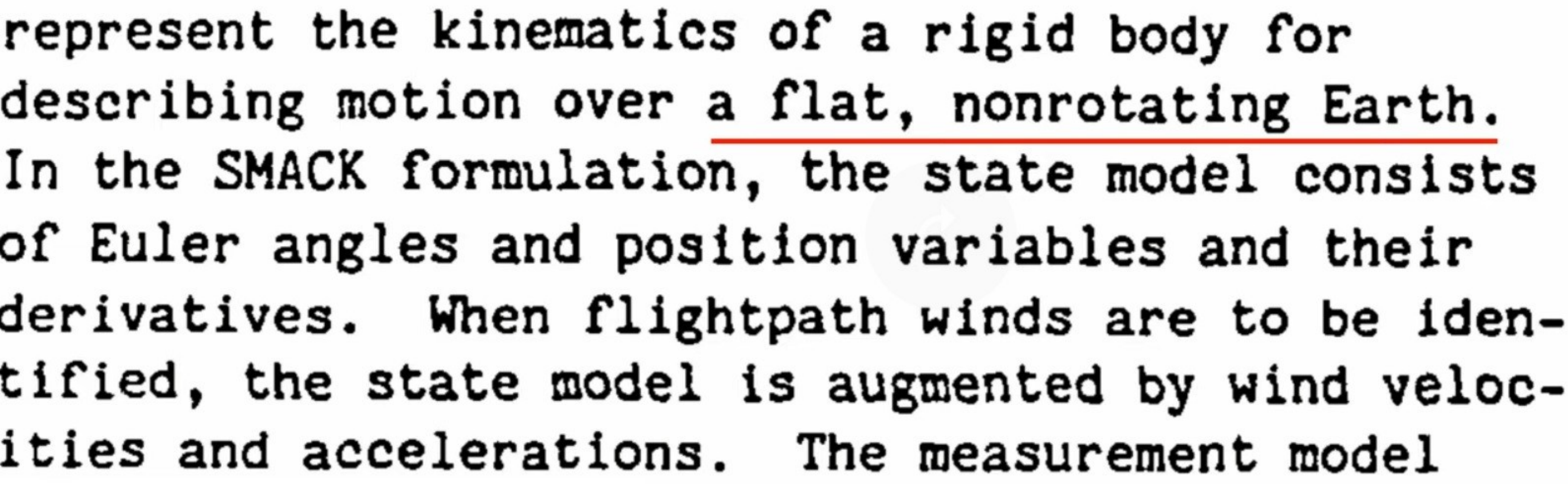


Flight Testing a V/STOL Aircraft to Identify a Full-Envelope Aerodynamic Model

B. David McNally and Ralph E. Bach, Jr.

May 1988

NASA
National Aeronautics and
Space Administration



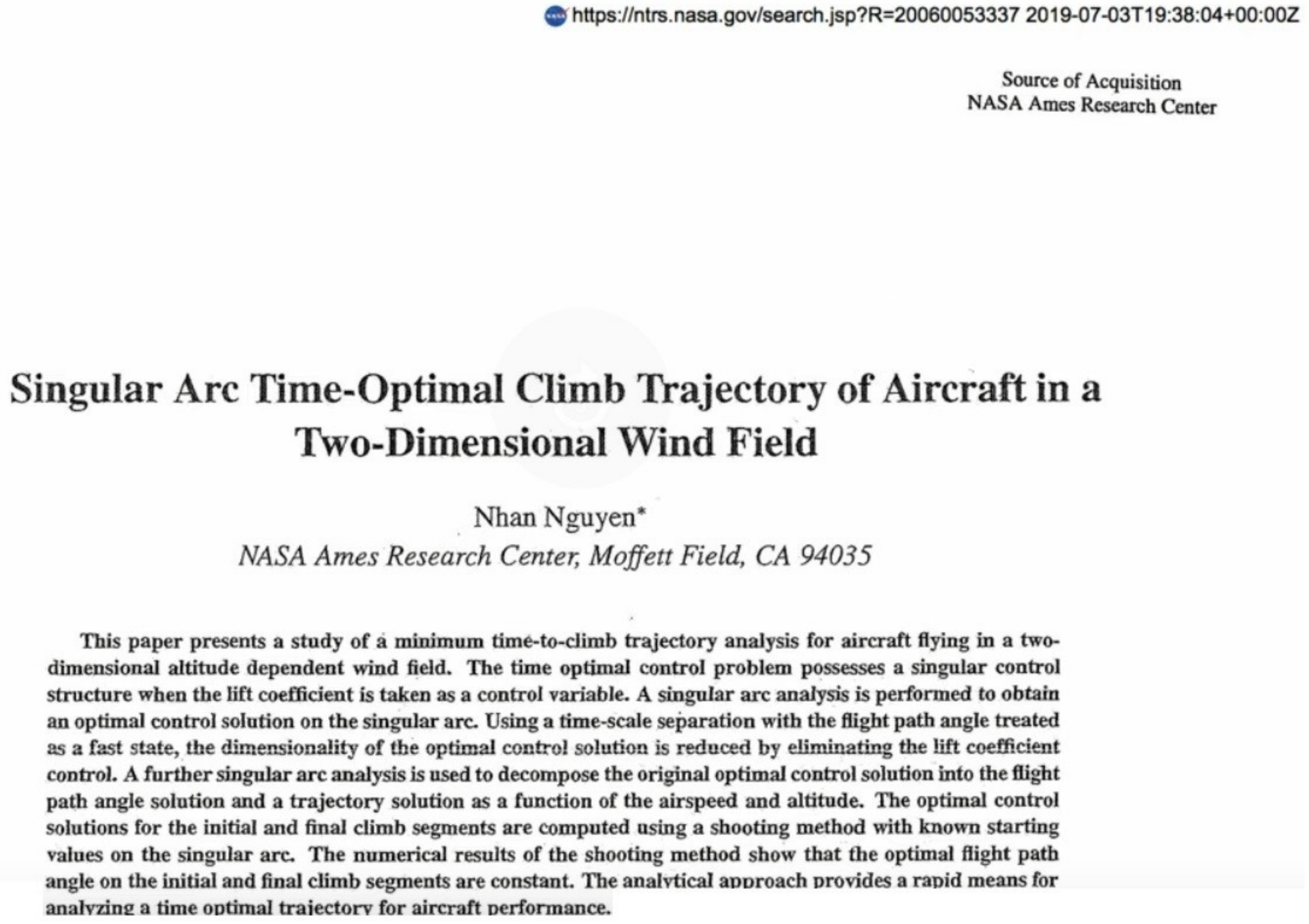
represent the kinematics of a rigid body for describing motion over a flat, nonrotating Earth. In the SMACK formulation, the state model consists of Euler angles and position variables and their derivatives. When flightpath winds are to be identified, the state model is augmented by wind velocities and accelerations. The measurement model

Regierung gibt Flache Erde zu: Dok #24

Title: Singular Arc Time-Optimal Climb Trajectory of Aircraft in a Two-Dimensional Wind Field

Author: Nhan Nguyen

URL:
https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20060053337.pdf

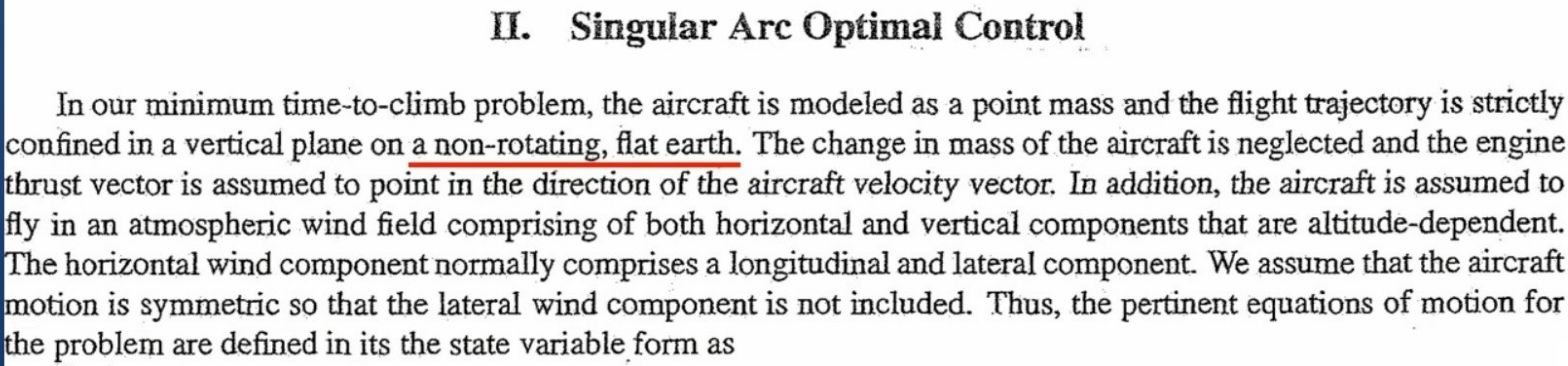


Source of Acquisition
NASA Ames Research Center

Singular Arc Time-Optimal Climb Trajectory of Aircraft in a Two-Dimensional Wind Field

Nhan Nguyen*
NASA Ames Research Center, Moffett Field, CA 94035

This paper presents a study of a minimum time-to-climb trajectory analysis for aircraft flying in a two-dimensional altitude dependent wind field. The time optimal control problem possesses a singular control structure when the lift coefficient is taken as a control variable. A singular arc analysis is performed to obtain an optimal control solution on the singular arc. Using a time-scale separation with the flight path angle treated as a fast state, the dimensionality of the optimal control solution is reduced by eliminating the lift coefficient control. A further singular arc analysis is used to decompose the original optimal control solution into the flight path angle solution and a trajectory solution as a function of the airspeed and altitude. The optimal control solutions for the initial and final climb segments are computed using a shooting method with known starting values on the singular arc. The numerical results of the shooting method show that the optimal flight path angle on the initial and final climb segments are constant. The analytical approach provides a rapid means for analyzing a time optimal trajectory for aircraft performance.



II. Singular Arc Optimal Control

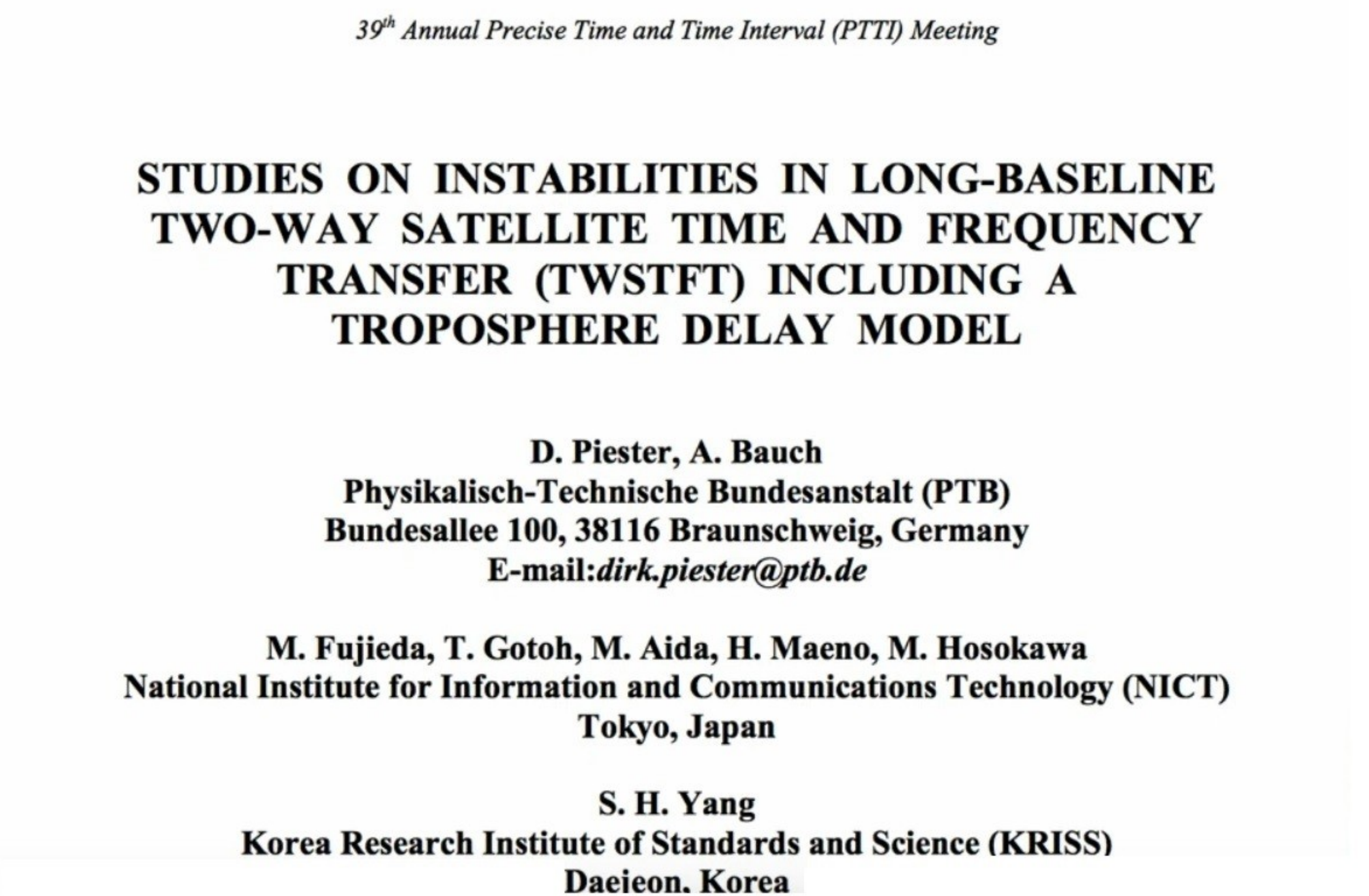
In our minimum time-to-climb problem, the aircraft is modeled as a point mass and the flight trajectory is strictly confined in a vertical plane on a non-rotating, flat earth. The change in mass of the aircraft is neglected and the engine thrust vector is assumed to point in the direction of the aircraft velocity vector. In addition, the aircraft is assumed to fly in an atmospheric wind field comprising of both horizontal and vertical components that are altitude-dependent. The horizontal wind component normally comprises a longitudinal and lateral component. We assume that the aircraft motion is symmetric so that the lateral wind component is not included. Thus, the pertinent equations of motion for the problem are defined in its the state variable form as

Regierung gibt Flache Erde zu: Dok #25

Title: STUDIES ON INSTABILITIES IN LONG-BASELINE TWO-WAY SATELLITE TIME AND FREQUENCY TRANSFER (TWSTFT) INCLUDING A TROPOSPHERE DELAY MODEL

Author: D. Piester, A. Bauch

URL:
https://tycho.usno.navy.mil/ptti/2007papers/paper21.pdf



39th Annual Precise Time and Time Interval (PTTI) Meeting

STUDIES ON INSTABILITIES IN LONG-BASELINE TWO-WAY SATELLITE TIME AND FREQUENCY TRANSFER (TWSTFT) INCLUDING A TROPOSPHERE DELAY MODEL

D. Piester, A. Bauch
Physikalisch-Technische Bundesanstalt (PTB)
Bundesallee 100, 38116 Braunschweig, Germany
E-mail:*dirk.piester@ptb.de*

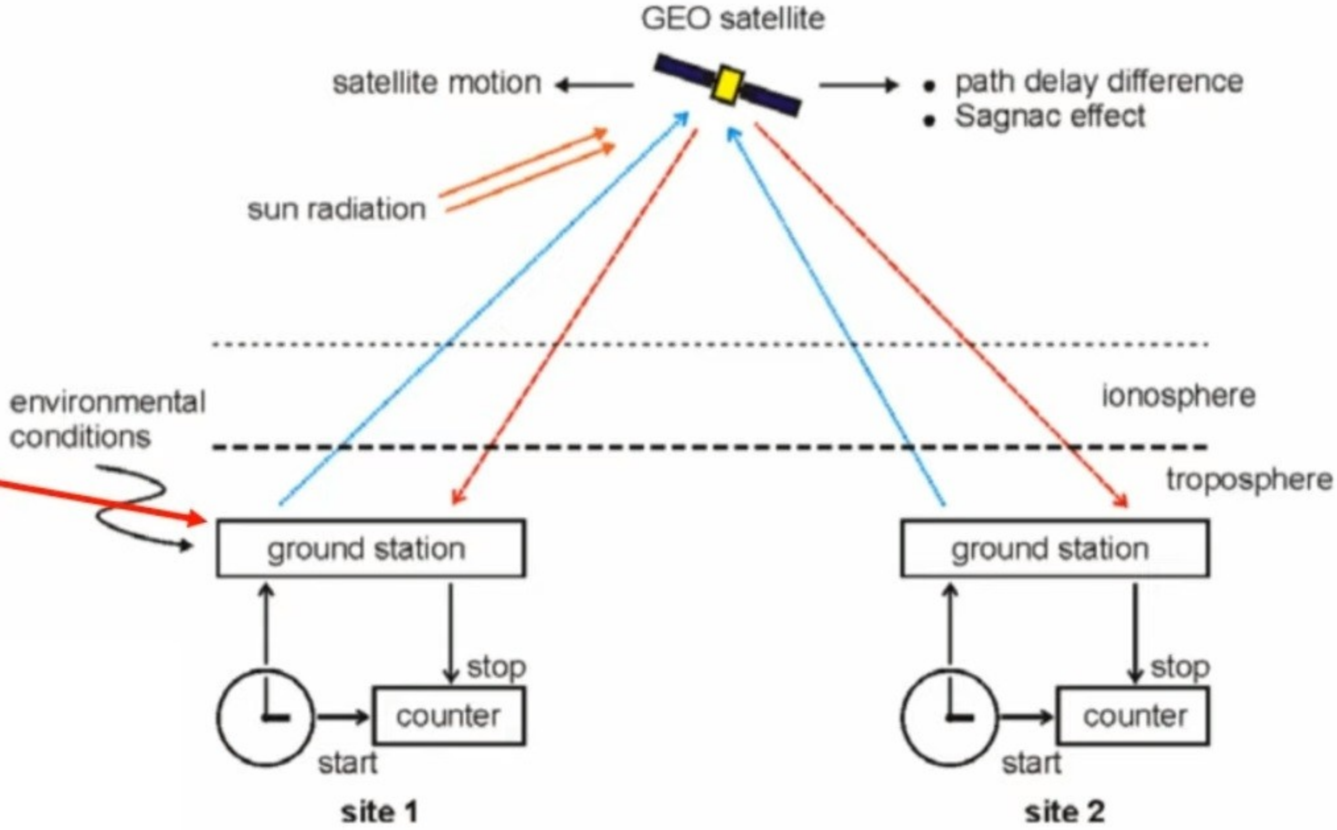
M. Fujieda, T. Gotoh, M. Aida, H. Maeno, M. Hosokawa
National Institute for Information and Communications Technology (NICT)
Tokyo, Japan

S. H. Yang
Korea Research Institute of Standards and Science (KRISS)
Daejeon, Korea

UNITED STATES NAVY

- Environmental conditions

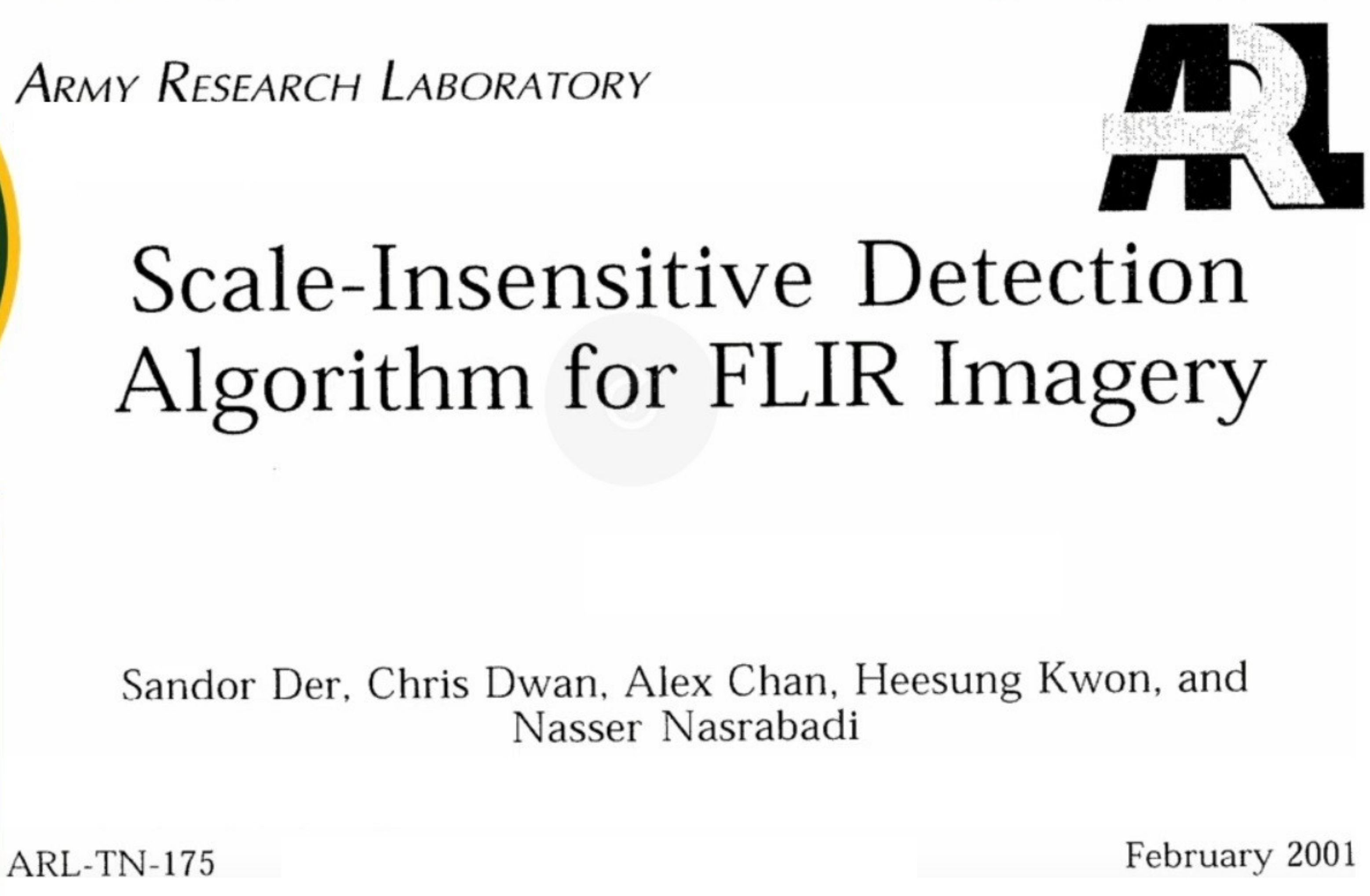
  Ground station's internal delays affected by temperature, humidity, pressure
  Satellite transponder delays affected by heating due to solar radiation.



Both Ground Stations on same FLAT plane

mapping functions. Two are rough approaches, namely a simple plane troposphere (assuming a flat Earth) and the straight "line of sight" through the spherical troposphere shell **[14]**. While these two functions result in too large or too small values, respectively, we use for the path length computation the mapping function as reported by Niell (equation 4 in **[15]**). The results for all three mapping functions for different elevation angles at a fixed troposphere height (11 km) is shown in Fig. 6 (right).

Regierung gibt Flache Erde zu: Dok #26



ARMY RESEARCH LABORATORY

Scale-Insensitive Detection Algorithm for FLIR Imagery

Sandor Der, Chris Dwan, Alex Chan, Heesung Kwon, and
Nasser Nasrabadi

ARL-TN-175

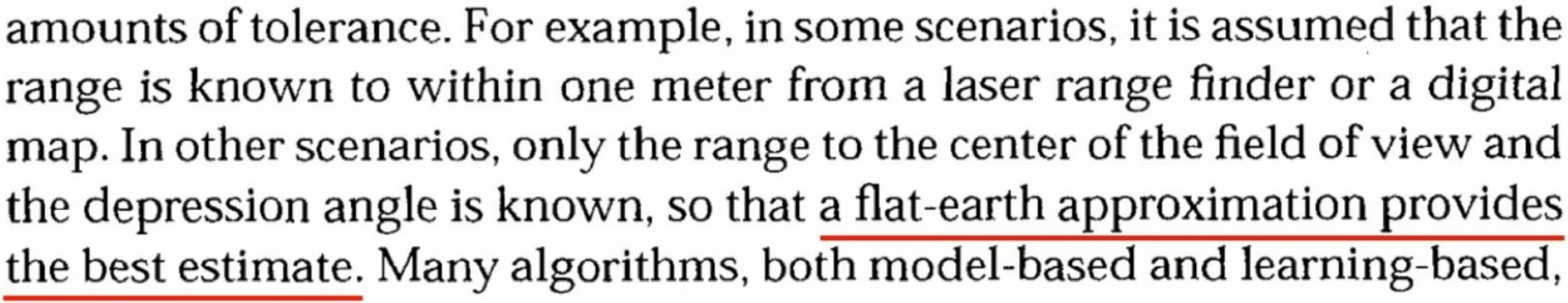
February 2001

Title: Scale-Insensitive Detection Algorithm for FLIR Imagery

Author: Sandor Der, Chris Dwan, Alex Chan, Heesung Kwon, and Nasser Nasrabadi

URL: https://www.arl.army.mil/arlreports/2001/ARL-TN-175.pdf

UNITED STATES ARMY



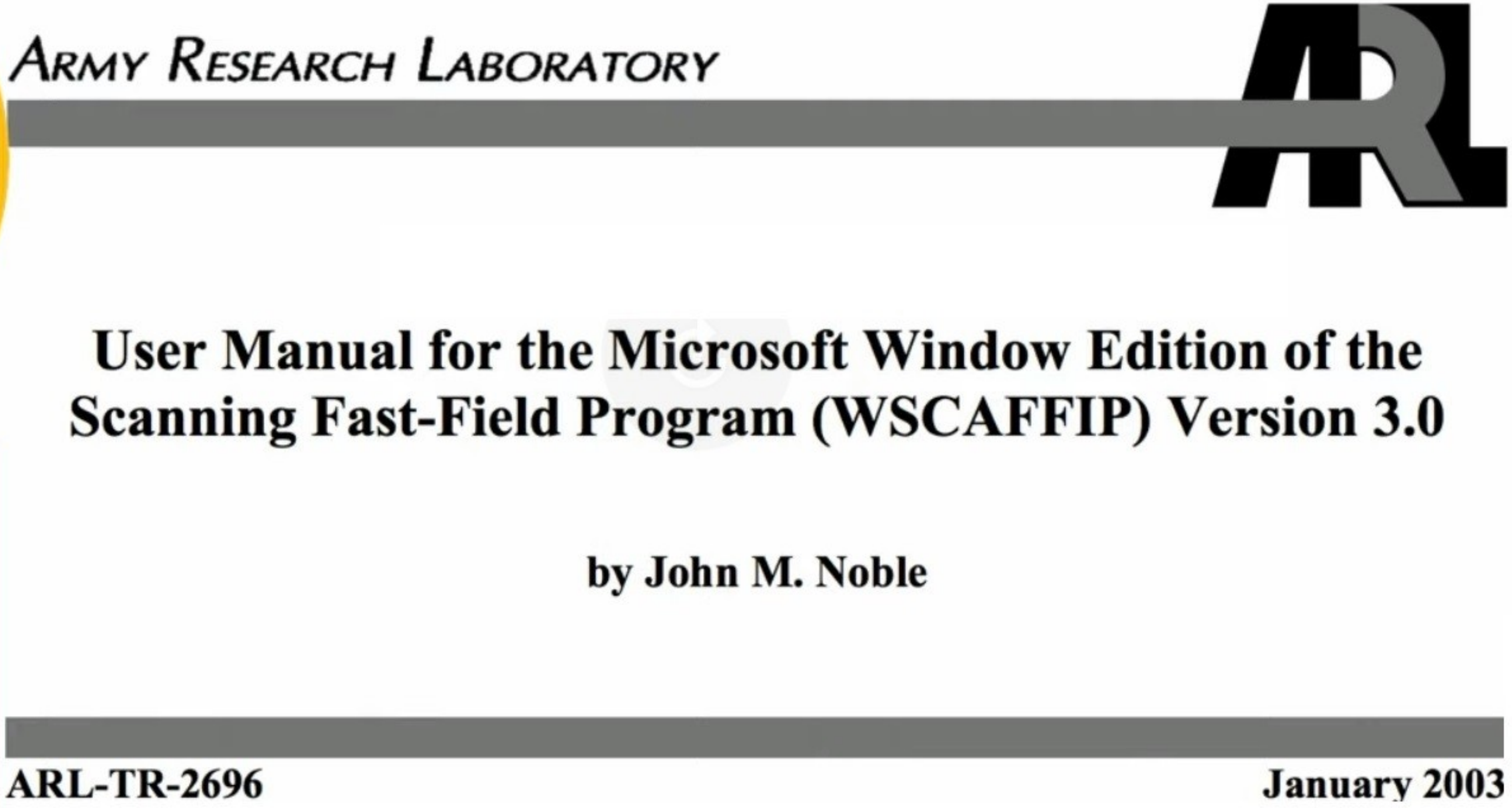
amounts of tolerance. For example, in some scenarios, it is assumed that the range is known to within one meter from a laser range finder or a digital map. In other scenarios, only the range to the center of the field of view and the depression angle is known, so that a flat-earth approximation provides the best estimate. Many algorithms, both model-based and learning-based,

Regierung gibt Flache Erde zu: Dok #27

Title: User Manual for the Microsoft Window Edition of the Scanning Fast-Field Program (WSCAFFIP) Version 3.0

Author: John M. Noble

URL: https://www.arl.army.mil/arlreports/2003/ARL-TR-2696.pdf



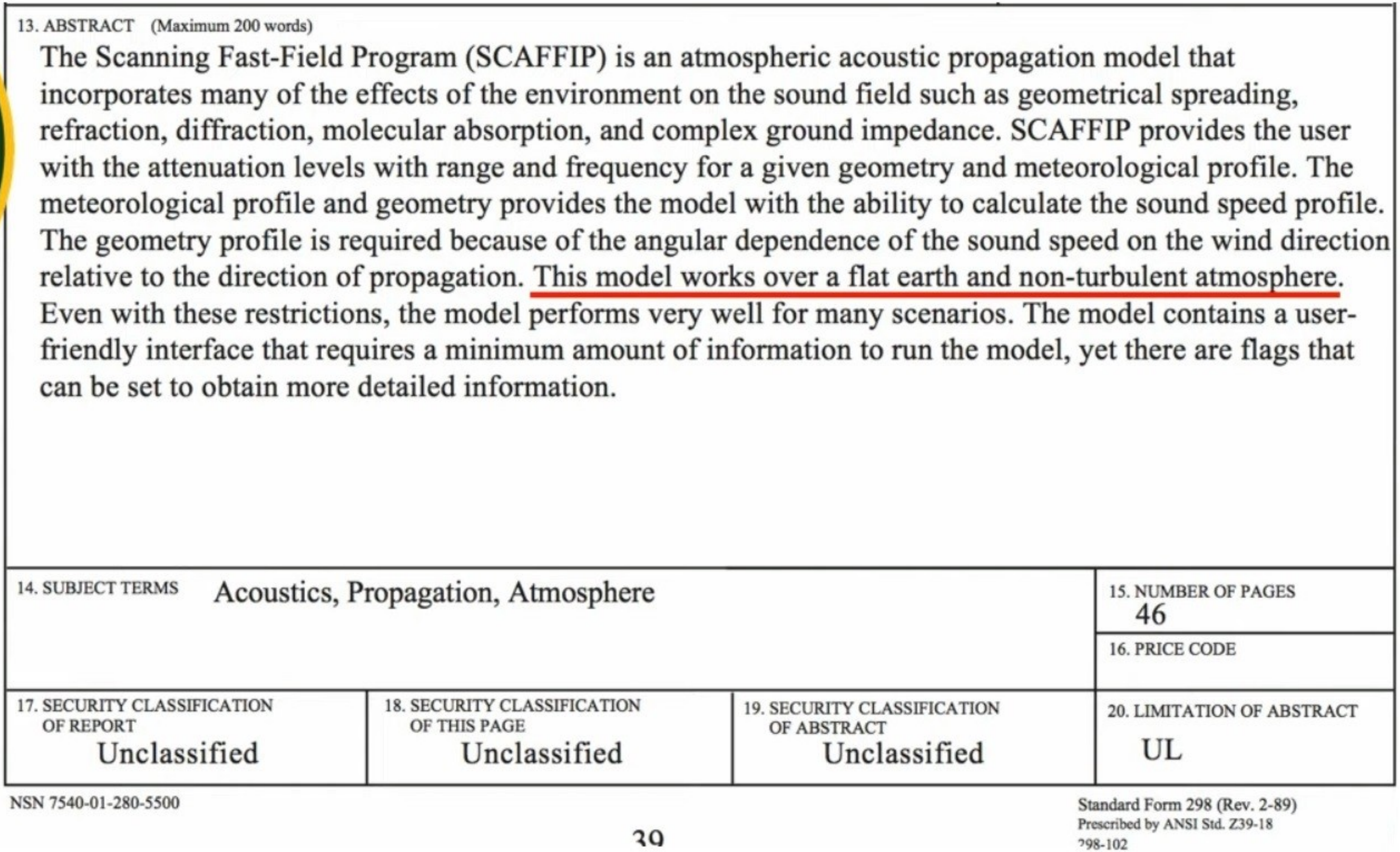
ARMY RESEARCH LABORATORY

ARL

User Manual for the Microsoft Window Edition of the Scanning Fast-Field Program (WSCAFFIP) Version 3.0

by John M. Noble

ARL-TR-2696 January 2003



13. ABSTRACT (Maximum 200 words)

The Scanning Fast-Field Program (SCAFFIP) is an atmospheric acoustic propagation model that incorporates many of the effects of the environment on the sound field such as geometrical spreading, refraction, diffraction, molecular absorption, and complex ground impedance. SCAFFIP provides the user with the attenuation levels with range and frequency for a given geometry and meteorological profile. The meteorological profile and geometry provides the model with the ability to calculate the sound speed profile. The geometry profile is required because of the angular dependence of the sound speed on the wind direction relative to the direction of propagation. This model works over a flat earth and non-turbulent atmosphere. Even with these restrictions, the model performs very well for many scenarios. The model contains a user-friendly interface that requires a minimum amount of information to run the model, yet there are flags that can be set to obtain more detailed information.

14. SUBJECT TERMS Acoustics, Propagation, Atmosphere			15. NUMBER OF PAGES 46
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

Regierung gibt Flache Erde zu: Dok #28

UNITED STATES ARMY

ARMY RESEARCH LABORATORY

ARL

Path-Loss Measurements in a Forested Environment at VHF

Robert J. Tan and Suzanne R. Stratton

ARL-TR-2156

September 2000

Title: Path-Loss Measurements in a Forested Environment at VHF

Author: Robert J. Tan and Suzanne R. Stratton

URL: http://www.arl.army.mil/arlreports/2000/ARL-TR-2156.pdf

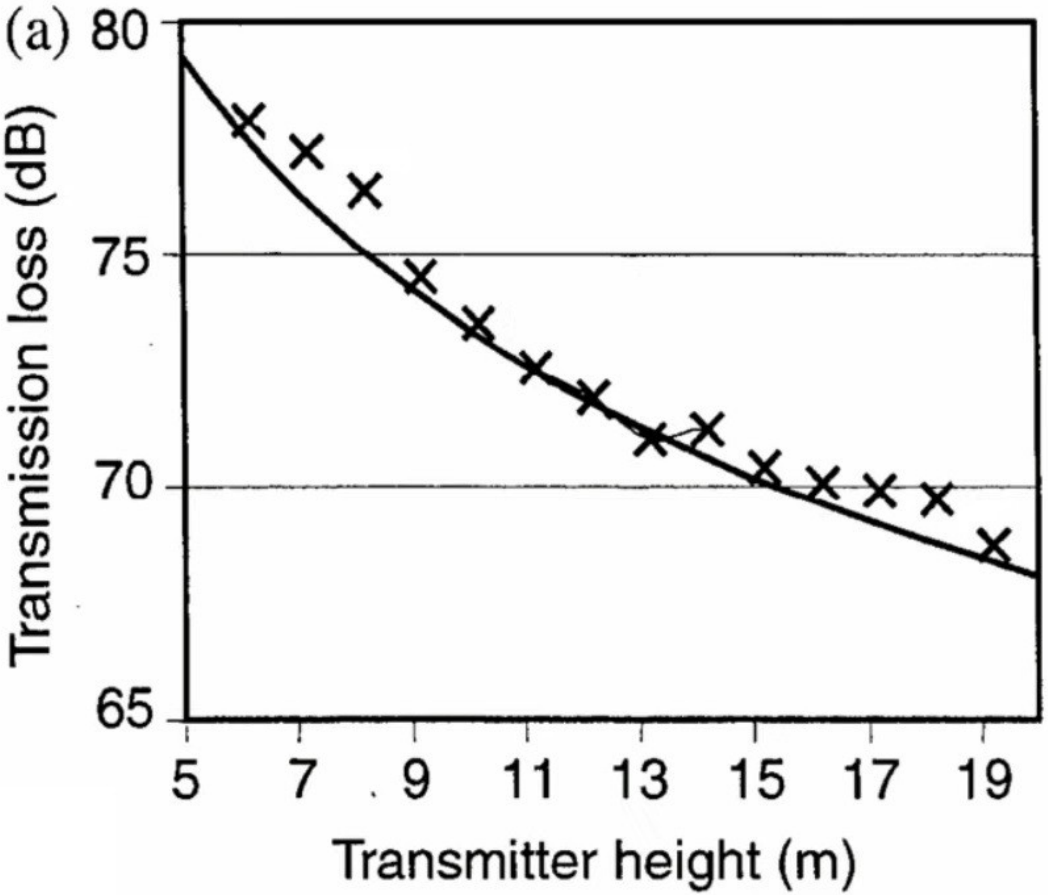
UNITED STATES ARMY

Multipath Measurements

We made multipath measurements to provide confidence in the data and to get an idea of how well our measurements of the clearing represented an ideal flat earth. We measured the path loss at a range of 410 m with the

UNITED STATES ARMY

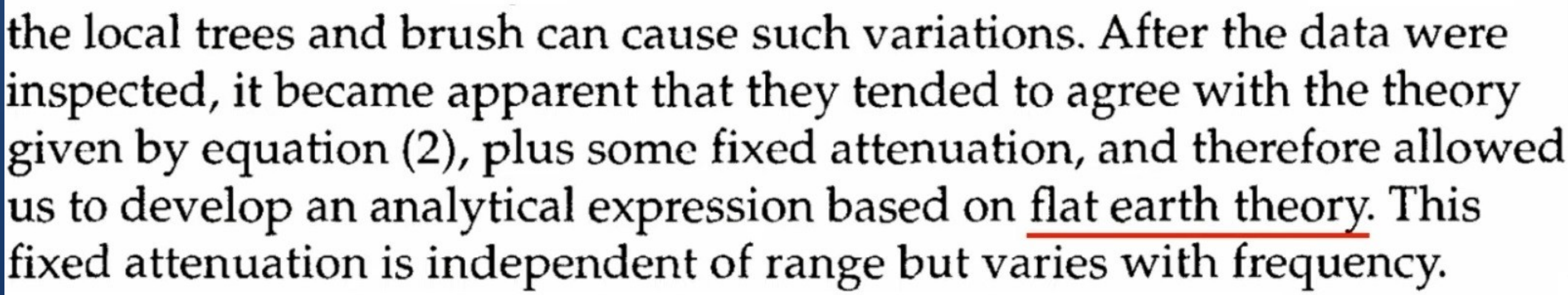
Figure 9. Comparison of measurements to theory for transmission loss over flat earth for a range of 410 m and a receive antenna height of 2.7 m for (a) 145, (b) 223, and (c) 300 MHz.



UNITED STATES ARMY

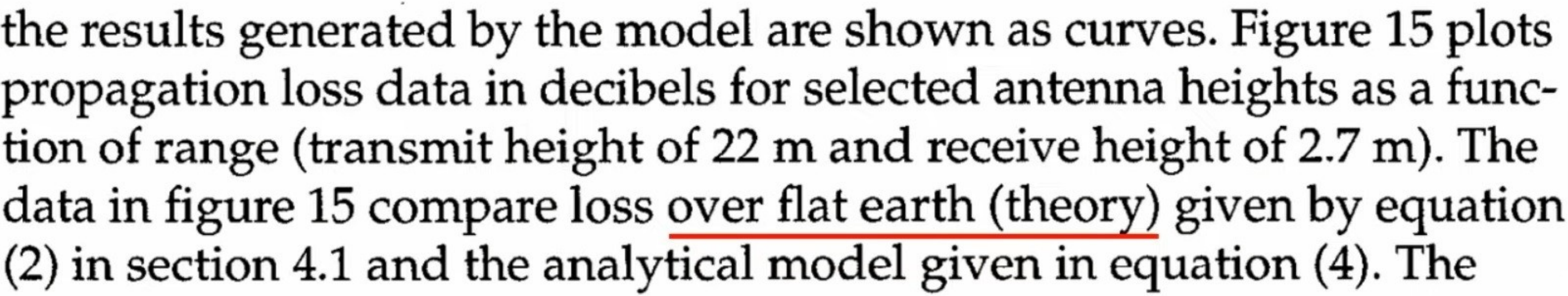
and with loss over the earth, in decibels, given by equation (2) (theory). Equation (2) assumes a flat, lossless, and perfectly reflecting ground. The measured data in figure 11 are for a transmit height of 22 m, a receive height of 5 m, and for HH polarization. Agreement within about 5 dB is obtained between theory and measurements. The difference between the theory for propagation over flat earth given by equation (2) and the measurements is because the measurements were made on an irregular lossy ground with obstacles on both sides.

UNITED STATES ARMY



the local trees and brush can cause such variations. After the data were inspected, it became apparent that they tended to agree with the theory given by equation (2), plus some fixed attenuation, and therefore allowed us to develop an analytical expression based on flat earth theory. This fixed attenuation is independent of range but varies with frequency.

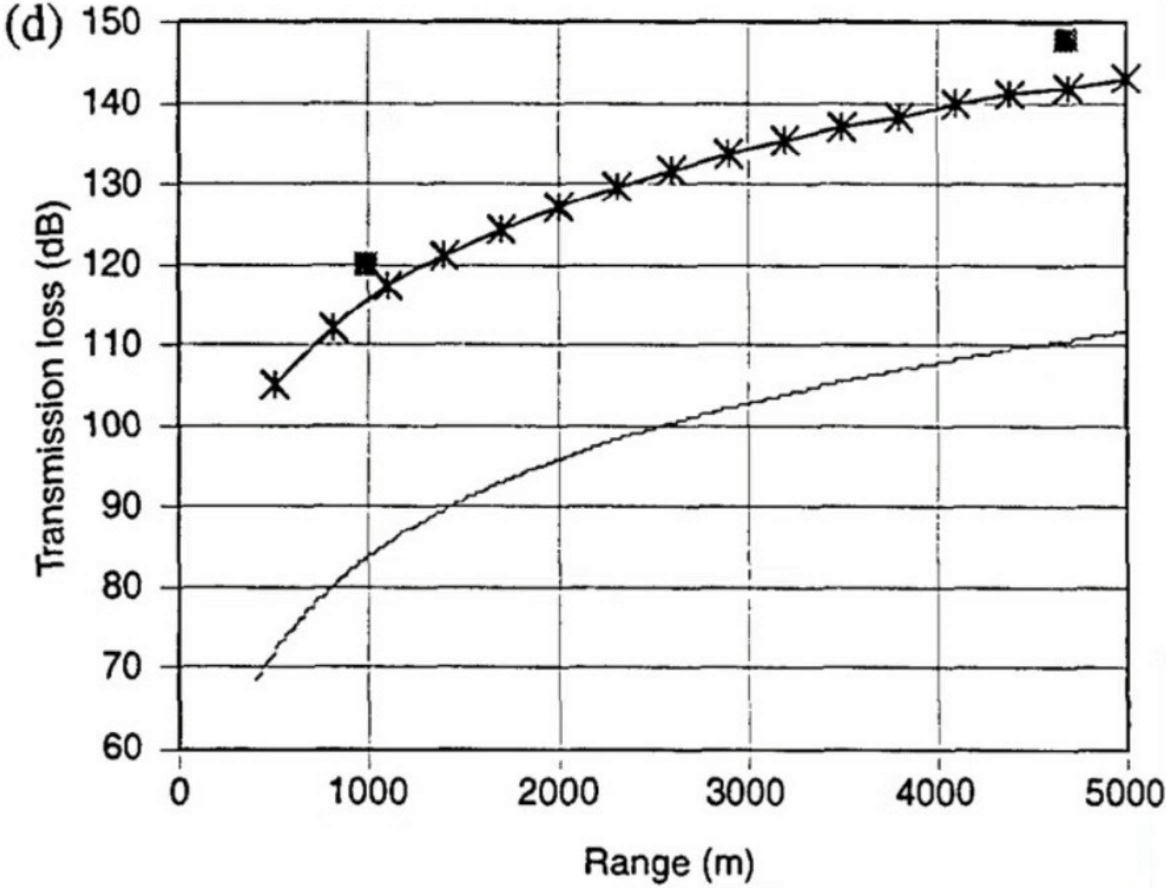
UNITED STATES ARMY

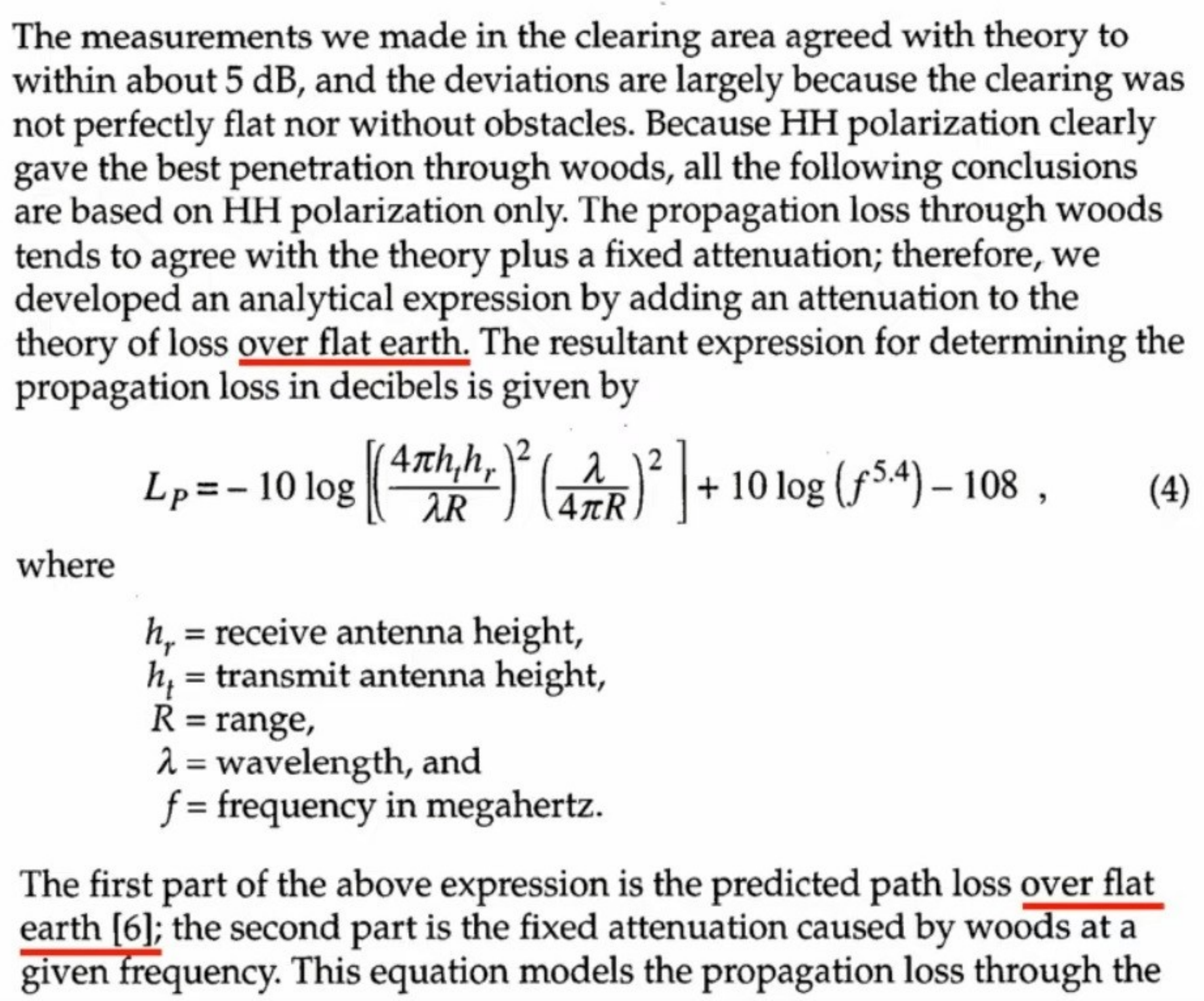


the results generated by the model are shown as curves. Figure 15 plots propagation loss data in decibels for selected antenna heights as a function of range (transmit height of 22 m and receive height of 2.7 m). The data in figure 15 compare loss over flat earth (theory) given by equation (2) in section 4.1 and the analytical model given in equation (4). The

UNITED STATES ARMY

Figure 15 (cont'd). Comparison of measured propagation loss, loss over flat earth, and an analytical model for HH polarization in decibels plotted as a function of range for (d) 435 and (e) 910 MHz.





The measurements we made in the clearing area agreed with theory to within about 5 dB, and the deviations are largely because the clearing was not perfectly flat nor without obstacles. Because HH polarization clearly gave the best penetration through woods, all the following conclusions are based on HH polarization only. The propagation loss through woods tends to agree with the theory plus a fixed attenuation; therefore, we developed an analytical expression by adding an attenuation to the theory of loss over flat earth. The resultant expression for determining the propagation loss in decibels is given by

$$L_P = -10 \log \left[\left(\frac{4\pi h_t h_r}{\lambda R} \right)^2 \left(\frac{\lambda}{4\pi R} \right)^2 \right] + 10 \log \left(f^{5.4} \right) - 108 \ , \qquad (4)$$

where

h_r = receive antenna height,
h_t = transmit antenna height,
R = range,
λ = wavelength, and
f = frequency in megahertz.

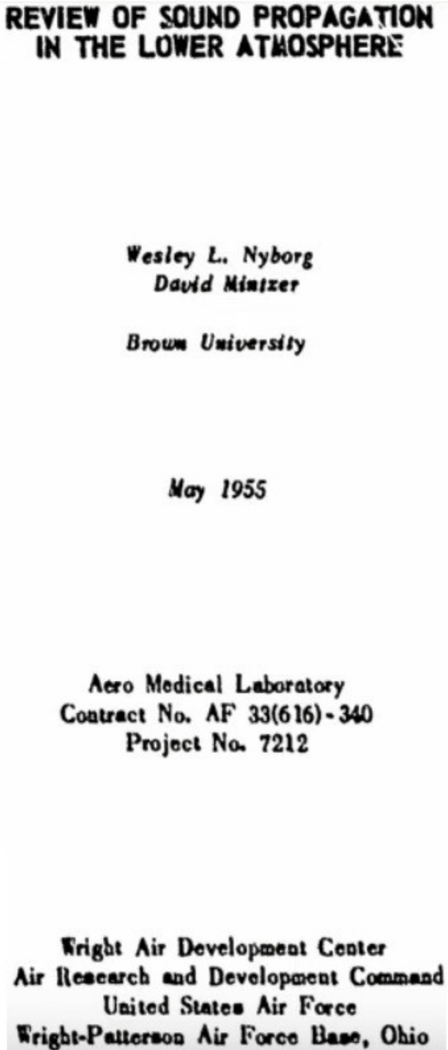
The first part of the above expression is the predicted path loss over flat earth [6]; the second part is the fixed attenuation caused by woods at a given frequency. This equation models the propagation loss through the

Regierung gibt Flache Erde zu: Dok #29

Title: Review of Sound Propagation in the Lower Atmosphere

Author: Wesley L. Nyborg, David Minizer

URL:
https://apps.dtic.mil/dtic/tr/fulltext/u2/067880.pdf



REVIEW OF SOUND PROPAGATION
IN THE LOWER ATMOSPHERE

Wesley L. Nyborg
David Mintzer

Brown University

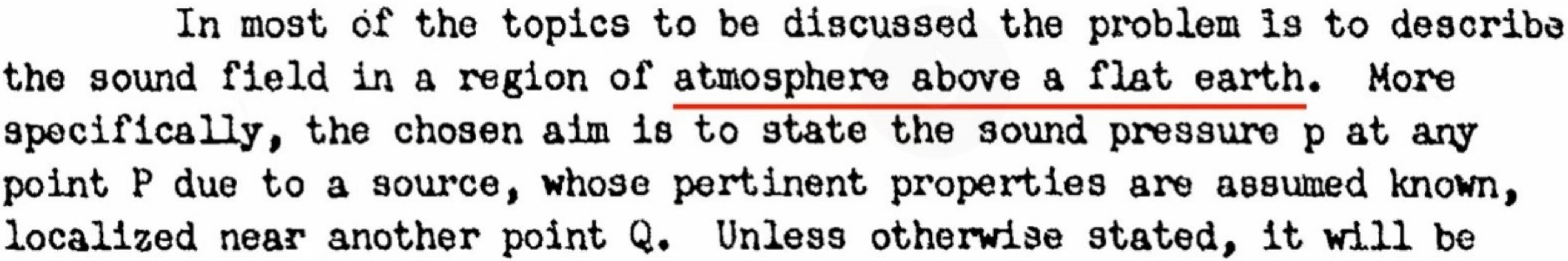
May 1955

Aero Medical Laboratory
Contract No. AF 33(616)-340
Project No. 7212

Wright Air Development Center
Air Research and Development Command
United States Air Force
Wright-Patterson Air Force Base, Ohio

U.S. AIR FORCE

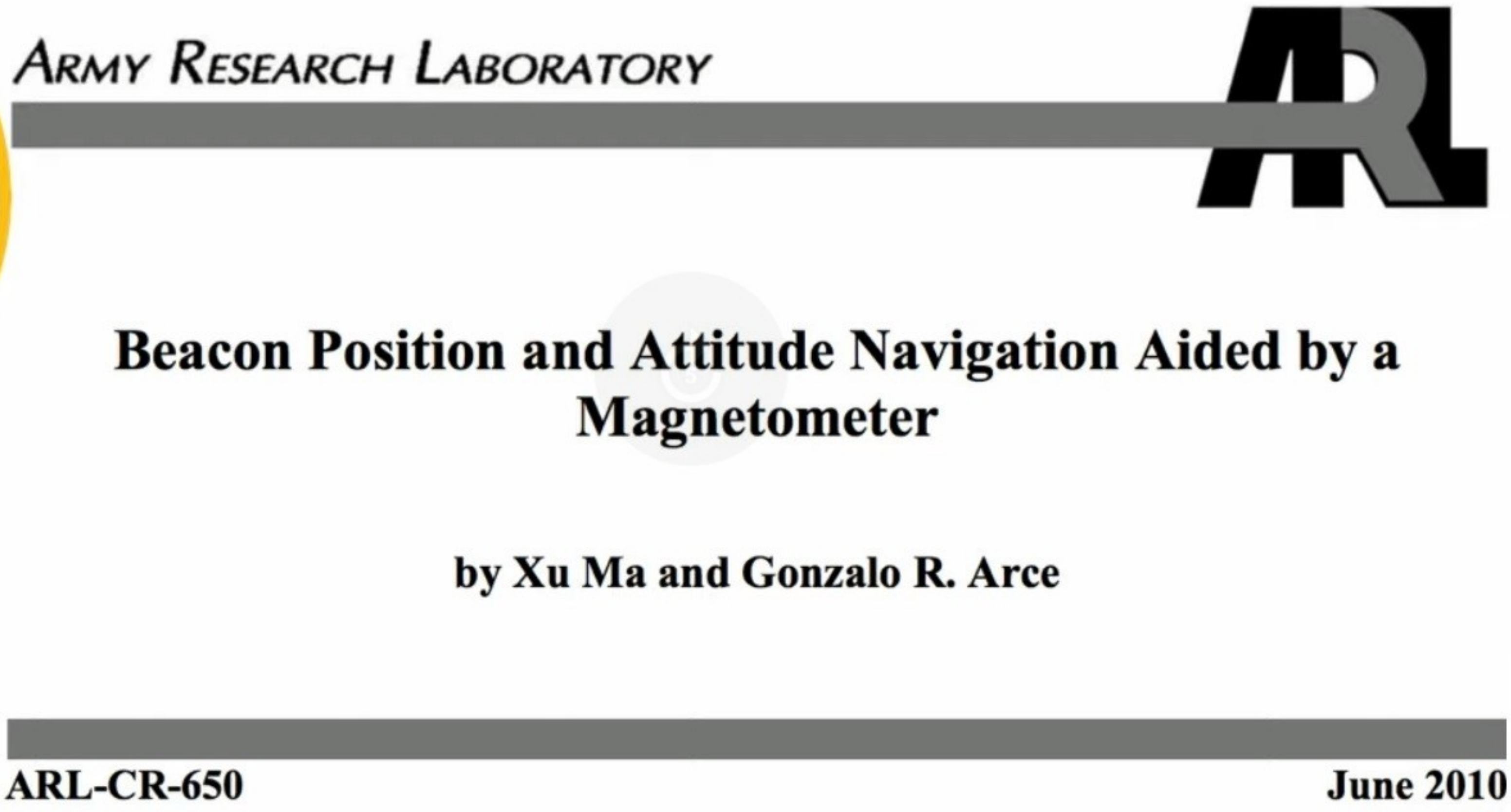
BROWN
UNIVERSITY



In most of the topics to be discussed the problem is to describe the sound field in a region of atmosphere above a flat earth. More specifically, the chosen aim is to state the sound pressure p at any point P due to a source, whose pertinent properties are assumed known, localized near another point Q. Unless otherwise stated, it will be

Regierung gibt Flache Erde zu: Dok #30

UNITED STATES ARMY



ARMY RESEARCH LABORATORY

ARL

Beacon Position and Attitude Navigation Aided by a Magnetometer

by Xu Ma and Gonzalo R. Arce

ARL-CR-650 **June 2010**

Title: Beacon Position and Attitude Navigation Aided by a Magnetometer

Author: Xu Ma and Gonzalo R. Arce

URL: https://www.arl.army.mil/arlreports/2010/ARL-CR-650.pdf

UNITED STATES ARMY

2.1 Coordinate Systems

The motion of an object is usually described by rigid body equations of motion derived from Newton's laws (*29*). This section summarizes and notates three kinds of coordinate systems. The first is the Earth-fixed coordinate system, which is fixed to the Earth with a flat Earth assumption. Denote **X**, **Y**, and **Z** as the unit vectors pointing in the directions of the X, Y, and Z axes, respectively. Without loss of generality, the X, Y, and Z axes point to forward, right, and down, respectively. The second is the body-fixed coordinate system, with three unit vectors $\mathbf{X_b}$,

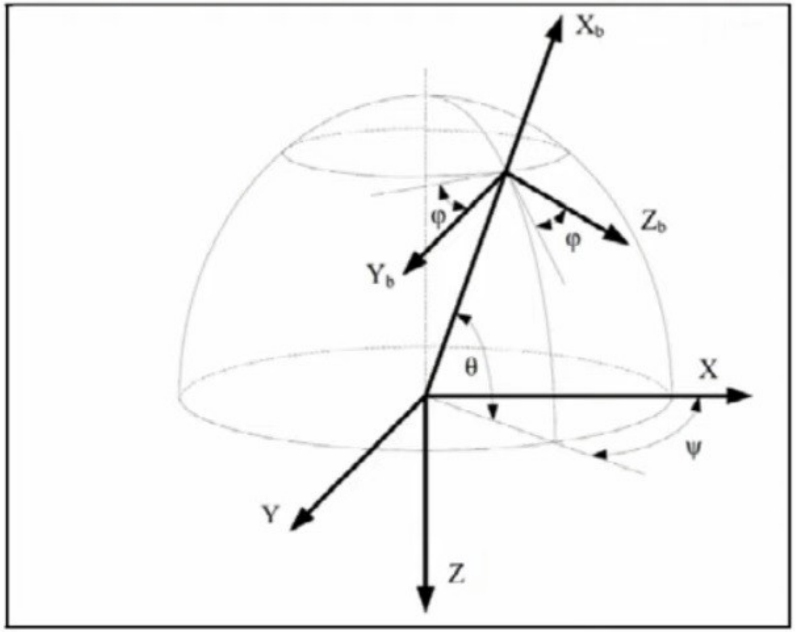
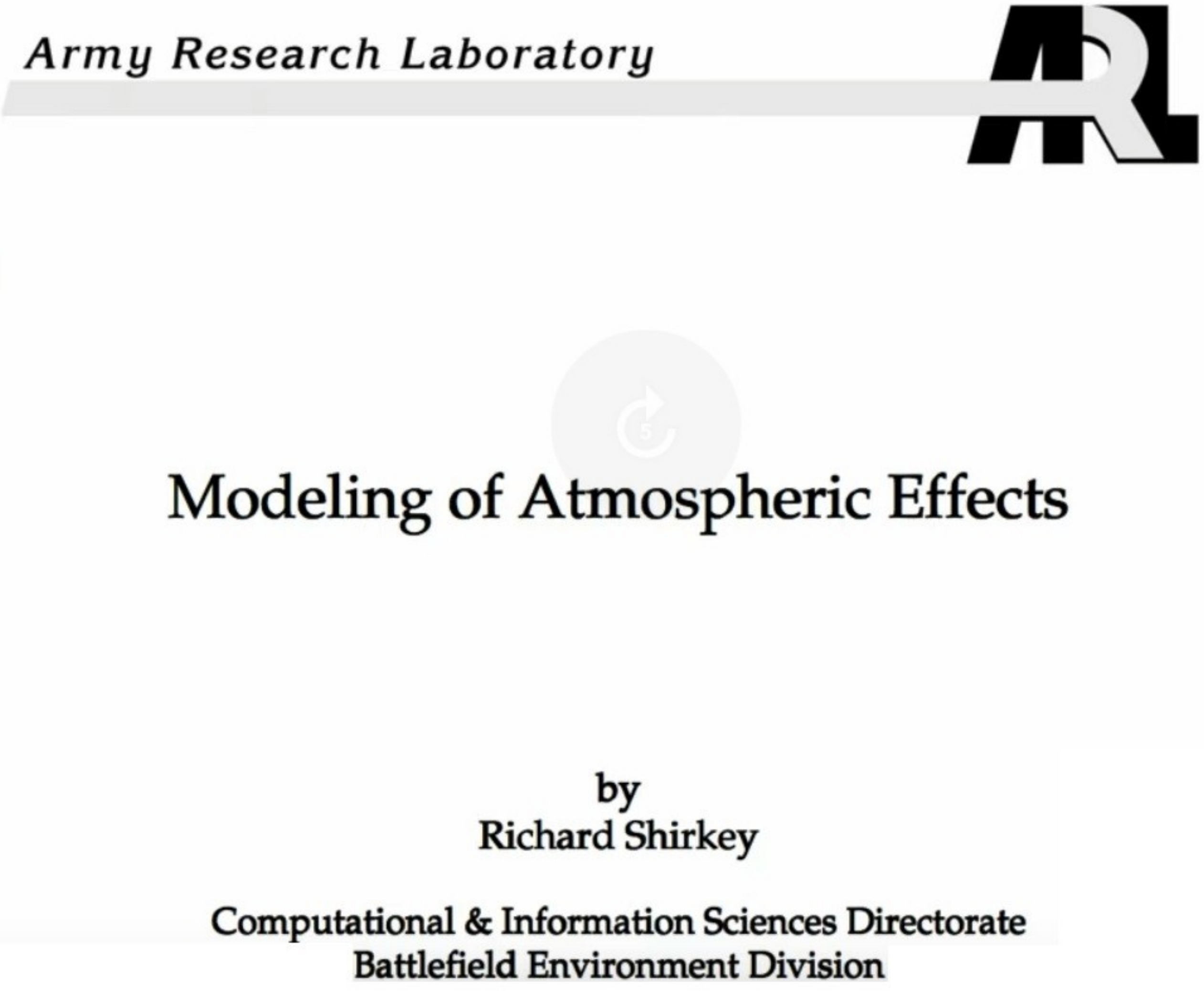


Figure 1. Earth- and body-fixed coordinate systems and the Euler angle rotations.

UNITED STATES ARMY

of tolerance. For example, in some scenarios, it is assumed that the range is known to within a meter from a laser range finder or a digital map. In other scenarios, only the range to the center of the field-of-view and the depression angle is known so that a flat earth approximation provides the best estimate. Many algorithms, both model-based and learning-based, either require accurate range information or compensate for inaccurate information by attempting to detect targets at a number of different ranges within the tolerance of the range. Because many

Regierung gibt Flache Erde zu: Dok# 32



Army Research Laboratory

Modeling of Atmospheric Effects

by
Richard Shirkey

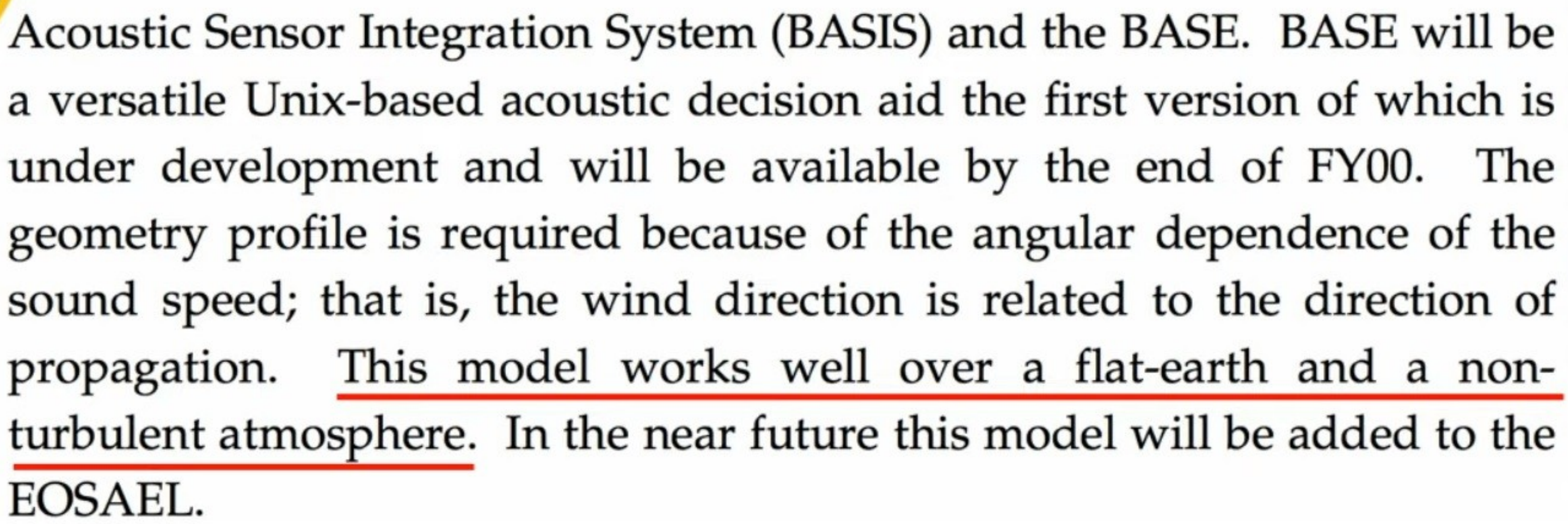
Computational & Information Sciences Directorate
Battlefield Environment Division

Title: Modeling of Atmospheric Effects

Author: Richard Shirkey

URL:
https://www.arl.army.mil/arlreports/2000/ARL-TR-1812.pdf

UNITED STATES
ARMY



Acoustic Sensor Integration System (BASIS) and the BASE. BASE will be a versatile Unix-based acoustic decision aid the first version of which is under development and will be available by the end of FY00. The geometry profile is required because of the angular dependence of the sound speed; that is, the wind direction is related to the direction of propagation. This model works well over a flat-earth and a non-turbulent atmosphere. In the near future this model will be added to the EOSAEL.

Regierung gibt Flache Erde zu: Dok #33

Title: Telemetry Standards

URL:
http://www.irig106.org/docs/106-17/106-17_Telemetry_Standards.pdf

IRIG STANDARD 106-17

Range
Commanders
Council
TELEMETRY GROUP

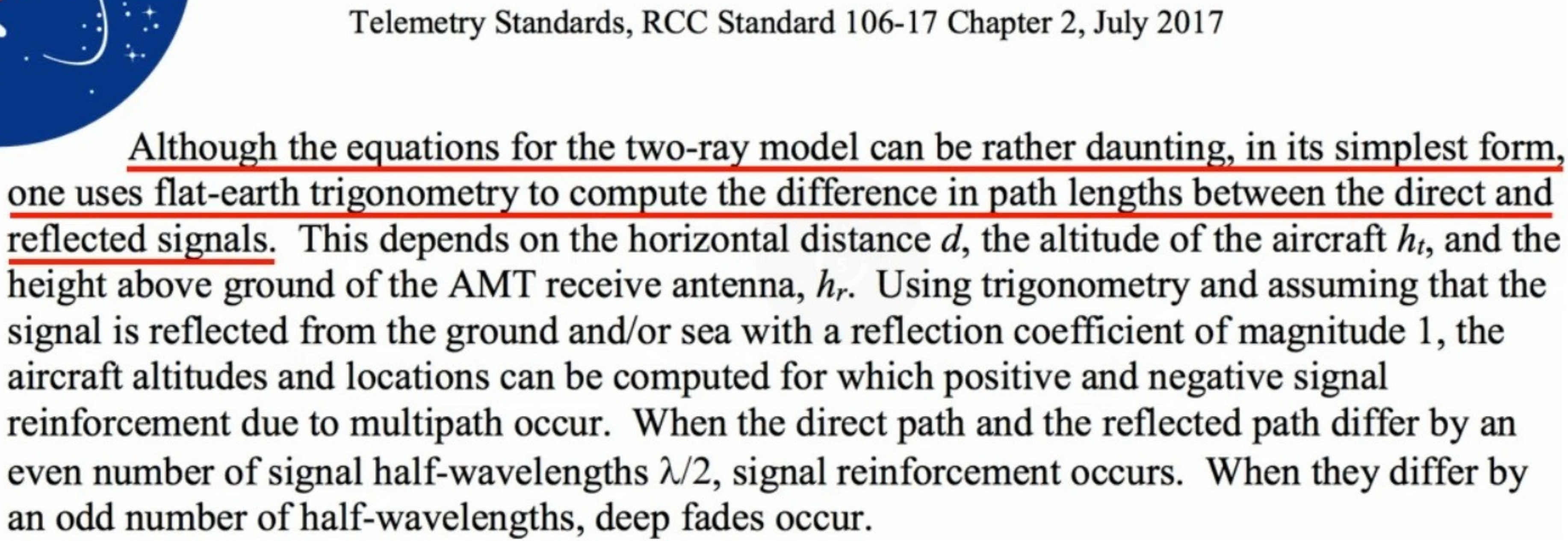
TELEMETRY STANDARDS

ABERDEEN TEST CENTER
DUGWAY PROVING GROUND
REAGAN TEST SITE
REDSTONE TEST CENTER
WHITE SANDS MISSILE RANGE
YUMA PROVING GROUND

NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
NAVAL AIR WARFARE CENTER WEAPONS DIVISION
NAVAL UNDERSEA WARFARE CENTER DIVISION, KEYPORT
NAVAL UNDERSEA WARFARE CENTER DIVISION, NEWPORT
PACIFIC MISSILE RANGE FACILITY

30TH SPACE WING
45TH SPACE WING
96TH TEST WING
412TH TEST WING
ARNOLD ENGINEERING DEVELOPMENT COMPLEX

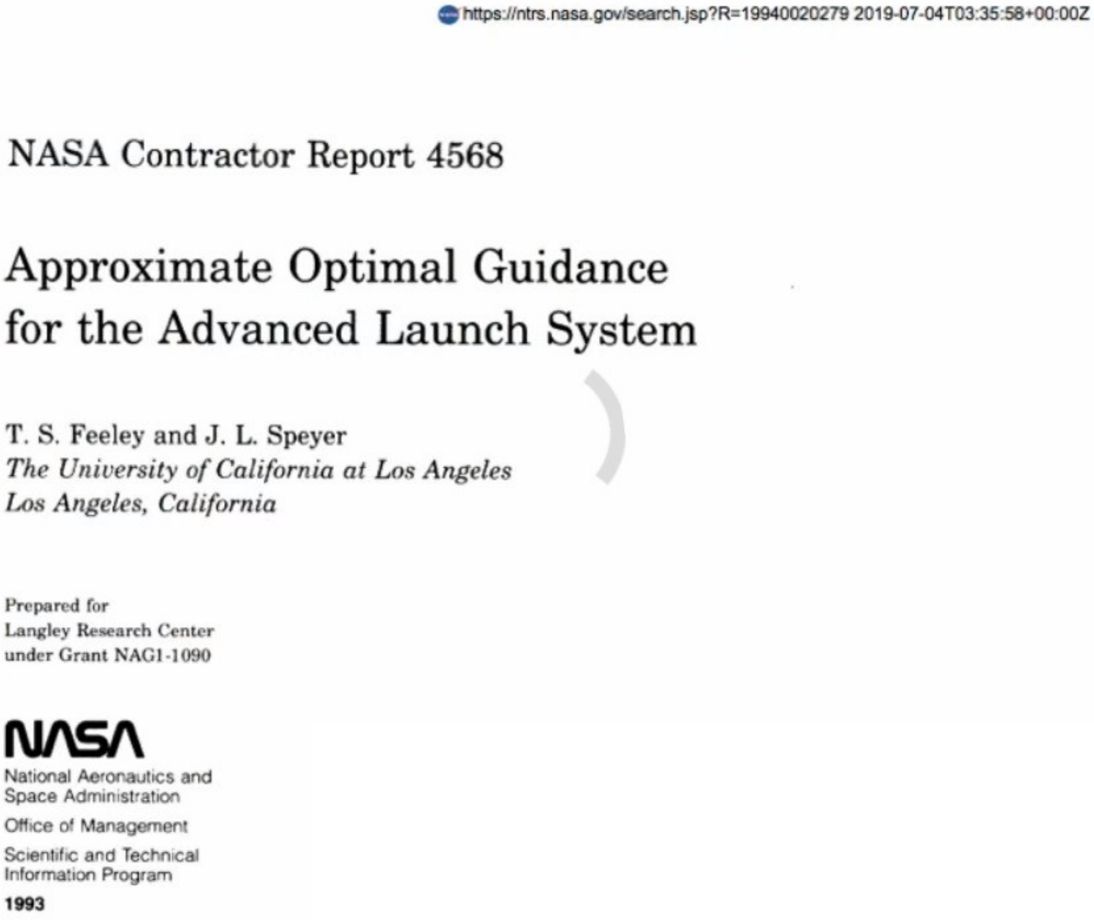
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



Telemetry Standards, RCC Standard 106-17 Chapter 2, July 2017

Although the equations for the two-ray model can be rather daunting, in its simplest form, one uses flat-earth trigonometry to compute the difference in path lengths between the direct and reflected signals. This depends on the horizontal distance *d*, the altitude of the aircraft h_t, and the height above ground of the AMT receive antenna, h_r. Using trigonometry and assuming that the signal is reflected from the ground and/or sea with a reflection coefficient of magnitude 1, the aircraft altitudes and locations can be computed for which positive and negative signal reinforcement due to multipath occur. When the direct path and the reflected path differ by an even number of signal half-wavelengths $\lambda/2$, signal reinforcement occurs. When they differ by an odd number of half-wavelengths, deep fades occur.

Regierung gibt Flache Erde zu: Dok #34



https://ntrs.nasa.gov/search.jsp?R=19940020279 2019-07-04T03:35:58+00:00Z

NASA Contractor Report 4568

Approximate Optimal Guidance for the Advanced Launch System

T. S. Feeley and J. L. Speyer
The University of California at Los Angeles
Los Angeles, California

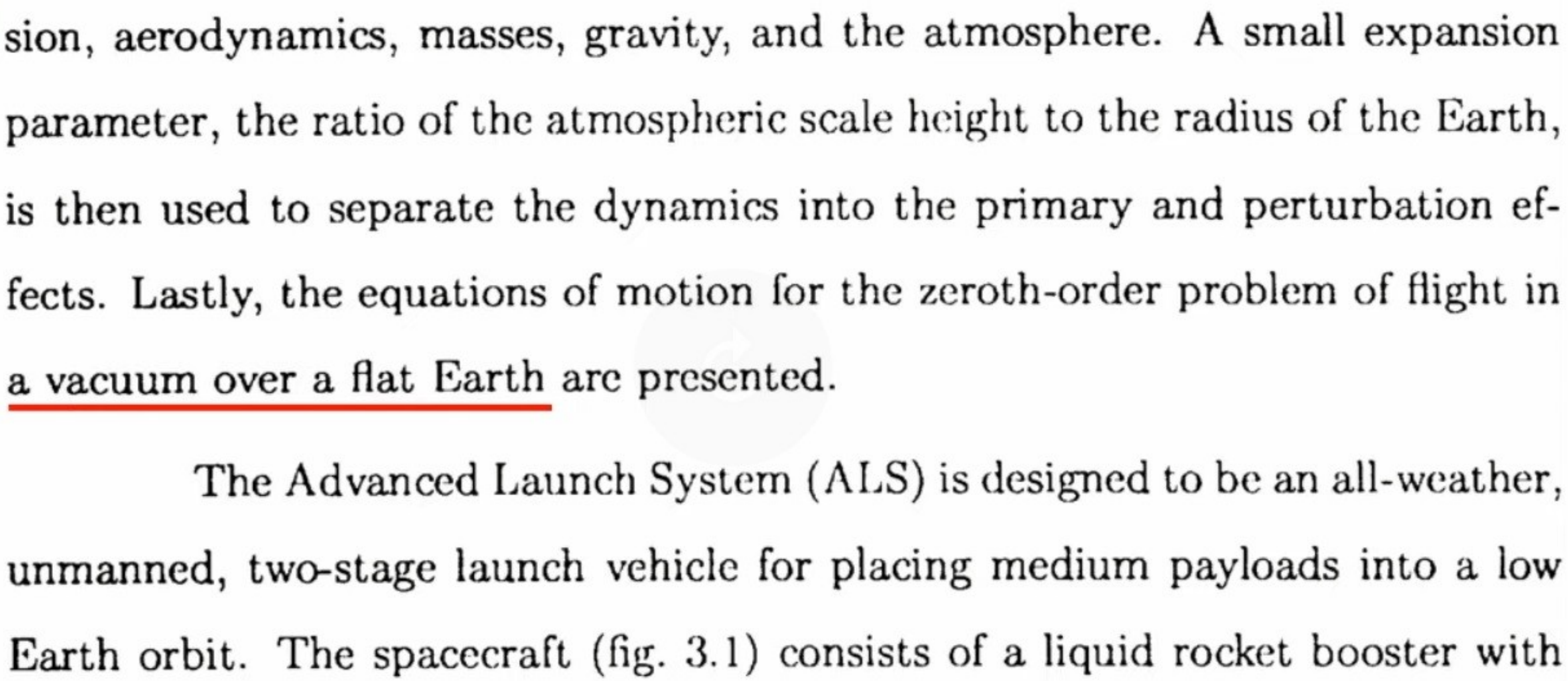
Prepared for
Langley Research Center
under Grant NAG1-1090

NASA
National Aeronautics and
Space Administration
Office of Management
Scientific and Technical
Information Program
1993

Title: Approximate Optimal Guidance for the Advanced Launch System

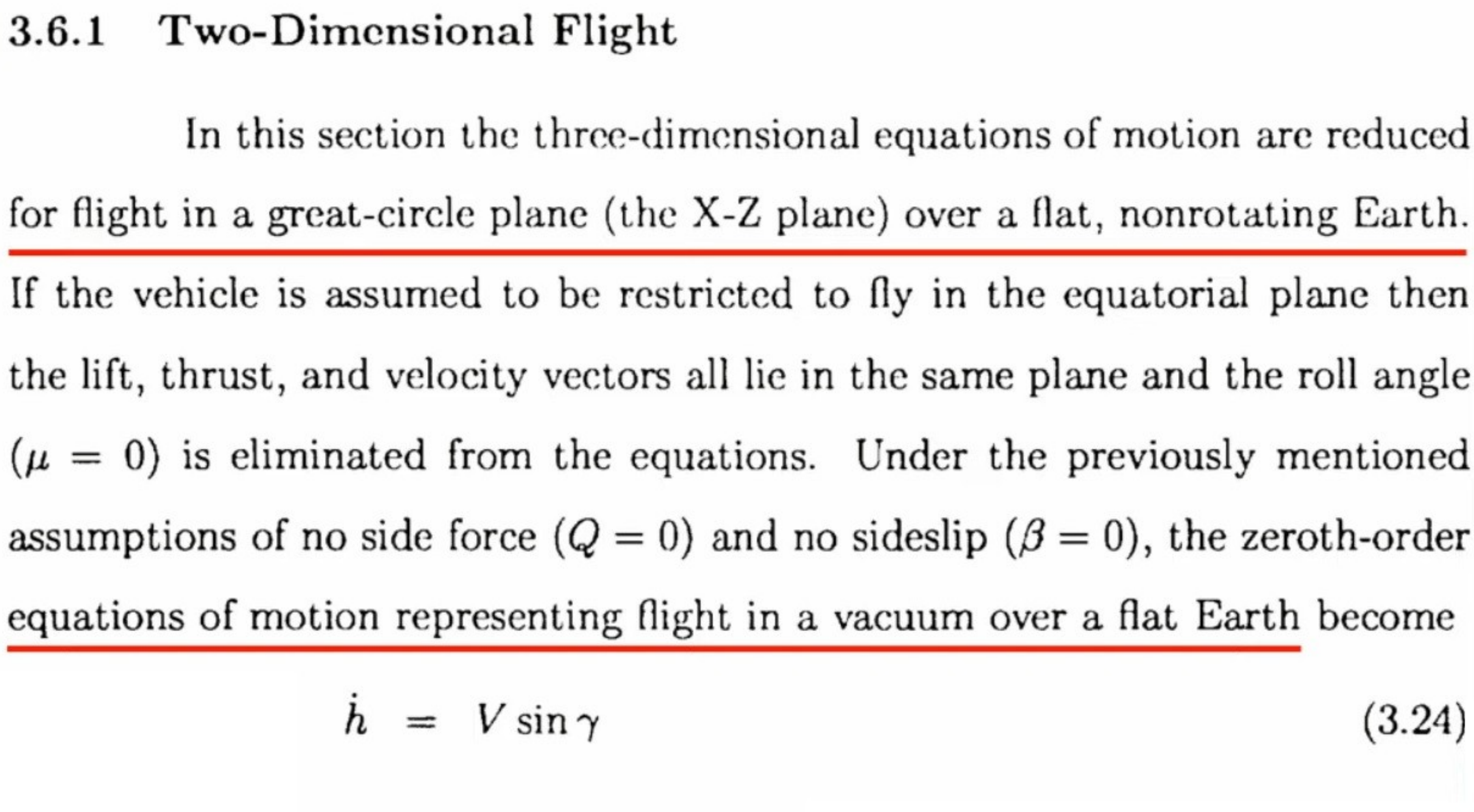
Authors: T.S. Feeley and J.L Speyer

URL: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19940020279.pdf



sion, aerodynamics, masses, gravity, and the atmosphere. A small expansion parameter, the ratio of the atmospheric scale height to the radius of the Earth, is then used to separate the dynamics into the primary and perturbation effects. Lastly, the equations of motion for the zeroth-order problem of flight in a vacuum over a flat Earth are presented.

The Advanced Launch System (ALS) is designed to be an all-weather, unmanned, two-stage launch vehicle for placing medium payloads into a low Earth orbit. The spacecraft (fig. 3.1) consists of a liquid rocket booster with

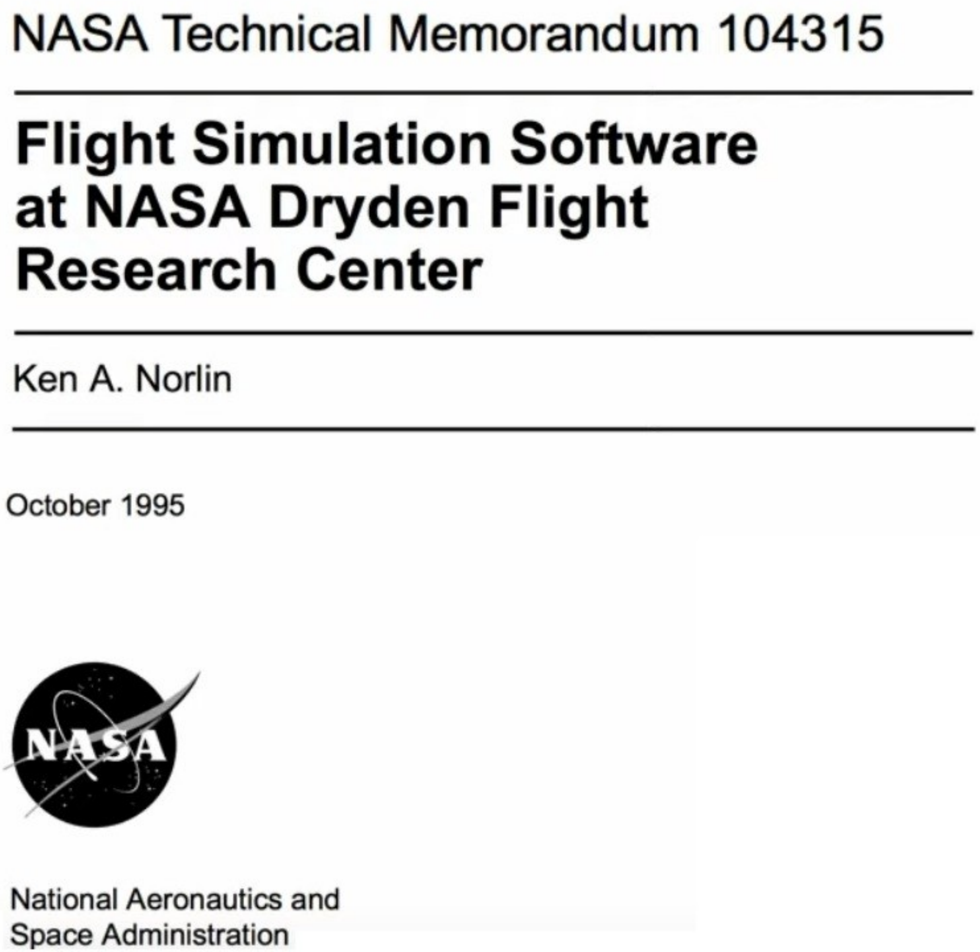


3.6.1 Two-Dimensional Flight

In this section the three-dimensional equations of motion are reduced for flight in a great-circle plane (the X-Z plane) over a flat, nonrotating Earth. If the vehicle is assumed to be restricted to fly in the equatorial plane then the lift, thrust, and velocity vectors all lie in the same plane and the roll angle ($\mu = 0$) is eliminated from the equations. Under the previously mentioned assumptions of no side force ($Q = 0$) and no sideslip ($\beta = 0$), the zeroth-order equations of motion representing flight in a vacuum over a flat Earth become

$$\dot{h} = V \sin\gamma \tag{3.24}$$

Regierung gibt Flache Erde zu: Dok #35



NASA Technical Memorandum 104315

Flight Simulation Software at NASA Dryden Flight Research Center

Ken A. Norlin

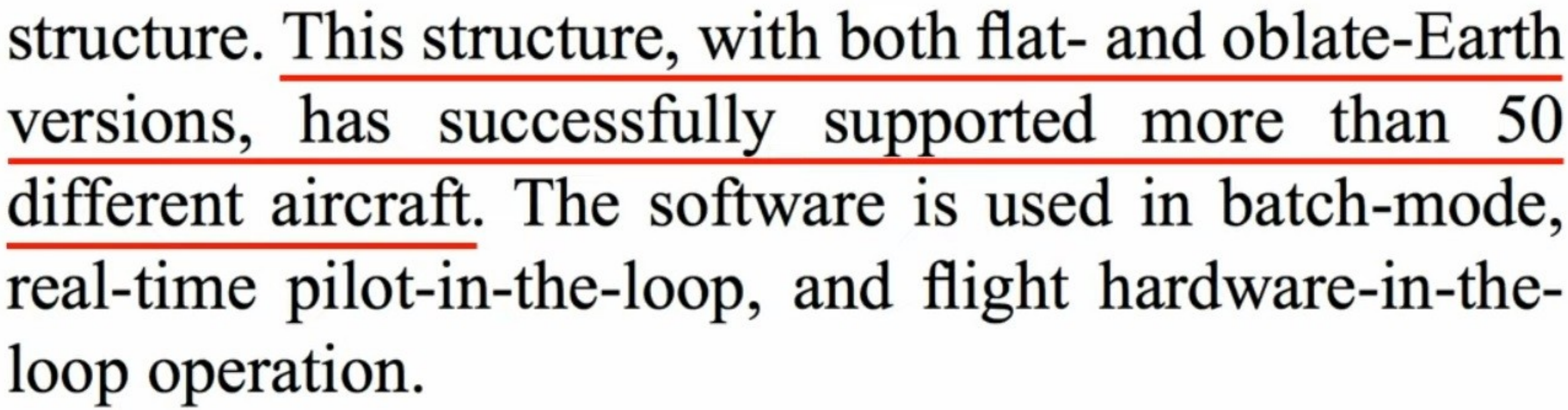
October 1995

National Aeronautics and
Space Administration

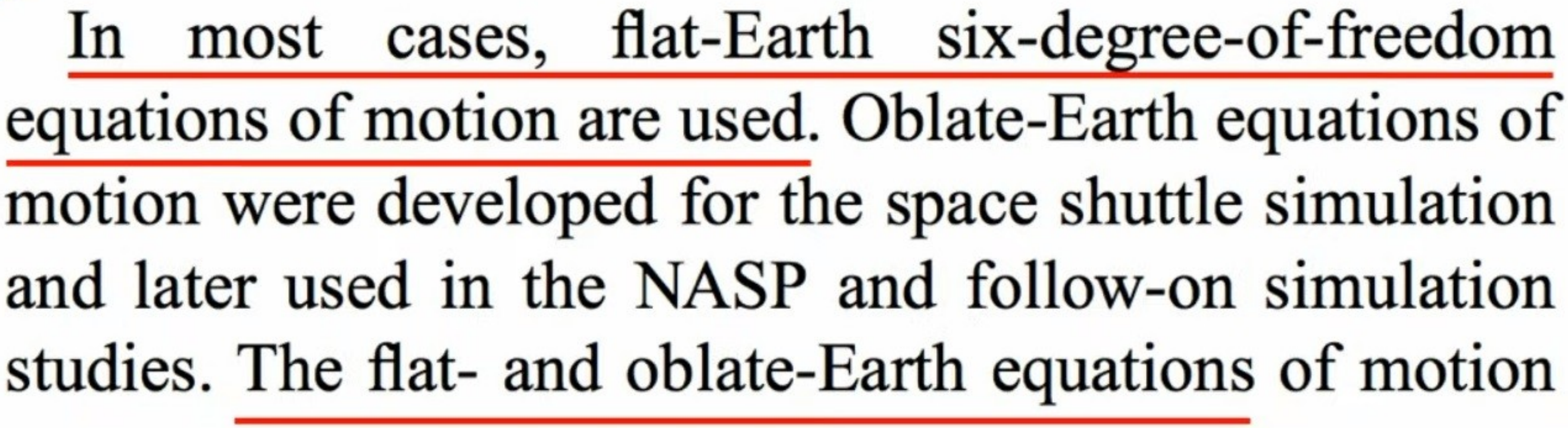
Title: Flight Simulation Software at NASA Dryden Flight Research Center

Authors: Ken A. Norlin

URL:
https://www.nasa.gov/centers/dryden/pdf/88380main_H-2052.pdf

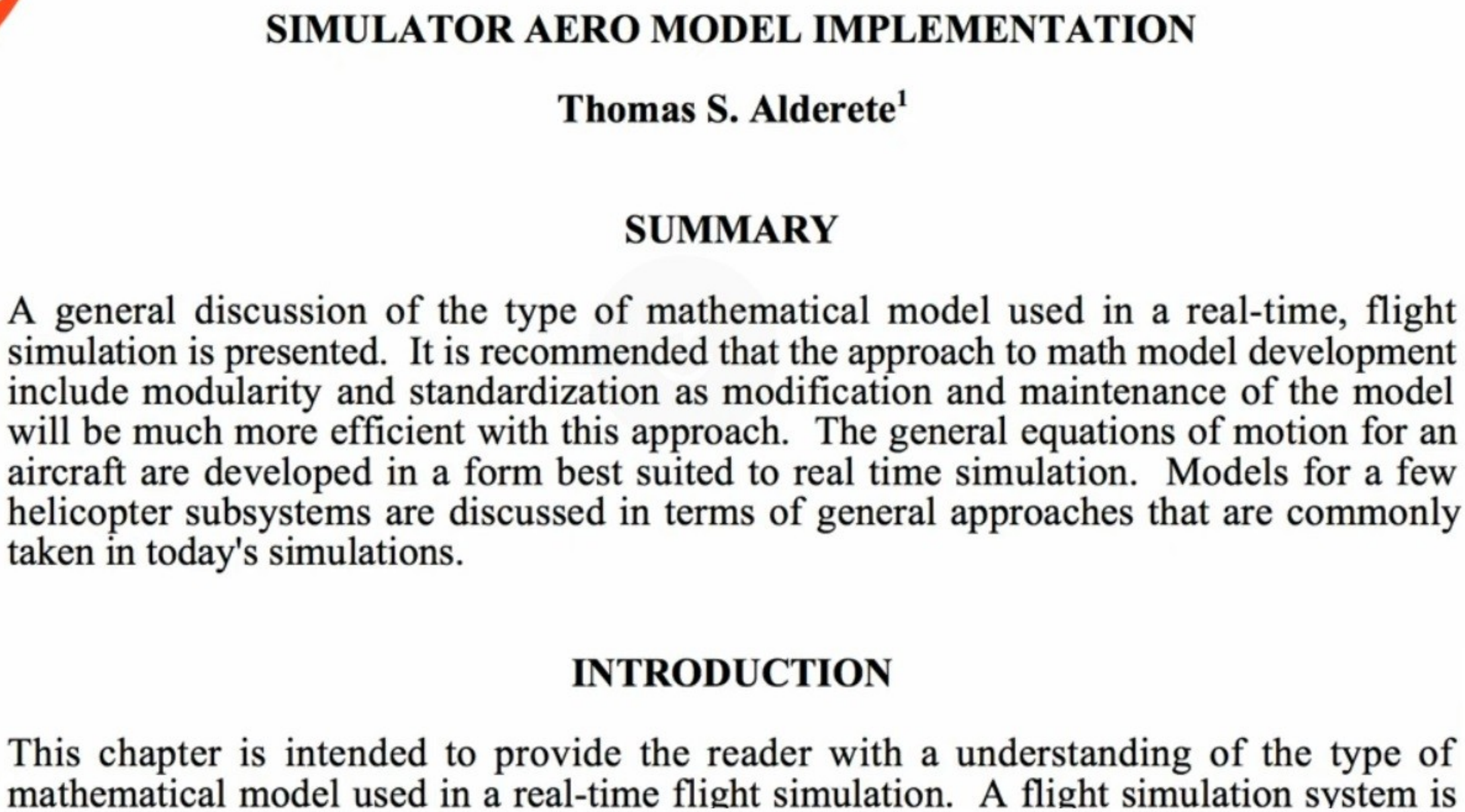


structure. This structure, with both flat- and oblate-Earth versions, has successfully supported more than 50 different aircraft. The software is used in batch-mode, real-time pilot-in-the-loop, and flight hardware-in-the-loop operation.



In most cases, flat-Earth six-degree-of-freedom equations of motion are used. Oblate-Earth equations of motion were developed for the space shuttle simulation and later used in the NASP and follow-on simulation studies. The flat- and oblate-Earth equations of motion

Regierung gibt Flache Erde zu: Dok #36



SIMULATOR AERO MODEL IMPLEMENTATION

Thomas S. Alderete[1]

SUMMARY

A general discussion of the type of mathematical model used in a real-time, flight simulation is presented. It is recommended that the approach to math model development include modularity and standardization as modification and maintenance of the model will be much more efficient with this approach. The general equations of motion for an aircraft are developed in a form best suited to real time simulation. Models for a few helicopter subsystems are discussed in terms of general approaches that are commonly taken in today's simulations.

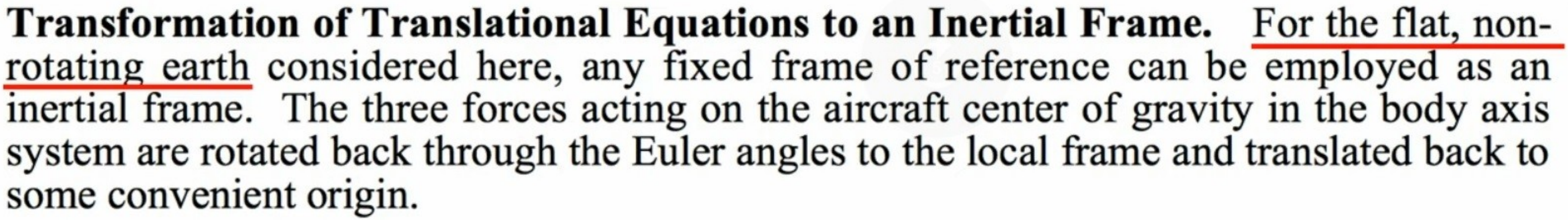
INTRODUCTION

This chapter is intended to provide the reader with a understanding of the type of mathematical model used in a real-time flight simulation. A flight simulation system is

Title: Simulator Aero Model Implementation

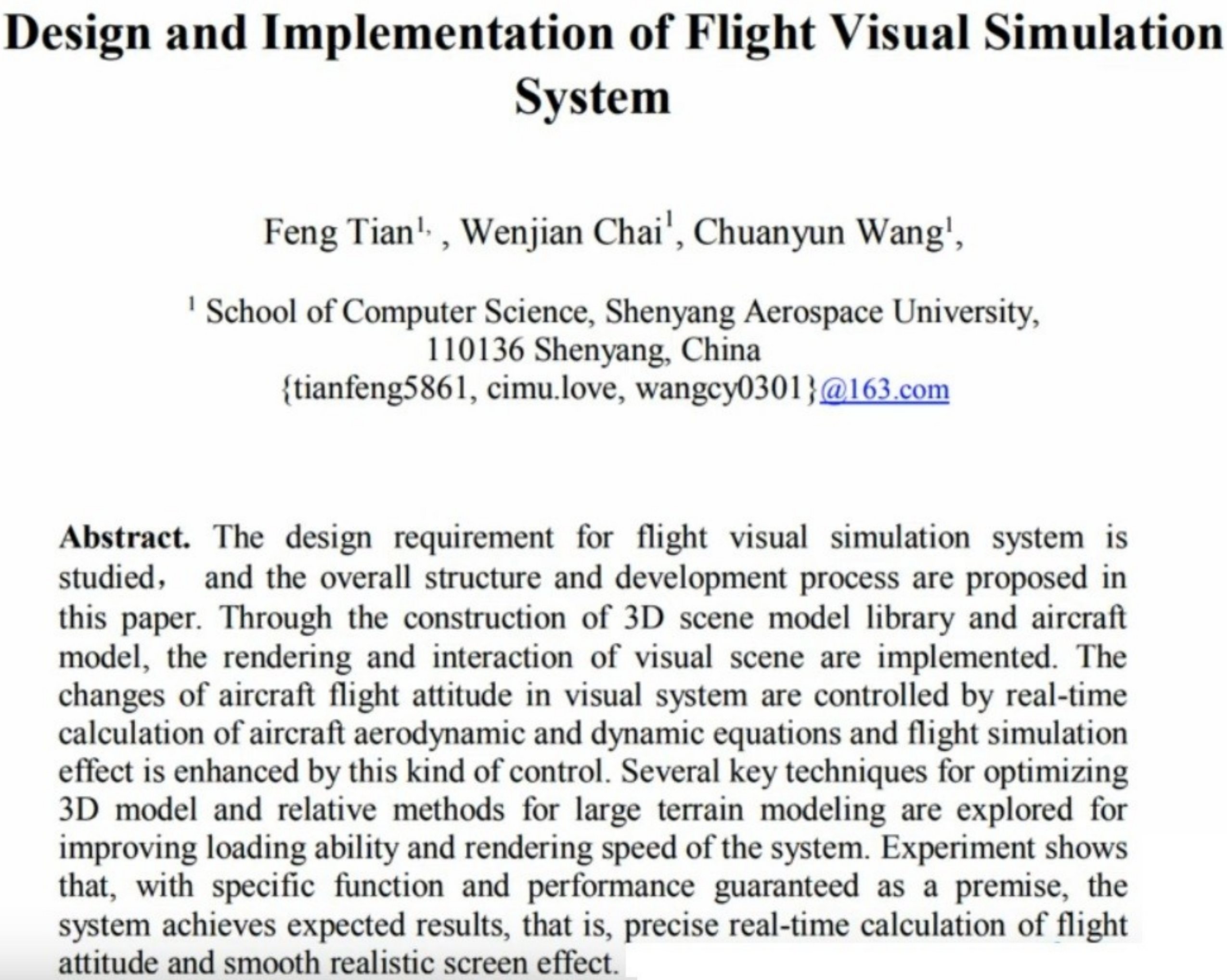
Authors: Thomas S. Alderete

URL:
https://www.aviationsystemsdivision.arc.nasa.gov/publications/hitl/rtsim/Toms.pdf



Transformation of Translational Equations to an Inertial Frame. For the flat, non-rotating earth considered here, any fixed frame of reference can be employed as an inertial frame. The three forces acting on the aircraft center of gravity in the body axis system are rotated back through the Euler angles to the local frame and translated back to some convenient origin.

Regierung gibt Flache Erde zu: Dok #37



Design and Implementation of Flight Visual Simulation System

Feng Tian[1,] , Wenjian Chai[1], Chuanyun Wang[1],

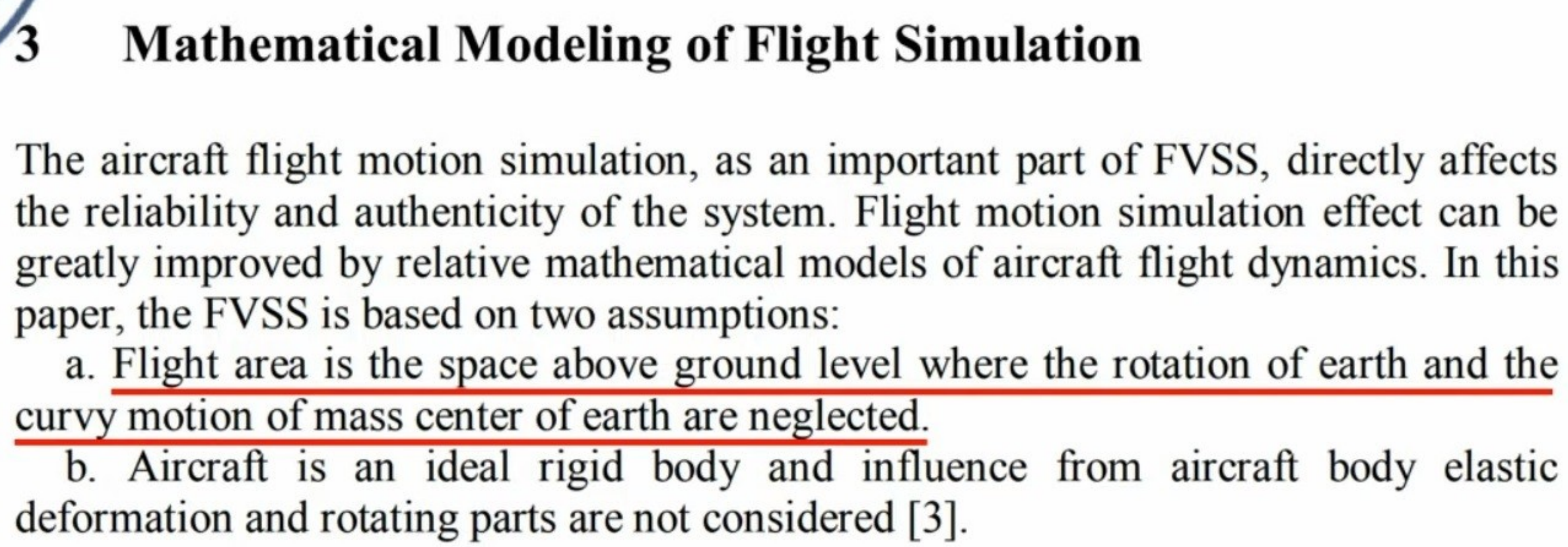
[1] School of Computer Science, Shenyang Aerospace University,
110136 Shenyang, China
{tianfeng5861, cimu.love, wangcy0301}@163.com

Abstract. The design requirement for flight visual simulation system is studied， and the overall structure and development process are proposed in this paper. Through the construction of 3D scene model library and aircraft model, the rendering and interaction of visual scene are implemented. The changes of aircraft flight attitude in visual system are controlled by real-time calculation of aircraft aerodynamic and dynamic equations and flight simulation effect is enhanced by this kind of control. Several key techniques for optimizing 3D model and relative methods for large terrain modeling are explored for improving loading ability and rendering speed of the system. Experiment shows that, with specific function and performance guaranteed as a premise, the system achieves expected results, that is, precise real-time calculation of flight attitude and smooth realistic screen effect.

Title: Design and Implementation of Flight Visual Simulation System

Authors: Feng Tian, Wenjian Chai, Chuanyan Wang

URL: https://arxiv.org/pdf/1212.0365.pdf



3 Mathematical Modeling of Flight Simulation

The aircraft flight motion simulation, as an important part of FVSS, directly affects the reliability and authenticity of the system. Flight motion simulation effect can be greatly improved by relative mathematical models of aircraft flight dynamics. In this paper, the FVSS is based on two assumptions:

a. Flight area is the space above ground level where the rotation of earth and the curvy motion of mass center of earth are neglected.

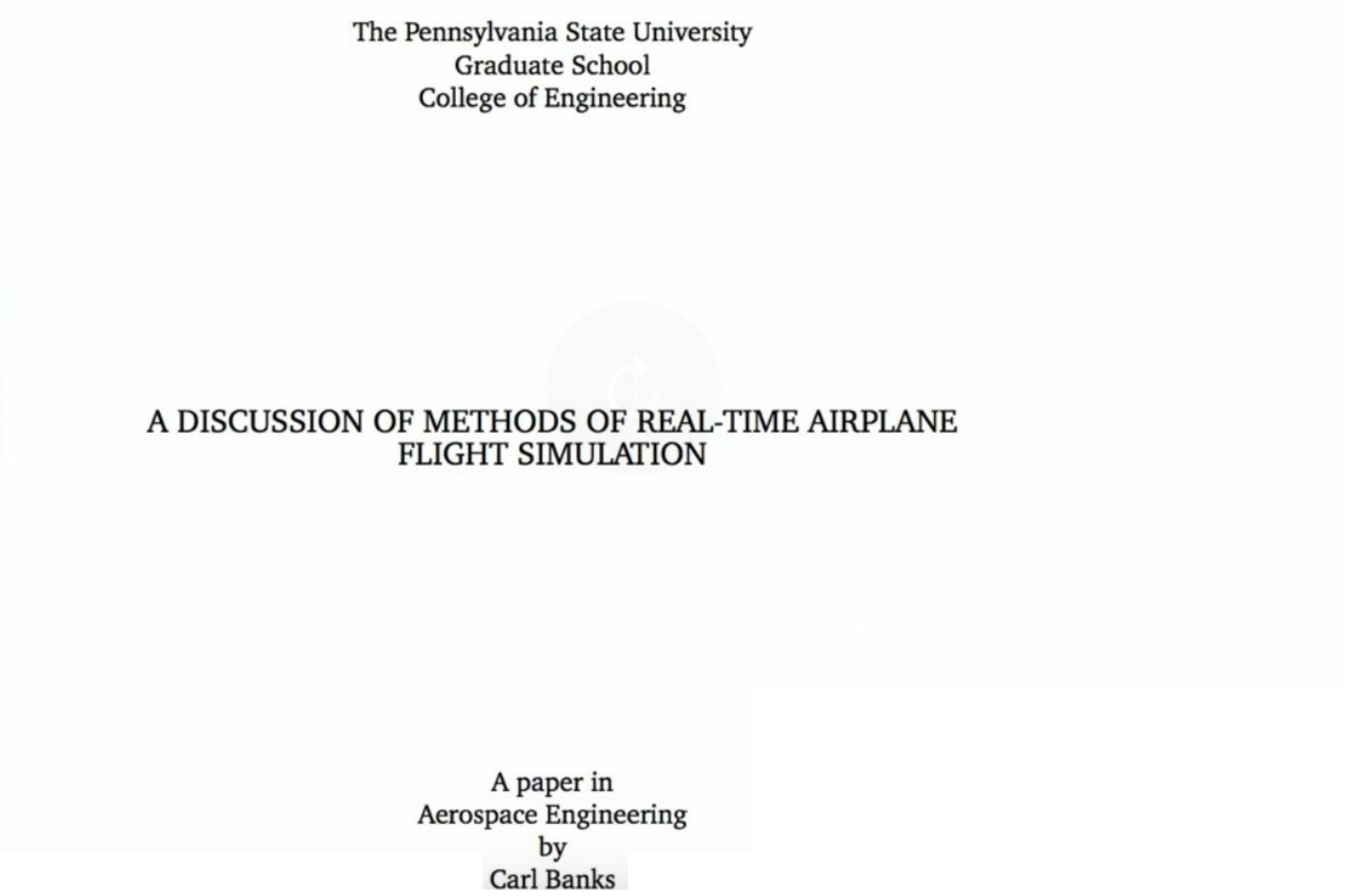
b. Aircraft is an ideal rigid body and influence from aircraft body elastic deformation and rotating parts are not considered [3].

Regierung gibt Flache Erde zu: Dok #38

Title: A Discussion of Methods of Real-Time Airplane Flight Simulation

Authors: Carl Banks

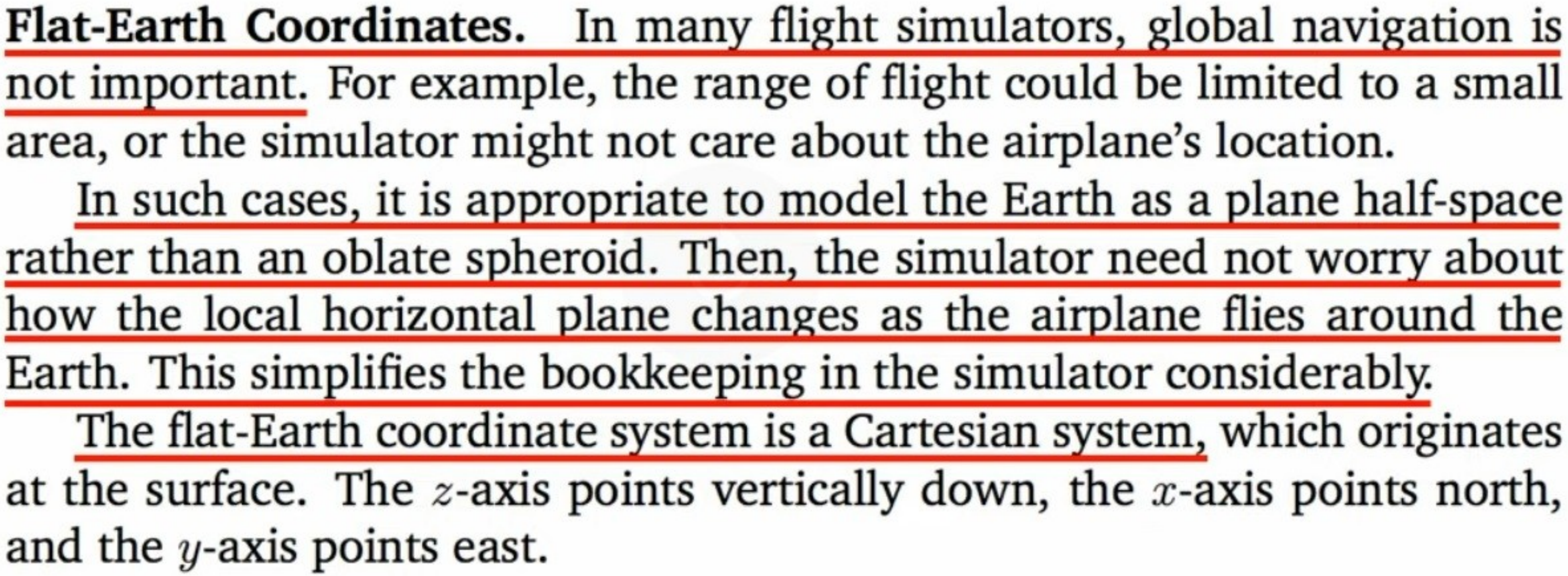
URL:
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.510.7499&rep=rep1&type=pdf



The Pennsylvania State University
Graduate School
College of Engineering

A DISCUSSION OF METHODS OF REAL-TIME AIRPLANE FLIGHT SIMULATION

A paper in
Aerospace Engineering
by
Carl Banks



Flat-Earth Coordinates. In many flight simulators, global navigation is not important. For example, the range of flight could be limited to a small area, or the simulator might not care about the airplane's location.

In such cases, it is appropriate to model the Earth as a plane half-space rather than an oblate spheroid. Then, the simulator need not worry about how the local horizontal plane changes as the airplane flies around the Earth. This simplifies the bookkeeping in the simulator considerably.

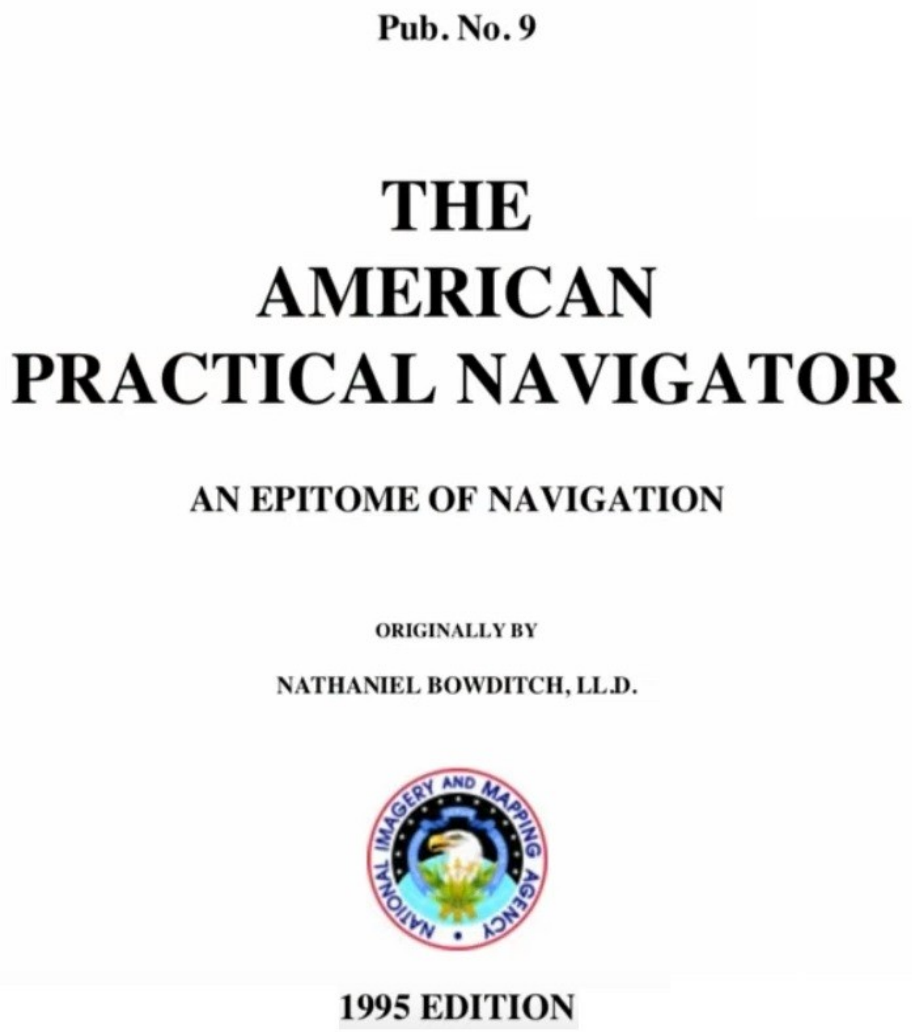
The flat-Earth coordinate system is a Cartesian system, which originates at the surface. The z-axis points vertically down, the x-axis points north, and the y-axis points east.

Regierung gibt Flache Erde zu: Dok #39

Title: The American Practical Navigator: An Epitome of Navigation

Original Author: Nathaniel Bowditch, LL.D.

URL: http://geocenter.survey.ntua.gr/main/labs/carto/academic/persons/bnakos_site_nafp/documentation/american_practical_navigator.pdf



Pub. No. 9

THE
AMERICAN
PRACTICAL NAVIGATOR

AN EPITOME OF NAVIGATION

ORIGINALLY BY

NATHANIEL BOWDITCH, LL.D.

1995 EDITION

NATIONAL IMAGERY AND MAPPING AGENCY

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY
UNITED STATES OF AMERICA

Distance by vertical angle between the waterline and the top of an object is computed by solving the right triangle formed between the observer, the top of the object, and the waterline of the object by simple trigonometry. This assumes that the observer is at sea level, the earth is flat between observer and object, there is no refraction, and the object and its waterline form a right angle. For most cases of practical significance, these assumptions produce no ~~large~~ errors.

NATIONAL IMAGERY AND MAPPING AGENCY

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY
UNITED STATES OF AMERICA

Earth

Acceleration due to gravity (standard) = 980.665 centimeters per second per second
= 32.1740 feet per second per second
Mass-ratio—Sun/Earth = 332,958
Mass-ratio—Sun/(Earth & Moon) = 328,912
Mass-ratio—Earth/Moon = 81.30
Mean density = 5.517 grams per cubic centimeter
Velocity of escape = 6.94 statute miles per second
Curvature of surface = 0.8 foot per nautical mile

backshore, *n*. That part of a beach which is usually dry, being reached only by the highest tides, and by extension, a narrow strip of relatively flat coast bordering the sea. See also FORESHORE.

NATIONAL IMAGERY AND MAPPING AGENCY

NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY
UNITED STATES OF AMERICA

line of sight. The straight line between two points, which does not follow the curvature of the earth.

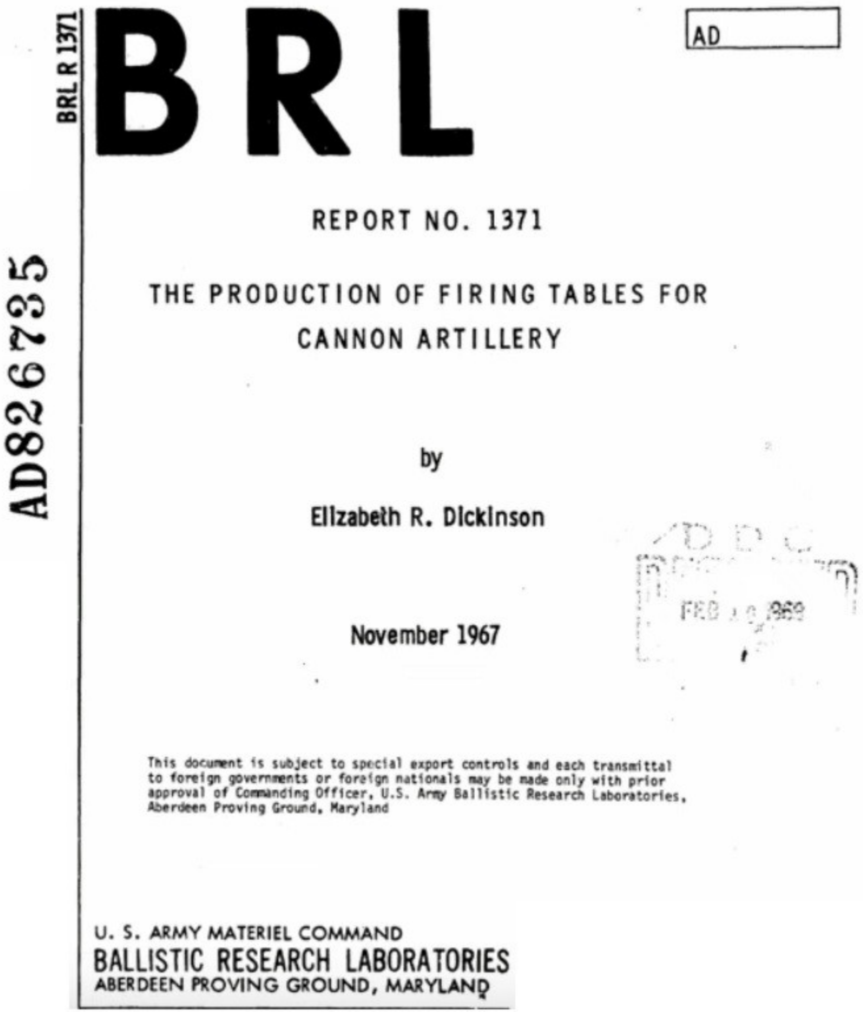
* By Admission & Omission *

Regierung gibt Flache Erde zu: Dok #40

Title: The Production of Firing Tables for Cannon Artillery

Author: Elizabeth R. Dickinson

URL:
https://apps.dtic.mil/dtic/tr/fulltext/u2/826735.pdf



BRL R 1371

AD826735

BRL

AD

REPORT NO. 1371

THE PRODUCTION OF FIRING TABLES FOR
CANNON ARTILLERY

by

Elizabeth R. Dickinson

November 1967

DDC
FEB 10 1969

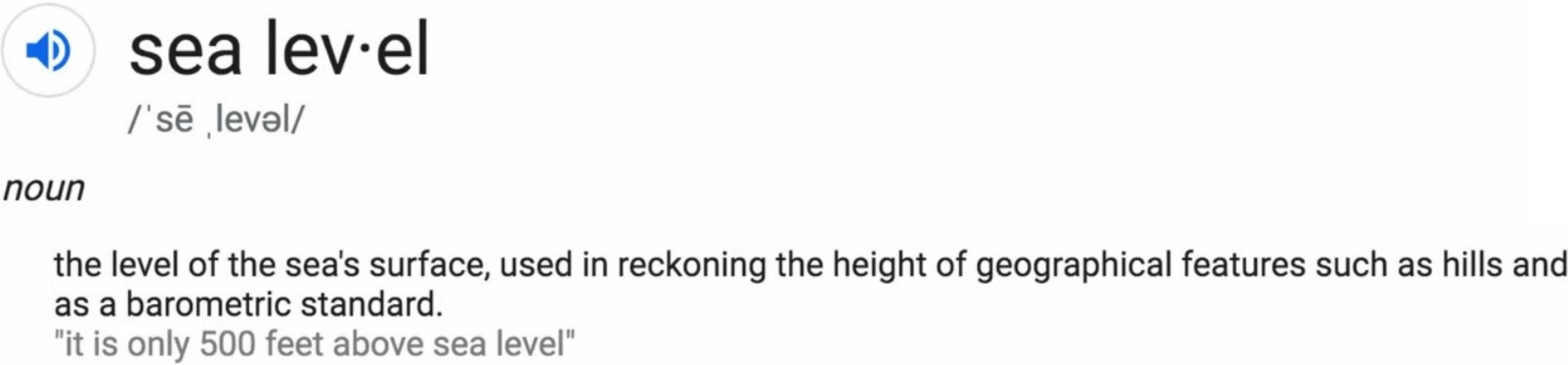
This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of Commanding Officer, U.S. Army Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland

U. S. ARMY MATERIEL COMMAND
BALLISTIC RESEARCH LABORATORIES
ABERDEEN PROVING GROUND, MARYLAND

UNITED STATES ARMY

MSL	Mean sea level

What is the definition of “sea level”?



sea lev·el

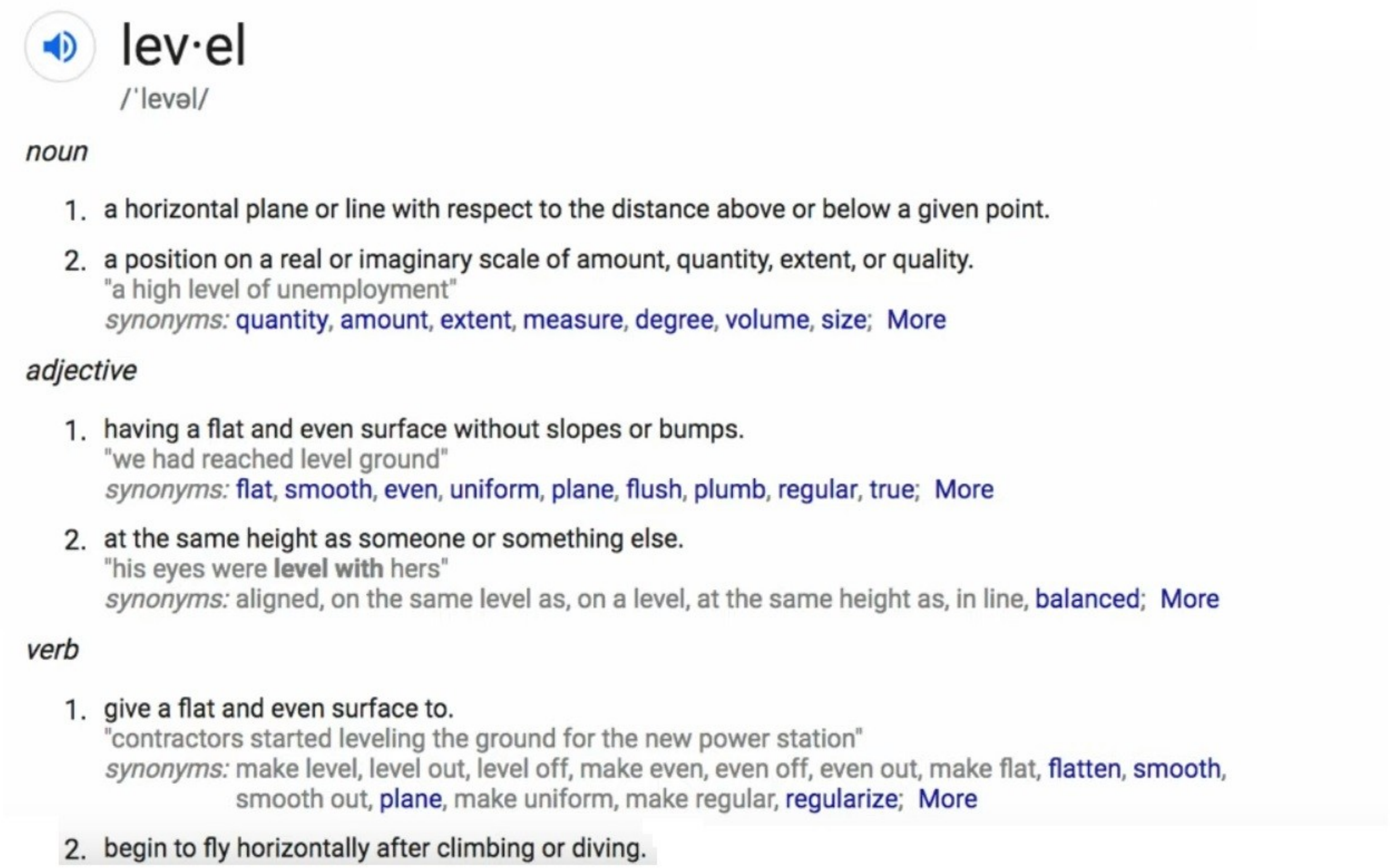
/ˈsē ˌlevəl/

noun

the level of the sea's surface, used in reckoning the height of geographical features such as hills and
as a barometric standard.

"it is only 500 feet above sea level"

What is the definition of “level”?



lev·el

/ˈlevəl/

noun

1. a horizontal plane or line with respect to the distance above or below a given point.
2. a position on a real or imaginary scale of amount, quantity, extent, or quality.
   "a high level of unemployment"
   synonyms: quantity, amount, extent, measure, degree, volume, size; More

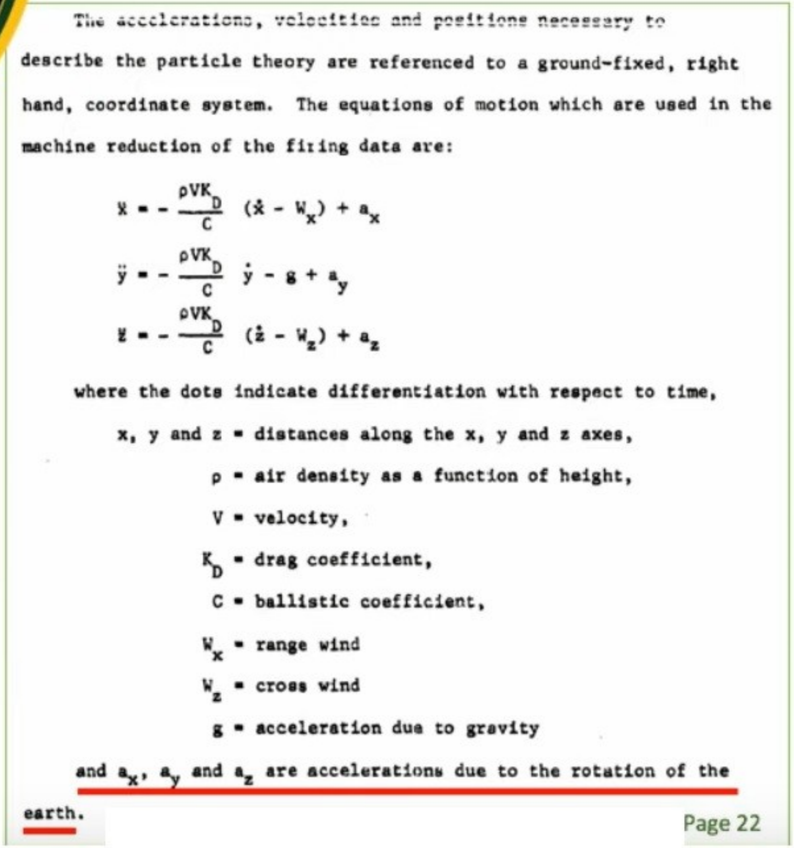
adjective

1. having a flat and even surface without slopes or bumps.
   "we had reached level ground"
   synonyms: flat, smooth, even, uniform, plane, flush, plumb, regular, true; More
2. at the same height as someone or something else.
   "his eyes were **level with** hers"
   synonyms: aligned, on the same level as, on a level, at the same height as, in line, balanced; More

verb

1. give a flat and even surface to.
   "contractors started leveling the ground for the new power station"
   synonyms: make level, level out, level off, make even, even off, even out, make flat, flatten, smooth, smooth out, plane, make uniform, make regular, regularize; More
2. begin to fly horizontally after climbing or diving.

The phrase "rotation of the earth" is cited 3 times between pages 22 and 34, however, an equation based on a "theory" (particle theory) is not a proof for "rotation of the earth". For each of the 3 variables for the "rotation of the earth" in the theoretical equation the number zero (0) can be plugged in without negatively impacting the entirety of the equation.



The accelerations, velocities and positions necessary to describe the particle theory are referenced to a ground-fixed, right hand, coordinate system. The equations of motion which are used in the machine reduction of the firing data are:

$$\ddot{x} = -\frac{\rho V K_D}{C}(\dot{x} - W_x) + a_x$$

$$\ddot{y} = -\frac{\rho V K_D}{C}\dot{y} - g + a_y$$

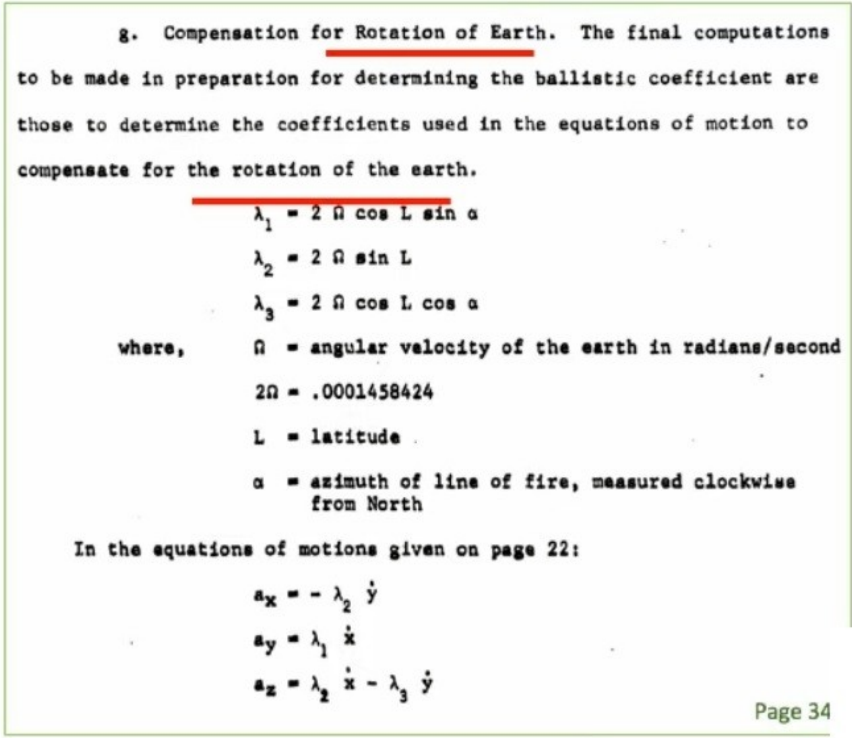
$$\ddot{z} = -\frac{\rho V K_D}{C}(\dot{z} - W_z) + a_z$$

where the dots indicate differentiation with respect to time,

x, y and z = distances along the x, y and z axes,
ρ = air density as a function of height,
V = velocity,
K_D = drag coefficient,
C = ballistic coefficient,
W_x = range wind
W_z = cross wind
g = acceleration due to gravity

and a_x, a_y and a_z are accelerations due to the rotation of the earth.

Page 22



g. Compensation for Rotation of Earth. The final computations to be made in preparation for determining the ballistic coefficient are those to determine the coefficients used in the equations of motion to compensate for the rotation of the earth.

$$\lambda_1 = 2\,\Omega \cos L \sin \alpha$$

$$\lambda_2 = 2\,\Omega \sin L$$

$$\lambda_3 = 2\,\Omega \cos L \cos \alpha$$

where,
Ω = angular velocity of the earth in radians/second
2Ω = .0001458424
L = latitude
α = azimuth of line of fire, measured clockwise from North

In the equations of motions given on page 22:

$$a_x = -\lambda_2\,\dot{y}$$

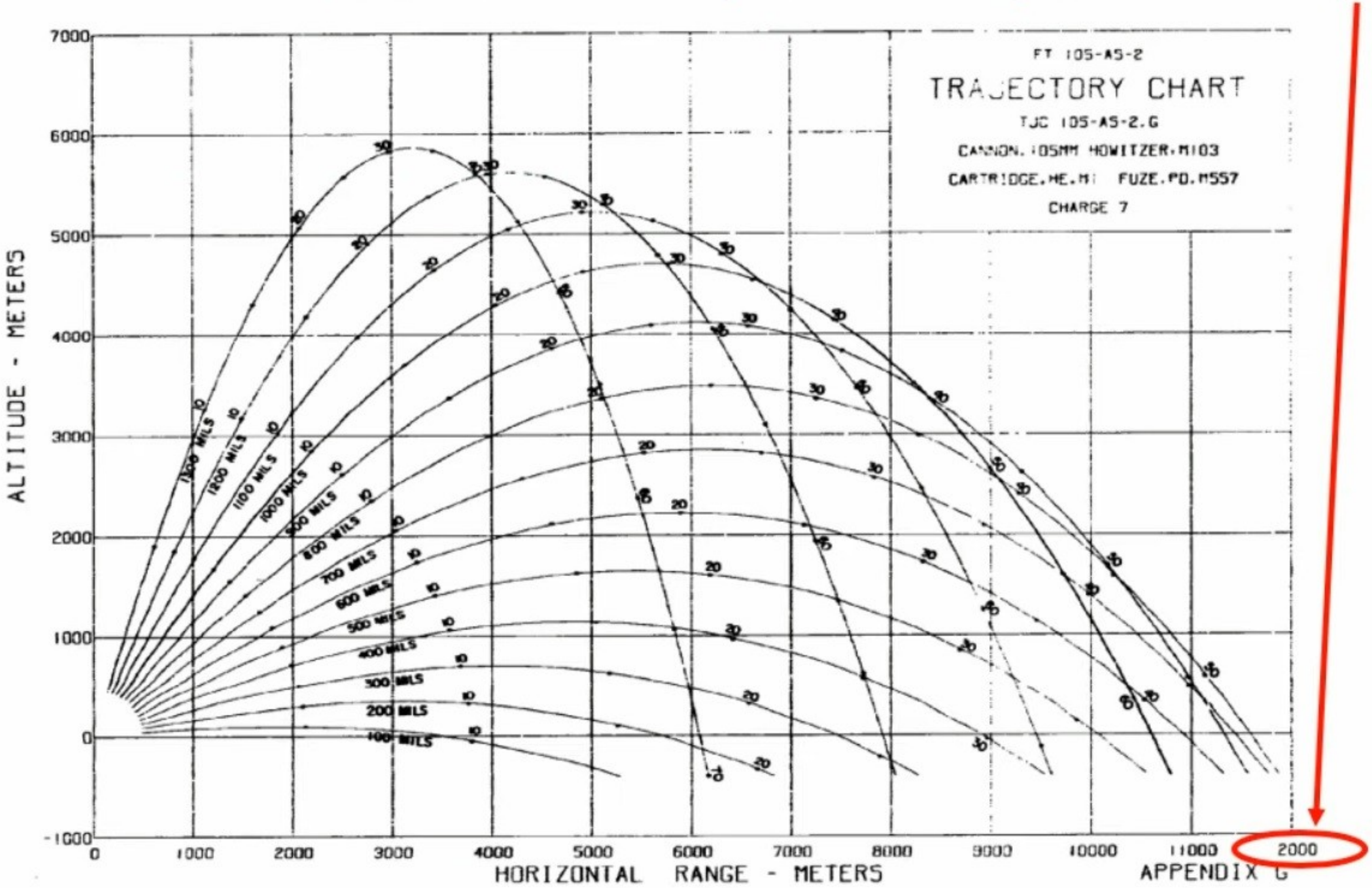
$$a_y = \lambda_1\,\dot{x}$$

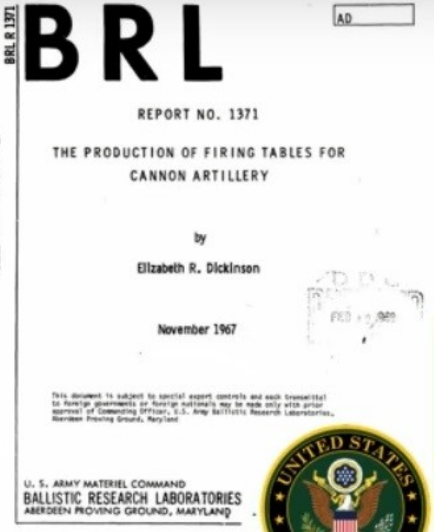
$$a_z = \lambda_2\,\dot{x} - \lambda_3\,\dot{y}$$

Page 34

Dok #40: Seite 22/34 von 115

12,000 meters = 7.45 miles and is a 37 foot drop IF earth is a ball, but earth curvature is not necessary for calculating ballistic artillery?





AD826735

BRL R 1371

BRL

AD

REPORT NO. 1371

THE PRODUCTION OF FIRING TABLES FOR
CANNON ARTILLERY

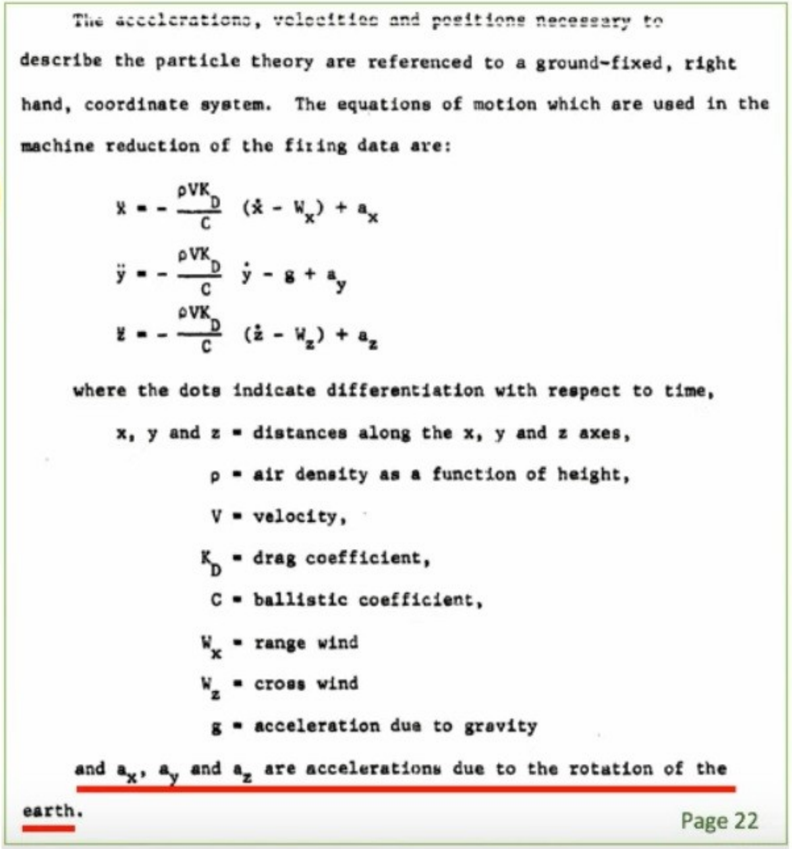
by

Elizabeth R. Dickinson

November 1967

U. S. ARMY MATERIEL COMMAND
BALLISTIC RESEARCH LABORATORIES
ABERDEEN PROVING GROUND, MARYLAND

The phrase "rotation of the earth" is cited 3 times between pages 22 and 34, however, an equation based on a "theory" (particle theory) is not a proof for "rotation of the earth". For each of the 3 variables for the "rotation of the earth" in the theoretical equation the number zero (0) can be plugged in without negatively impacting the entirety of the equation.



The accelerations, velocities and positions necessary to describe the particle theory are referenced to a ground-fixed, right hand, coordinate system. The equations of motion which are used in the machine reduction of the firing data are:

$$\ddot{x} = -\frac{\rho V K_D}{C}(\dot{x} - W_x) + a_x$$

$$\ddot{y} = -\frac{\rho V K_D}{C}\dot{y} - g + a_y$$

$$\ddot{z} = -\frac{\rho V K_D}{C}(\dot{z} - W_z) + a_z$$

where the dots indicate differentiation with respect to time,

x, y and z = distances along the x, y and z axes,

ρ = air density as a function of height,

V = velocity,

K_D = drag coefficient,

C = ballistic coefficient,

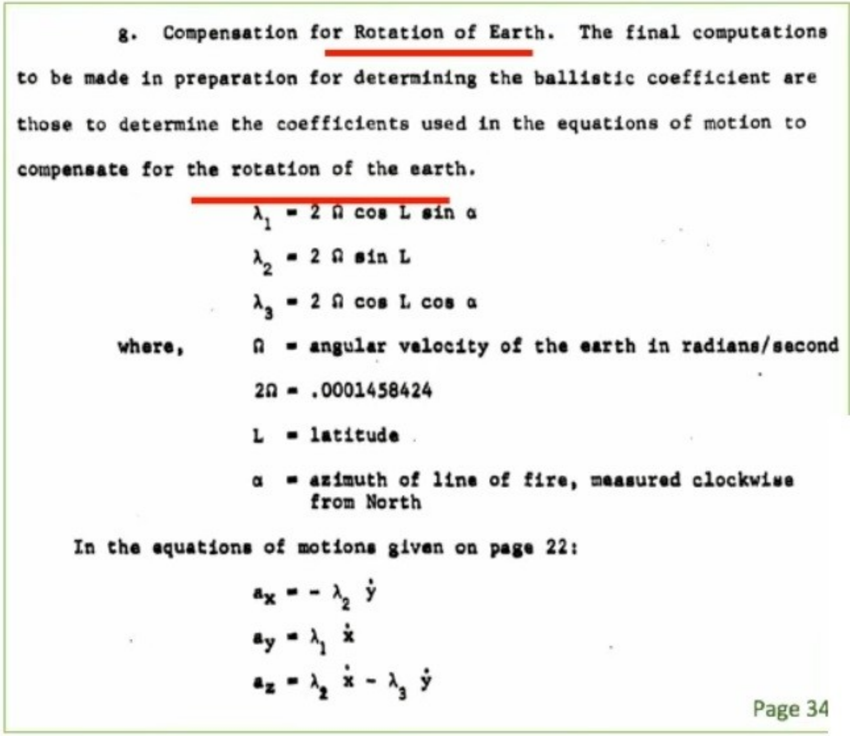
W_x = range wind

W_z = cross wind

g = acceleration due to gravity

and a_x, a_y and a_z are accelerations due to the rotation of the earth.

Page 22



g. Compensation for Rotation of Earth. The final computations to be made in preparation for determining the ballistic coefficient are those to determine the coefficients used in the equations of motion to compensate for the rotation of the earth.

$$\lambda_1 = 2\,\Omega \cos L \sin \alpha$$

$$\lambda_2 = 2\,\Omega \sin L$$

$$\lambda_3 = 2\,\Omega \cos L \cos \alpha$$

where,

Ω = angular velocity of the earth in radians/second

$2\Omega = .0001458424$

L = latitude

α = azimuth of line of fire, measured clockwise from North

In the equations of motions given on page 22:

$$a_x = -\lambda_2\,\dot{y}$$

$$a_y = \lambda_1\,\dot{x}$$

$$a_z = \lambda_2\,\dot{x} - \lambda_3\,\dot{y}$$

Page 34