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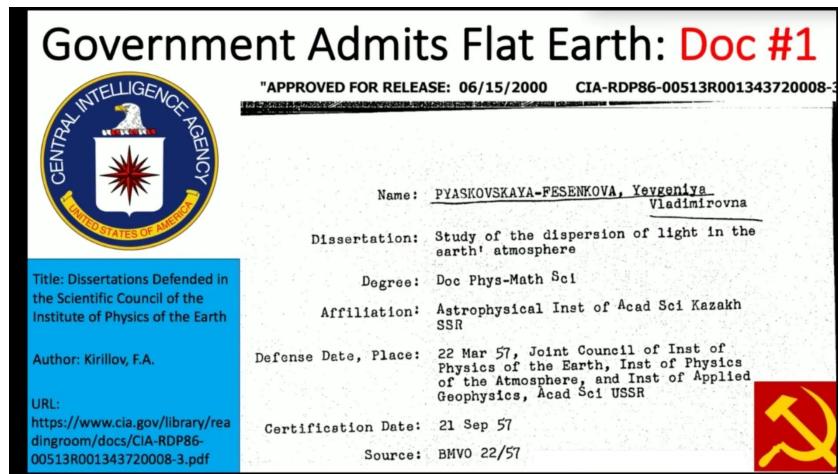
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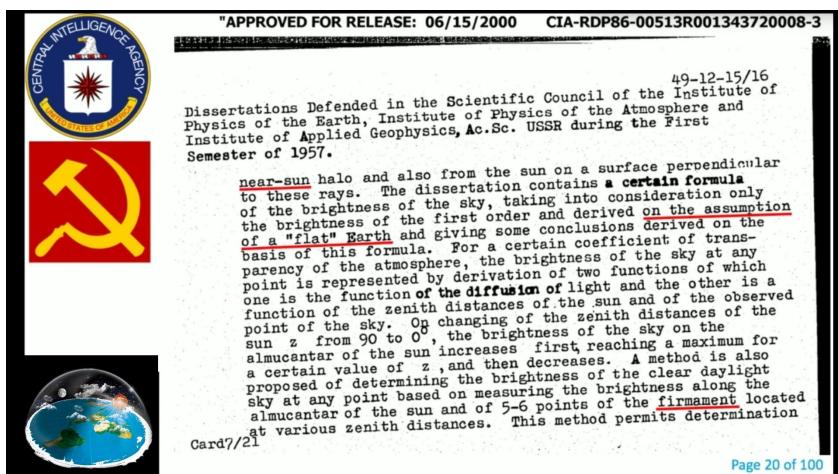
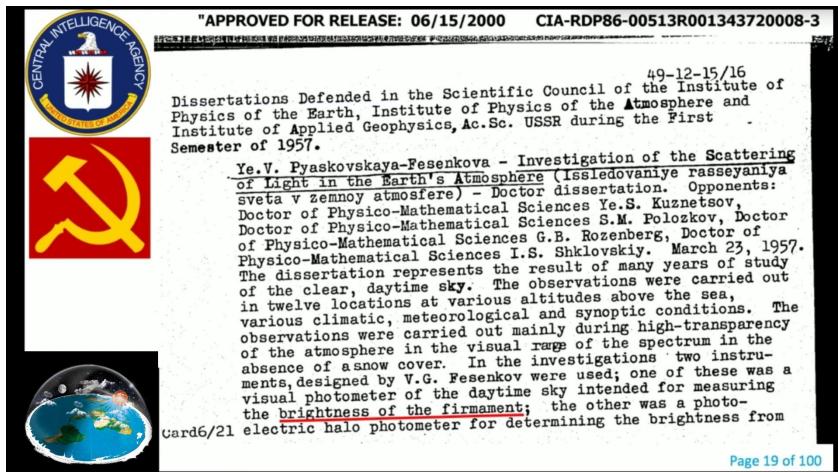


(1) Dissertations Defended in the Scientific Council of the Institute of Physics of the Earth

Pages: Cover Page, 19, 20

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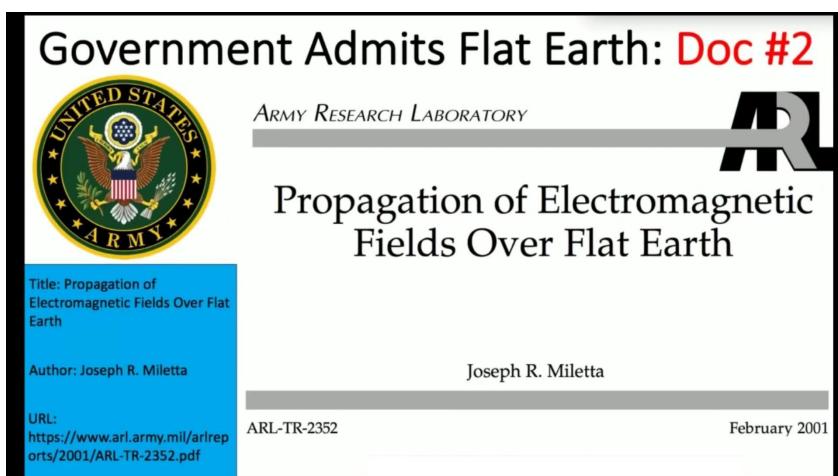




(2) Propagation of Electromagnetic Fields Over Flat Earth

Pages: Cover Page, 7, 17, 18, 28, 35

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





1. Introduction

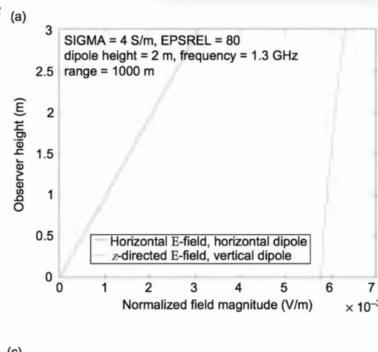


Effective military or law-enforcement applications of high-power microwave (HPM) systems in which the HPM system and the target system are on or near the ground or water require that the microwave power density on target be maximized. The power density at the target for a given source will depend on 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.

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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.



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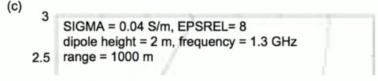
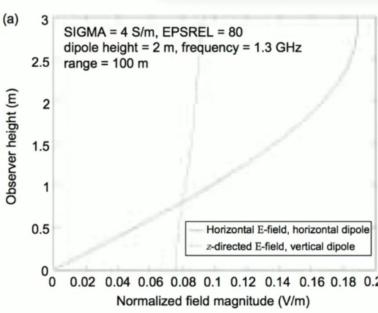
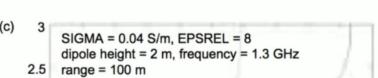


Figure 7. Comparison of principal fields from an ideal dipole oriented perpendicular and horizontal to a homogeneous flat earth. In each case, dipole is placed 2 m above ground plane and observer or target is 100 m down range: (a) sea water, (b) wet earth, (c) dry earth, (d) lake water, and (e) dry sand.



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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)
```



Doc #2: Page 28 of 35



REPORT DOCUMENTATION PAGE

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Doc #2: Page 35 of 35

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

Pages: Cover Page, 10, 16

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



ARMY RESEARCH LABORATORY



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

Author: Arnold Tunick

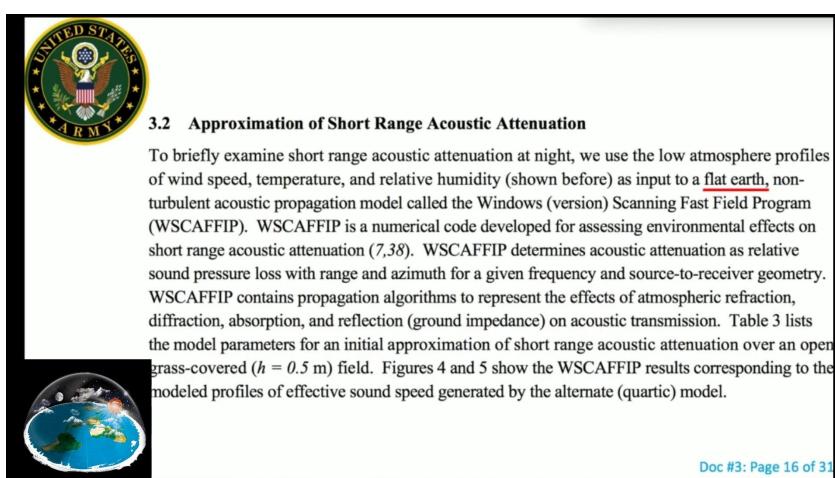
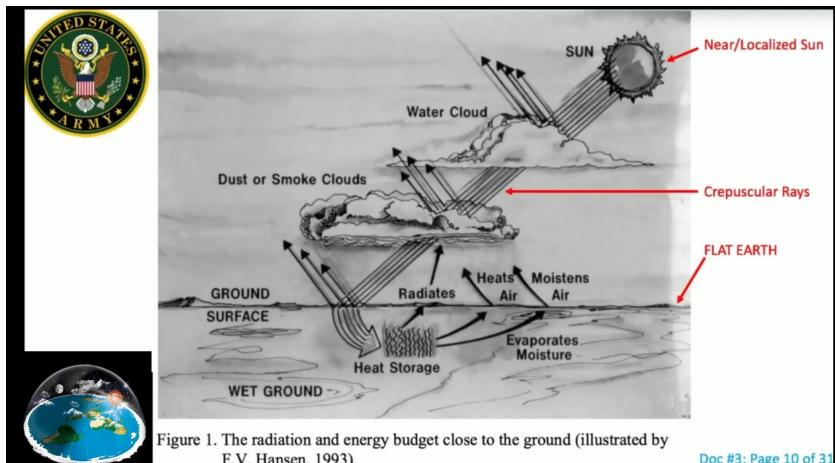
URL:
<https://www.arl.army.mil/arlreports/2003/ARL-MR-563.pdf>

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

by Arnold Tunick

ARL-MR-563

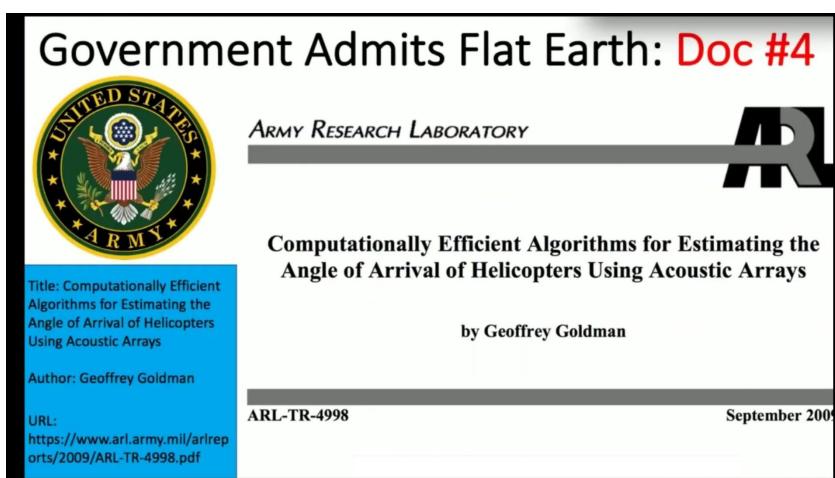
May 2003



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

Pages: Cover Page, 17, 30, 31, 35

<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 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.



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and letting the phase vary from -180° to 180° . The phase that produced the match was selected. The results are shown in figure 17 for a single spectral peak for frequencies between 21–27 Hz for a reflection coefficient with an amplitude of 1. The results based upon harmonics at higher frequencies were almost random and were not included. The results for frequencies below 27 Hz are reasonably consistent, but not close to the anticipated result of a reflection coefficient phase of 0° . The estimated phases of the reflection coefficients have a dependency on range. This may be caused by a violation of the assumption of the flat Earth model.



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The beamforming algorithm with multipath algorithm was rerun using the average of the computed reflection coefficient for two spectral peaks between 9 to 27 Hz. This is a more realistic simulation compared to the previous calculations. The results are shown in figure 19. These results are poor at all times and indicate that the model used to describe the propagation of the signal is not adequate. The assumptions of straight-line propagation, constant reflection coefficient, or reflection off a flat Earth may not be valid.



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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.



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

Page: Cover Page, 7

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



ARMY RESEARCH LABORATORY



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

by Gene R. Cooper

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>

ARL-TR-5118

March 2010



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.



Doc #5: Page 7 of 26

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

Page: Cover Page, 10

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

Government Admits Flat Earth: Doc #6



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

by Gene R. Cooper

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

Author: Gene R. Cooper

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<https://www.arl.army.mil/arlrepts/2011/ARL-TR-5810.pdf>

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.



Doc #6: Page 10 of 30

(7) Derivation and Definition of a Linear Aircraft Model

Pages: Cover Page, 6, 35, 55, 102

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

Government Admits Flat Earth: Doc #7



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1207

August 1988

Title: Derivation and Definition of a Linear Aircraft Model

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

URL:
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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.



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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*



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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, primitive terms, and the state, time derivative of state, and control variables. In this section, the notation $\partial(\dot{x}_i)/\partial x_j$ 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.



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 <p>16. Abstract</p> <p>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.</p>			
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(8) General Equations of Motion for a Damaged Asymmetric Aircraft

Page: Cover Page, 2

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20070030307.pdf>

Government Admits Flat Earth: Doc #8



<https://ntrs.nasa.gov/search.jsp?R=20070030307> 2019-07-03T20:22:50+00:00

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



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(9) Predicted Performance of a ThrustEnhanced SR-71 Aircraft with an External Payload

Page: Cover Page, 10

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

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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/88507/main_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 Admin



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-



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

Page: Cover Page, 7

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



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

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

MITRE Technical Report

Dr. Lesley A. Weitz

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2 Equations of Motion

2.1 Reference Frames

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

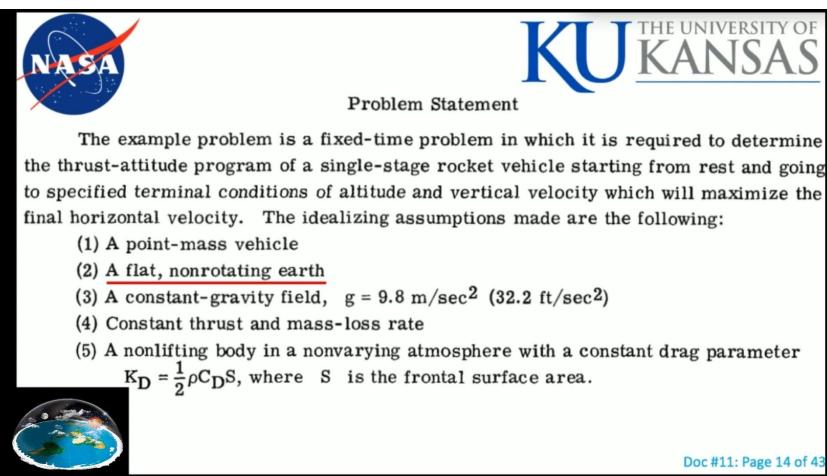
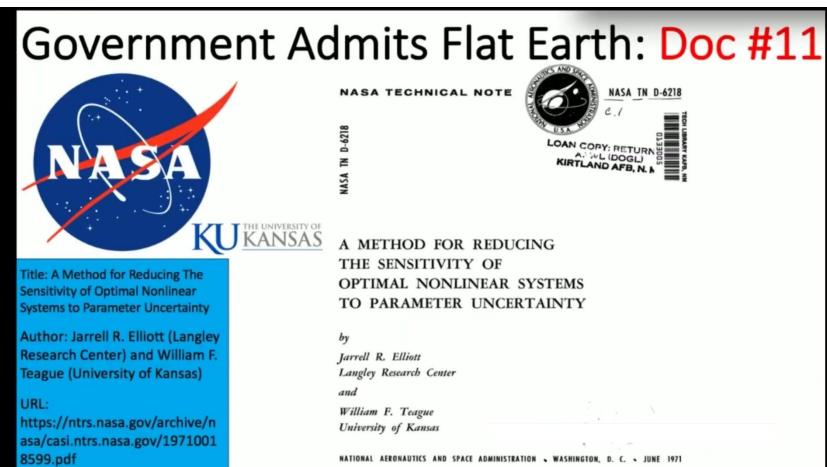


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(11) A Method for Reducing The Sensitivity of Optimal Nonlinear Systems to Parameter Uncertainty

Page: Cover Page, 14

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19710018599.pdf>



Doc #11: Page 14 of 43

(12) Calculation of Wind Compensation for Launching of Unguided Rockets

Pages: Cover Page, 8, 10

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20040008097.pdf>

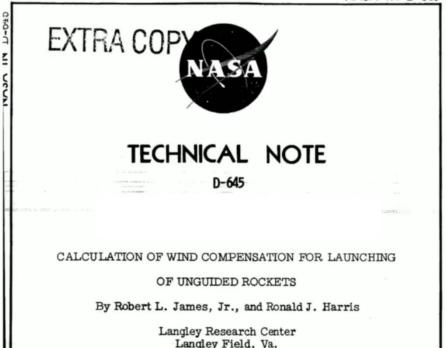
Government Admits Flat Earth: Doc #12



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>



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NASA
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.

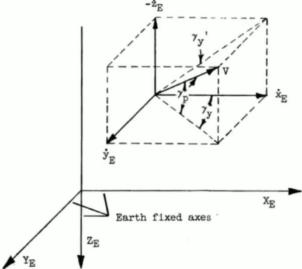


Diagram showing a vehicle trajectory in a 3D coordinate system defined by Earth fixed axes (x_E , y_E , z_E). The vehicle's position is defined by vectors \mathbf{r} and \mathbf{v} . The trajectory is shown as a series of points in the x_E - y_E plane, with angles γ_x , γ_y , and γ_z indicating the vehicle's orientation relative to the axes.



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

Page: Cover Page, 16

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NASA
Technical
Paper
2768

December 1987

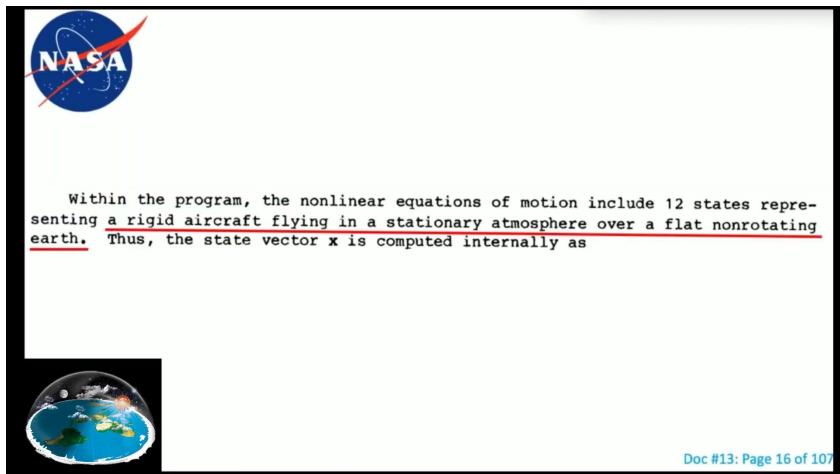
Title: User's Manual for LINEAR, a FORTRAN Program to Derive Linear Aircraft Models (2768)

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

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

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

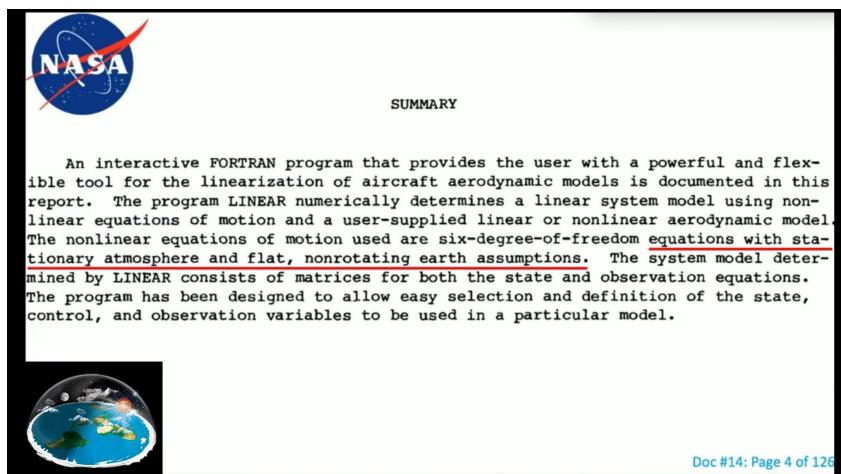
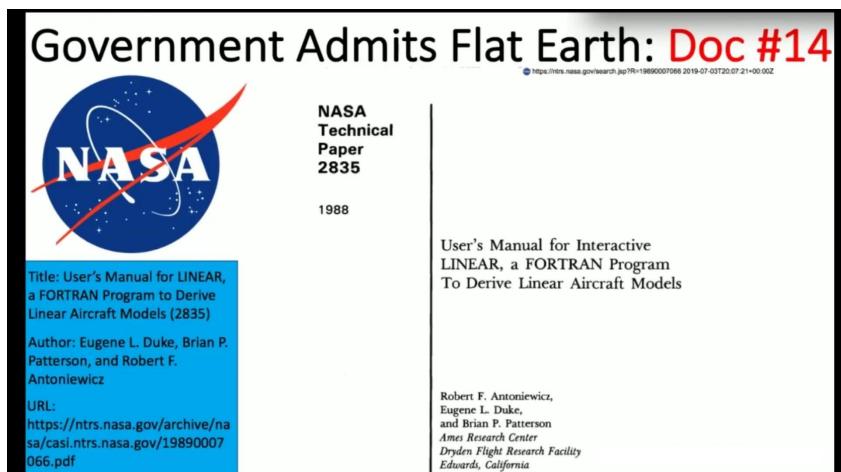
Eugene L. Duke,
Brian P. Patterson,
and Robert F. Antoniewicz



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

Page: Cover Page, 4, 126

https://www.nasa.gov/centers/dryden/pdf/88112main_H-1443.pdf



 <p>16. Abstract</p> <p>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.</p>	
<p>17. Key Words (Suggested by Author(s))</p> <p>Aircraft model Computer program Control law design Linearization</p> <p>18. Distribution Statement</p> <p>Unclassified - Unlimited</p>	
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<p>ASA FORM 1626 OCT 95 For sale by the National Technical Information Service, Springfield, Virginia 22161 NASA-Langley, 1988</p>	

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(15) Determination of Angles of Attack and Sideslip from Radar Data and a Roll-Stabilized Platform

Page: Cover Page, 2

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19720012071.pdf>

Government Admits Flat Earth: Doc #15

<https://ntrs.nasa.gov/search.jsp?R=19720012071> 2019-07-03T20:02:05+00:00

 <p>NASA TECHNICAL MEMORANDUM</p> <p>NATIONAL AERONAUTICS AND SPACE ADMINISTRATION NASA TM X-2514</p> <p>DETERMINATION OF ANGLES OF ATTACK AND SIDESLIP FROM RADAR DATA AND A ROLL-STABILIZED PLATFORM</p> <p>by John S. Preisser Langley Research Center Hampton, Va. 23365 www.FlatEarthDoctrine.com</p> <p>NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • MARCH 1972</p>	
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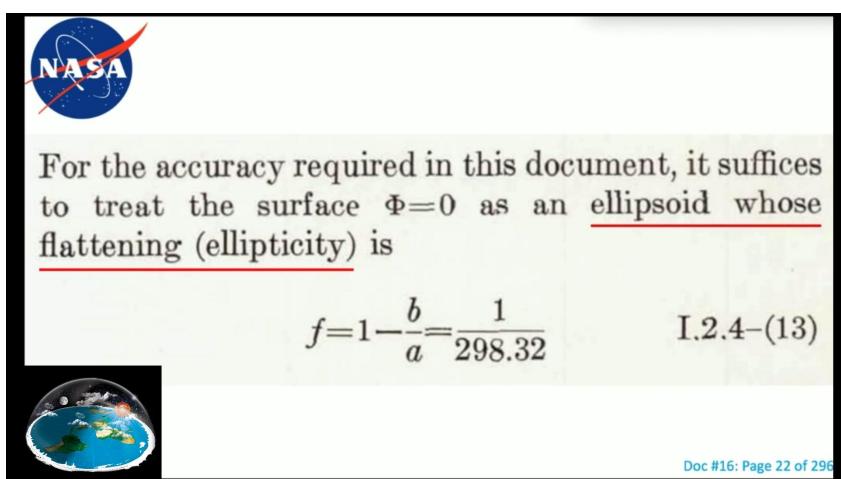
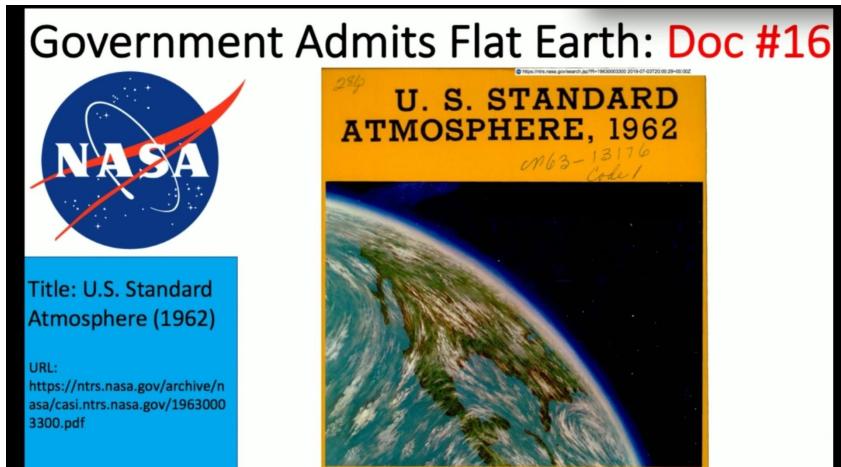
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Doc #15: Page 2 of 23

(16) U.S. Standard Atmosphere (1962)

Page: Cover Page, 22

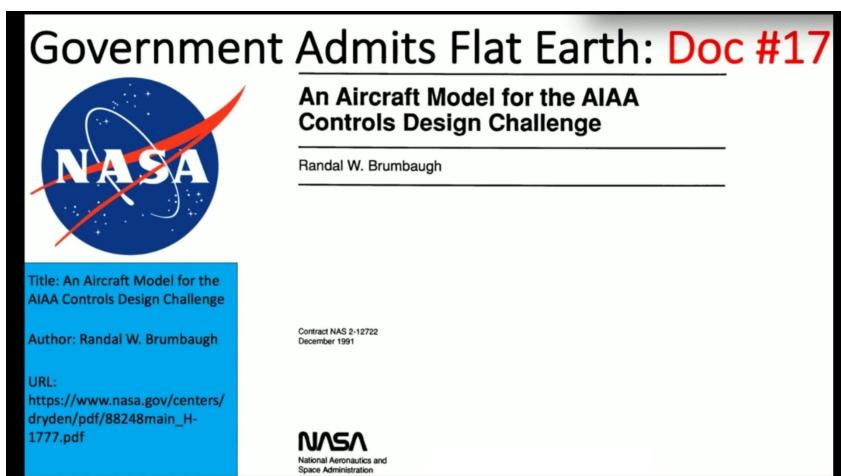
<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19630003300.pdf>



(17) An Aircraft Model for the AIAA Controls Design Challenge

Page: Cover Page, 13

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





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.



Doc #17: Page 13 of 19

(18) Investigation of Aircraft Landing in Variable Wind Fields

Page: Cover Page, 14

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19790005472.pdf>

Government Admits Flat Earth: Doc #18



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NASA Contractor Report 3073

Investigation of Aircraft Landing in Variable Wind Fields

Walter Frost and Kapuluru Ravikumar Reddy

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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:

- The earth is flat and non-rotating.



Doc #18: Page 14 of 93

(19) A Mathematical Model of the CH-53

Page: Cover Page, 25

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19810003557.pdf>

Government Admits Flat Earth: Doc #19



https://ntrs.nasa.gov/search.jsp?R=19810003557 2019-07-03T19:54:24+00:00

NASA Technical Memorandum 81238

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

A Mathematical Model of the CH-53 Helicopter

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

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/ncas/casi.ntrs.nasa.gov/19810003557.pdf>



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.



Doc #19: Page 25 of 58

(20) Development and Validation of a Piloted Simulation of a Helicopter and External Sling Load

Pages: Cover Page, 6, 37, 48

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19790005912.pdf>

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NASA Technical Paper 1285

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

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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/ncas/casi.ntrs.nasa.gov/19790005912.pdf>



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.



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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_g - z_g plane are planes of mass symmetry and that gyroscopic effects of engines are negligible. The equations of motion for the helicopter are developed first.



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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.

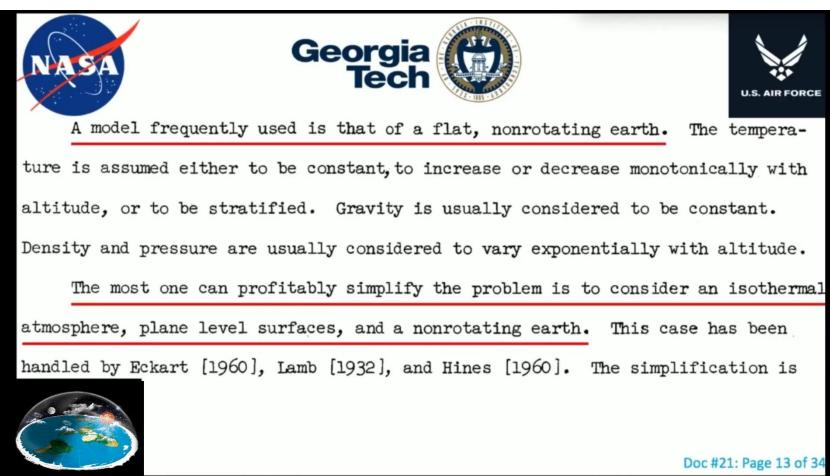
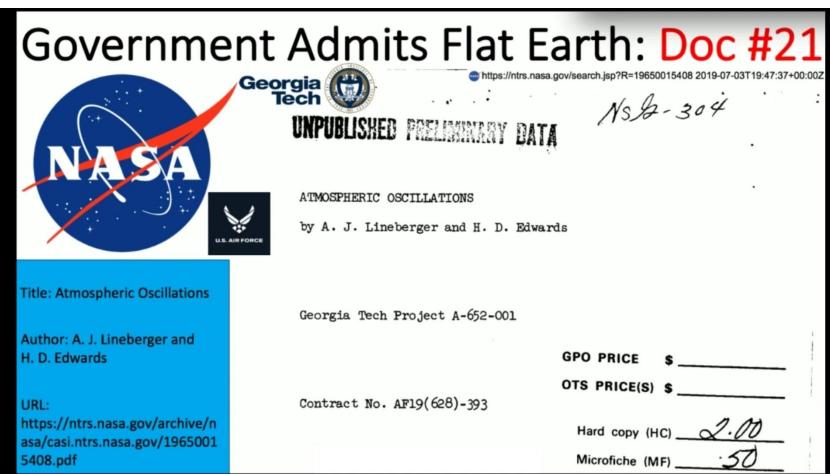


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(21) Atmospheric Oscillations

Page: Cover Page, 13

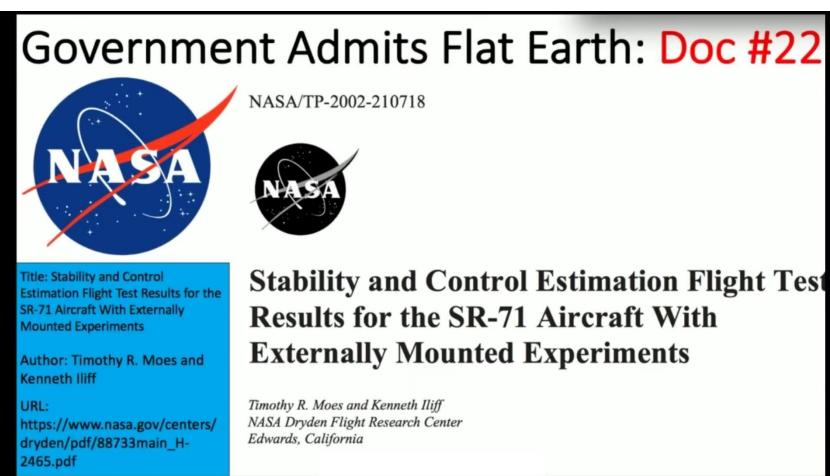
<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19650015408.pdf>



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

Page: Cover Page, 18, 19

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





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:



Doc #22: Page 18 & 19 of 96

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

Page: Cover Page, 9

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19880014378.pdf>

Government Admits Flat Earth: Doc #23



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

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

FOR REFERENCE

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA
National Aeronautics and
Space Administration

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

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

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



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 iden-
tified, the state model is augmented by wind veloc-
ities and accelerations. The measurement model



Doc #23: Page 9 of 18

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

Page: Cover Page, 2

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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>

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

Nhan Nguyen*
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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 variable, the singular optimal control is decomposed into the singular and the non-singular components. 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 state variable form as



Doc #24: Page 2 of 16

(25) Studies On Instabilities in Long-Baseline Two-Way Satellite Time and Frequency Transfer (TWSTFT) Including a Troposphere Delay Model

Pages: Cover Page, 2, 6

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

Government Admits Flat Earth: Doc #25



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

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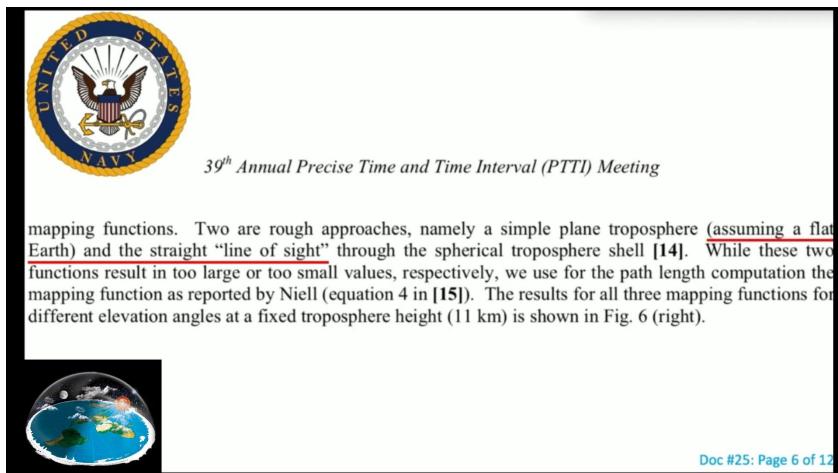
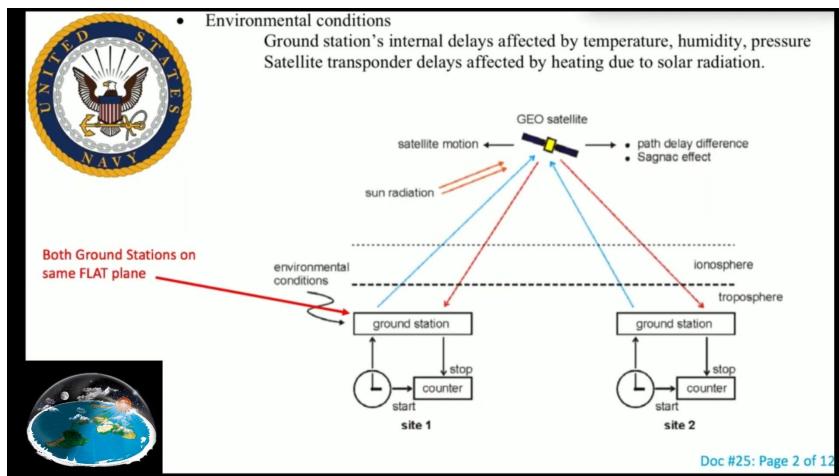
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Title: STUDIES ON INSTABILITIES IN LONG-BASELINE TWO-WAY SATELLITE TIME AND FREQUENCY TRANSFER (TWSTFT) INCLUDING A TROPOSPHERE DELAY MODEL

Author: D. Piester, A. Bauch

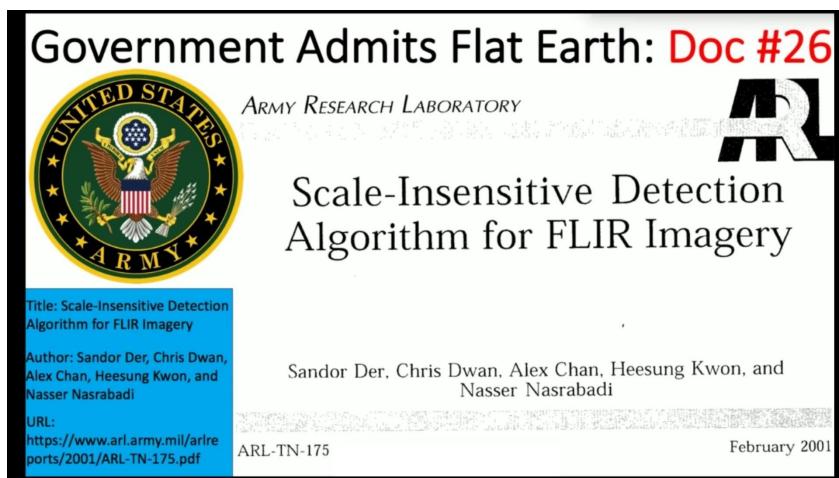
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(26) Scale-Insensitive Detection Algorithm for FLIR Imagery

Page: Cover Page, 6

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





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,



Doc #26: Page 6 of 22

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

Page: Cover Page, 45

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



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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

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16. PRICE CODE

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17. SECURITY CLASSIFICATION OF REPORT

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298-102

(28) Path-Loss Measurements in a Forested Environment at VHF

Pages: Cover Page, 8, 16, 17, 18, 19, 20, 23, 25, 26, 35

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

Government Admits Flat Earth: Doc #28



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Path-Loss Measurements in a Forested Environment at VHF

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>

ARL-TR-2156

Robert J. Tan and Suzanne R. Stratton

September 2000



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



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Multipath Data

In this section, we discuss the data for the measurements described in section 2.2. Figure 9 plots the transmission loss as a function of transmit antenna height for 145, 223, 300, 435, and 910 MHz, respectively. The receive antenna height was 2.7 m and the range was 410 m for all frequencies except 435 MHz, where the receive height was 3.6 m and the range was 200 m. The expected transmission loss in decibels over a flat earth is given by

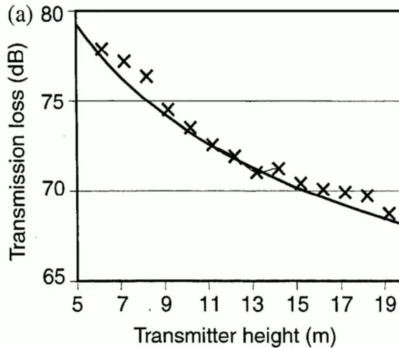
$$\frac{P_R}{P_T} = 10 \log \left[2 \sin \left(\frac{2\pi h_t h_r}{\lambda R} \right) \right]^2 \left[\frac{\lambda}{4\pi R} \right]^2, \quad (2)$$



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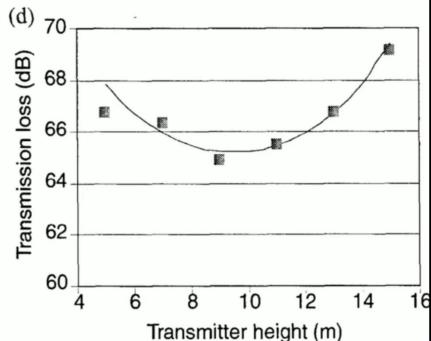
Figure 9. Comparison of measurements to theory for transmission loss over flat earth for a range of 410 m and a receive antenna height of 2.7 m for (a) 145, (b) 223, and (c) 300 MHz.



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Figure 9 (cont'd).
Comparison of
measurements to
theory for transmis-
sion loss over flat
earth for a range of
410 m and a receive
antenna height of
2.7 m for (d) 435 and
(e) 910 MHz.



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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.



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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.



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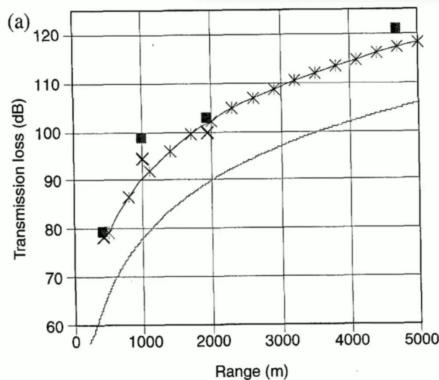
the results generated by the model are shown as curves. Figure 15 plots propagation loss data in decibels for selected antenna heights as a function of range (transmit height of 22 m and receive height of 2.7 m). The data in figure 15 compare loss over flat earth (theory) given by equation (2) in section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



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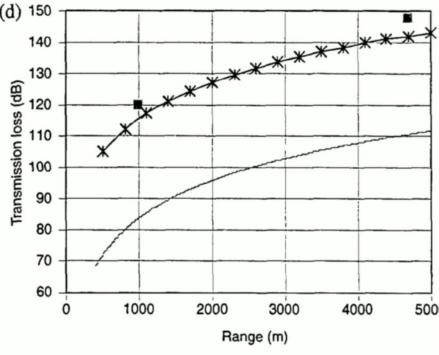
Figure 15. Comparison of measured propagation loss, loss over flat earth, and an analytical model for HH polarization in decibels plotted as a function of range for (a) 145, (b) 223, (c) 300 MHz.



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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.



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Conclusions

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

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

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

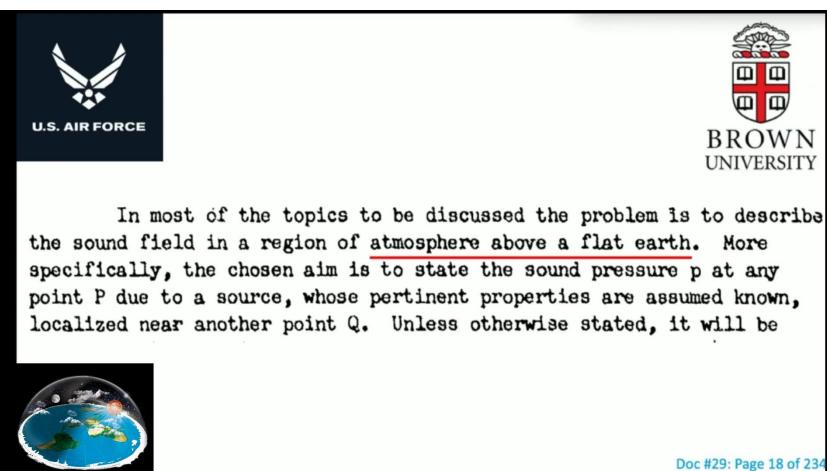
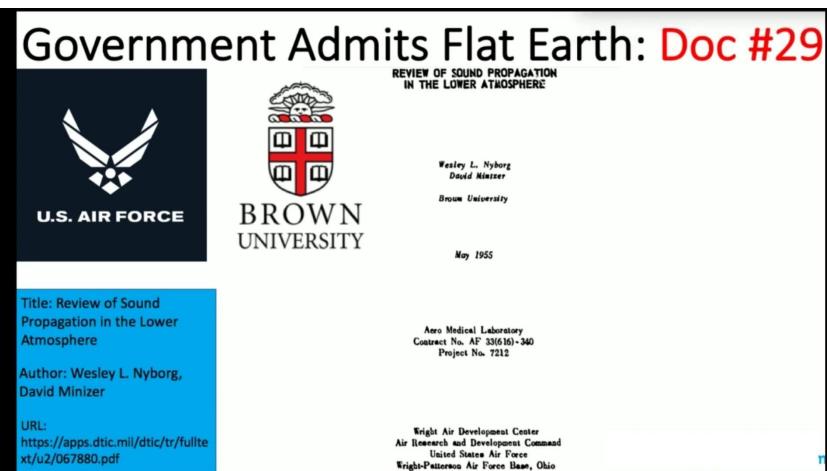
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(29) Review of Sound Propagation in the Lower Atmosphere

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





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21. H. Bremmer, The Extension of Sommerfeld's Formula for the Propagation of Radio Waves over a Flat Earth to Different Conductivities of the Soil, *Physica XX*, 441, (1954)



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(30) Beacon Position and Attitude Navigation Aided by a Magnetometer

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



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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>





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 \mathbf{X} , \mathbf{Y} , and \mathbf{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 ,

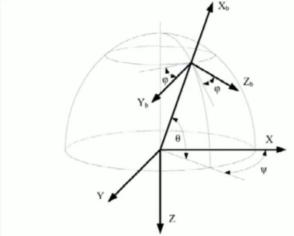


Figure 1. Earth- and body-fixed coordinate systems and the Euler angle rotations.

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(31) Automatic Target Acquisition of the DEMO III Program

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Automatic Target Acquisition of the DEMO III Program

by Sandor Der, Alex Chan, Gary Stolovy, Michael Lander,
and Matthew Thielke

ARL-TR-2683

August 200

Title: Automatic Target Acquisition of the DEMO III Program
Author: Sandor Der, Alex Chan, Gary Stolovy, Michael Lander, and Matthew Thielke
URL: <http://www.arl.army.mil/arlreports/2002/ARL-TR-2683.pdf>



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



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(32) Modeling of Atmospheric Effects

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

Government Admits Flat Earth: Doc #32



Army Research Laboratory



Modeling of Atmospheric Effects

Title: Modeling of Atmospheric Effects

Author: Richard Shirkey

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

by
Richard Shirkey

Computational & Information Sciences Directorate
Battlefield Environment Division



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.



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(33) Telemetry Standards

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

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IRIG STANDARD 106-17



TELEMETRY STANDARDS

ABERDEEN TEST CENTER
DUGWAY PROVING GROUND
REAGAN TEST CENTER
REFUGEE 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

Title: Telemetry Standards

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



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 , 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.

Doc #33: Page 172 of 1166

(34) Approximate Optimal Guidance for the Advanced Launch System

Page: Cover Page, 32, 43

<https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19940020279.pdf>

Government Admits Flat Earth: Doc #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. Feely and J. L. Speyer
The University of California at Los Angeles
Los Angeles, California

Title: Approximate Optimal Guidance for the Advanced Launch System

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

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

Prepared for
Langley Research Center
under Grant NAG-1-1090

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





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

Doc #34: Page 32 of 164





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

$$\dot{h} = V \sin \gamma \quad (3.24)$$

Doc #34: Page 43 of 164

(35) Flight Simulation Software at NASA Dryden Flight Research Center

Pages: Cover Page, 4, 10

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

Government Admits Flat Earth: Doc #35



NASA Technical Memorandum 104315

Flight Simulation Software at NASA Dryden Flight Research Center

Ken A. Norlin

October 1995



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

National Aeronautics and
Space Administration



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.



Doc #35: Page 4 of 21



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



Doc #35: Page 10 of 21

(36) Simulator Aero Model Implementation

Page: Cover Page, 10

<https://www.aviaionsystemsdivision.arc.nasa.gov/publications/hitl/rtsim/Toms.pdf>

Government Admits Flat Earth: Doc #36



Title: Simulator Aero Model Implementation

Authors: Thomas S. Alderete

URL: <https://www.aviationsystemsdivision.arc.nasa.gov/publications/itl/tsim/toms.pdf>

SIMULATOR AERO MODEL IMPLEMENTATION

Thomas S. Alderete¹

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



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.



Doc #36: Page 10 of 21

(37) Design and Implementation of Flight Visual Simulation System

Page: Cover Page, 3

<https://arxiv.org/pdf/1212.0365.pdf>

Government Admits Flat Earth: Doc #37

Design and Implementation of Flight Visual Simulation System



Feng Tian¹, Wenjian Chai¹, Chuanyun Wang¹,

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

Title: Design and Implementation of Flight Visual Simulation System

Authors: Feng Tian, Wenjian Chai, Chuanyun Wang

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

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.



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].



Doc #37: Page 3 of 13

(38) A Discussion of Methods of Real-Time Airplane Flight Simulation

Page: Cover Page, 11

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

Government Admits Flat Earth: Doc #38



The Pennsylvania State University
Graduate School
College of Engineering

A DISCUSSION OF METHODS OF REAL-TIME AIRPLANE
FLIGHT SIMULATION

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>

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.



Doc #38: Page 11 of 50

(39) The American Practical Navigator: An Epitome of Navigation

Pages: Cover Page, 351, 355, 573, 636

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

Government Admits Flat Earth: Doc #39

Pub. No. 9



THE AMERICAN PRACTICAL NAVIGATOR

AN EPITOME OF NAVIGATION

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/bnko/bsite_narp/documentation/america_n_practical_navigator.pdf

ORIGINALLY BY
NATHANIEL BOWDITCH, LL.D.



1995 EDITION



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.



Doc #39: Page 351 of 714




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



Doc #39: Page 355 of 714




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.



Doc #39: Page 573 of 714




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



Doc #39: Page 636 of 714

Doc #39 on page 11 of 714 states, “The earth is an oblate spheroid (a sphere flattened at the poles).” This statement is in direct contradiction to at least 5 different statements within the document itself:

Page 351 of 714 states, “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 assumption produce no large errors."

- 1) Waterline, assumes the water has a FLAT line
- 2) "Earth is Flat between observer and object"

Page 355 of 714 states, "Curvature of surface _____ = 0.8 foot per nautical mile"

3) If the earth was "flattened at the poles" then this calculation of the curvature is blatantly inaccurate, as the curvature of the surface of the earth would vary.

Page 574 of 714 states, "back shore, 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 boarding the sea. See also FORESHORE."

4) How can the there exist a "flat coast" bordering the sea if the sea curves? It can't.

Page 636 of 714 states, "line of sight. The straight line between two points, which does not follow the curvature of the earth."

5) If the earth is a globe and curving in every direction downward from the observer, given the definition of "line of sight" it is impossible to achieve "line of sight" for every observation necessitates that it occurs over the "curvature of the earth".

(40) The Production of Firing Tables for Cannon Artillery

Pages: Cover Page, 10, 22, 34, 110

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





MSL

Mean sea level



Doc #40: Page 10 of 115



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:

$$\ddot{x} = -\frac{g}{R_E^2} (1 - \frac{v_x}{v})^2 + a_x$$

$$\ddot{y} = -\frac{g}{R_E^2} \frac{v_y}{v} \ddot{z} - a + a_y$$

$$\ddot{z} = -\frac{g}{R_E^2} (1 - \frac{v_z}{v}) + a_z$$

where the dots indicate differentiation with respect to time,

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

a = air density as a function of height,

v = velocity,

a_x = drag coefficient,

a_y = ballistic coefficient,

a_z = range wind

v_x = cross wind

g = acceleration due to gravity

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

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.

$$a_x = 2 D \cos L \sin \alpha$$

$$a_y = 2 D \sin L$$

$$a_z = 2 D \cos L \cos \alpha$$

where,

D = angular velocity of the earth in radians/second

$2D = .0001458424$

L = latitude

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

In the equations of motion given on page 22:

$$a_x = -a_y \dot{y}$$

$$a_y = a_x \dot{x}$$

$$a_z = a_x \dot{z} - a_y \dot{x}$$

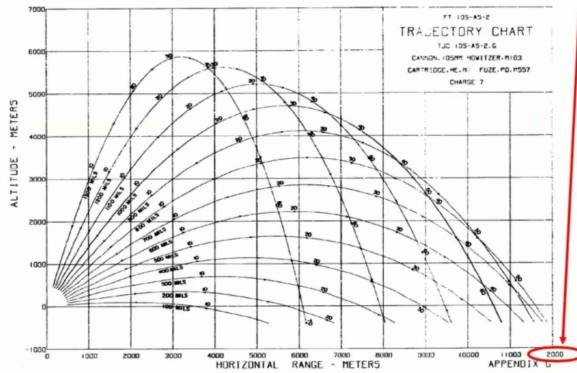
Page 34



Doc #40: Page 22 & 34 of 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?



Doc #40: Page 110 of 115

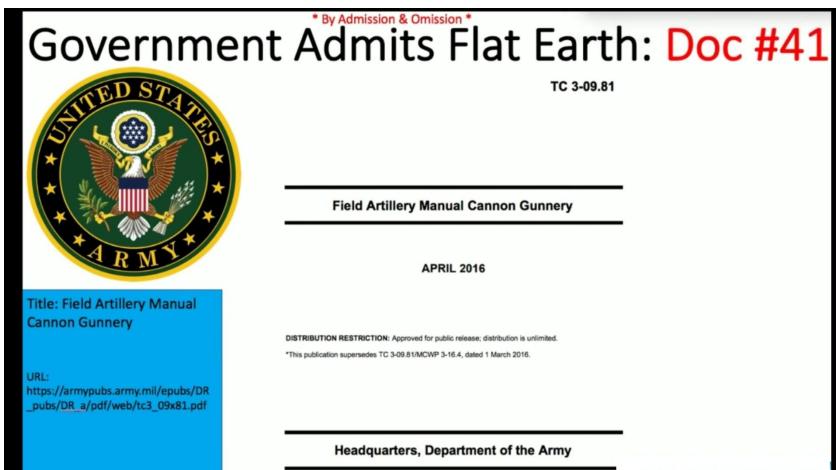
Doc #40 on pages 66 – 68 of 115 references "Rotation of Earth":

- 1) Doc #40 does NOT account for curvature of earth
- 2) Doc #40 represents the "Rotation of Earth" in an equation for "particle theory", whereby, when the numerical value of zero (0) is plugged in for the variable to account for the alleged rotation it does not negatively impact the rest of the equation and it is able to compute.

(41) Field Artillery Manual Cannon Gunnery

Page: Cover Page, 175, 192

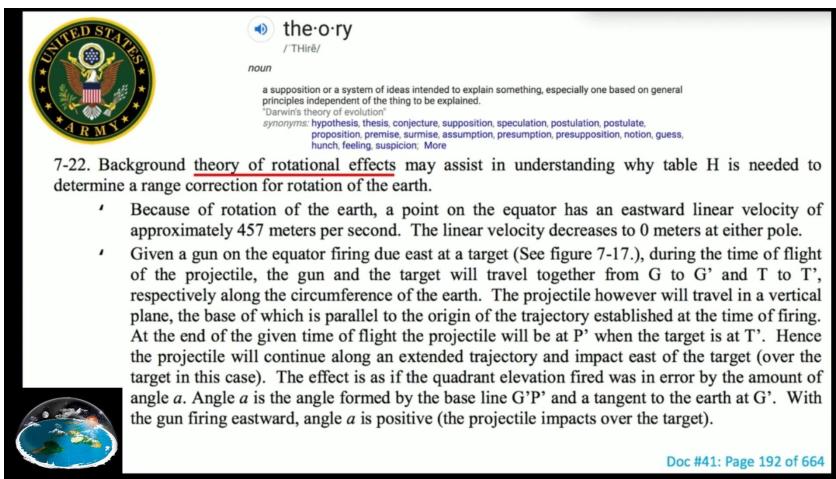
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/tc3_09x81.pdf



STANDARD CONDITIONS	
WEATHER	
1	AIR TEMPERATURE 100 PERCENT
2	AIR DENSITY 100 PERCENT
3	NO WIND
POSITION	
1	GUN, TARGET AND MDP AT SAME ALTITUDE
2	ACCURATE RANGE
3	NO ROTATION OF THE EARTH
MATERIAL	
1	STANDARD WEAPON, PROJECTILE, AND FUZE
2	PROPELLANT TEMPERATURE (70° F)
3	LEVEL TRUNNIONS AND PRECISION SETTINGS
4	FIRING TABLE MUZZLE VELOCITY
5	NO DRIFT

Figure 7-1. Standard Conditions.

Doc #41: Page 175 of 664





I should have done a better analysis on doc #41. Sorry about that, and now here it is.

Doc #41, "Field Artillery Manual Cannon Gunnery", page 48 of 664:

"3-55. If a round were fired in a vacuum, gravity would cause the projectile to return to the surface of the earth. The path or trajectory of the projectile would be simple to trace. All projectiles, regardless of size, shape, or weight, would follow paths of the same parabolic shape and would achieve the same range for a given muzzle velocity and quadrant elevation."

Nathan Roberts's reply: The "parabolic shape" of the trajectory of the bullet is caused by density, not gravity or the alleged curvature of a spherically shaped earth.

Doc #41, "Field Artillery Manual Cannon Gunnery", page 48 of 664:

3-57. Gravity causes a projectile in flight to fall to the earth. Because of gravity, the height of the projectile at any instant is less than it would be if no such force were acting on it. In a vacuum, the vertical velocity would decrease from the initial velocity to zero on the ascending branch of the trajectory and increase from zero to the initial velocity on the descending branch. Zero vertical velocity would occur at the summit of the trajectory. For every vertical velocity value on the upward leg of the ascending branch there is an equal vertical velocity value downward on the descending branch. Since there would be no resistance to the forward motion of the projectile in a vacuum, the horizontal velocity component would be a constant. The acceleration caused by the force of gravity (9.81 m/s) affects only the vertical velocity."

Nathan Roberts's reply: Gravity is an unproven theory, buoyancy is proven. Bullets fall because they are heavier than the medium they are within, that being the air.

Doc #41, "Field Artillery Manual Cannon Gunnery", page 49 of 664:

“The standard (chart) range is the range opposite a given elevation in the firing tables. It is assumed to have been measured along the surface of a sphere concentric with the earth and passing through the muzzle of a weapon. For all practical purposes, standard range is the horizontal distance from the origin of the trajectory to the level point.”

Nathan Roberts's reply: IF “It is assumed to have been measured along the surface of a sphere concentric with the earth”, then why in the very next sentence does it state “For all practical purposes, standard range is the horizontal distance from the origin of the trajectory to the level point.”

Doc #41, “Field Artillery Manual Cannon Gunnery”, page 51 of 664:

“Deflection effects. Some of the deviations from the standard conditions affecting deflection are:

- * Drift.
- * Crosswind.
- * Rotation of the earth.”

Nathan Roberts's reply: On page 192, “Rotation of the earth” is established as an “unproven theory”, which holds zero bearing in reality.

Doc #41, “Field Artillery Manual Cannon Gunnery”, page 132 of 664:

5-36. The third condition is valid met corrections considered by each of the firing platoons. This includes the met message valid for the firing platoon, propellant temperature, projectile weight, vertical interval, and corrections for earth rotation.

Nathan Roberts's reply: On page 192, “Rotation of the earth” is established as an “unproven theory”, which holds zero bearing in reality.

Doc #41, “Field Artillery Manual Cannon Gunnery”, page 186 of 664:

“Range (Column 1). This is the distance measured from the muzzle to the target on the surface of a sphere concentric with the earth. When chart range is used as the entry argument for this table, it is expressed to the nearest 10 meters and interpolation is necessary.”

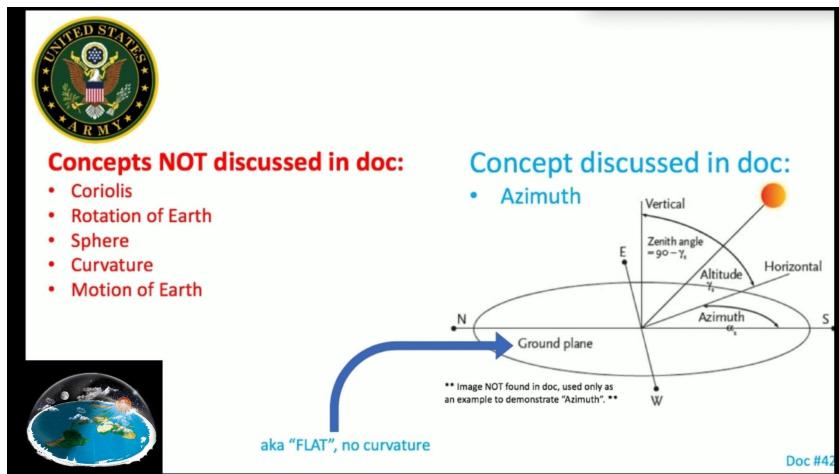
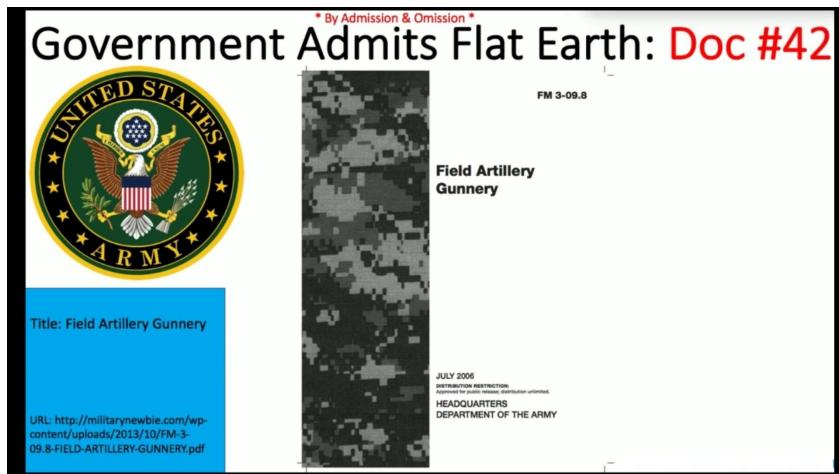
Nathan Roberts's reply: The same response given to “sphere concentric with earth” mentioned on page 49 applies here too.

(42) Field Artillery Gunnery

Pages: Cover Page, Azimuth

Only concept of Azimuth on a flat plane is discussed without reference to curvature or rotation of the globe earth or coriolis effect.

<http://militarynewbie.com/wp-content/uploads/2013/10/FM-3-09.8-FIELD-ARTILLERY-GUNNERY.pdf>

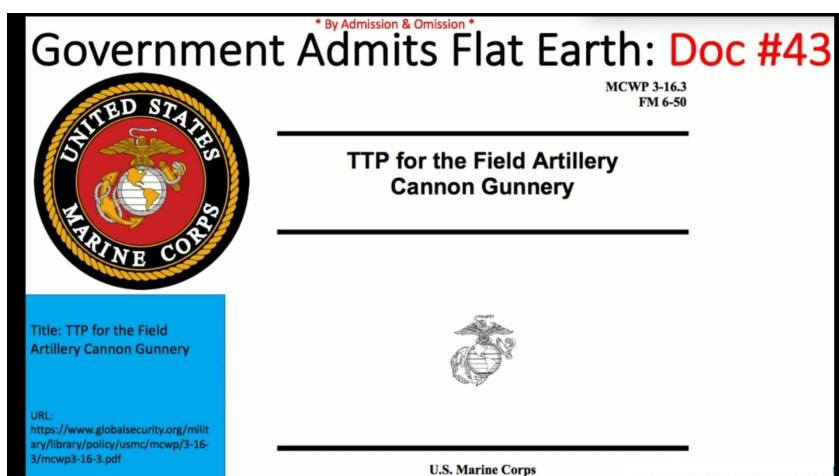


(43) TTP for the Field Artillery Cannon Gunnery

Pages: Cover Page, Azimuth

Only concept of Azimuth on a flat plane is discussed without reference to curvature or rotation of the globe earth or coriolis effect.

<https://www.globalsecurity.org/military/library/policy/usmc/mcwp/3-16-3/mcwp3-16-3.pdf>



UNITED STATES
MARINE CORPS

Concepts NOT discussed in doc:

- Coriolis
- Rotation of Earth
- Sphere
- Curvature
- Motion of Earth

Concept discussed in doc:

- Azimuth

Vertical

Zenith angle
 $= 90 - \gamma$

Altitude
 γ

Azimuth
 θ_e

Ground plane

N S

W E

** Image NOT found in doc, used only as an example to demonstrate "Azimuth". **

aka "FLAT", no curvature

Doc #43

(44) Tactics, Techniques, and Procedures for the field artillery Manual Cannon Gunnery

Pages: Cover Page, Concept, Reconcile, Azimuth

Only concept of Azimuth on a flat plane is discussed without reference to curvature or rotation of the globe earth or coriolis effect.

https://www.marines.mil/Portals/1/Publications/mcwp3_16_4.pdf

* By Admission & Omission *

Government Admits Flat Earth: Doc #44



FM 6-40
MCWP 3-16.4

Tactics, Techniques, and Procedures for the Field Artillery Manual Cannon Gunnery

Title: Tactics, Techniques, and
Procedures for the field
Artillery Manual Cannon
Gunnery

URL:
[https://www.marines.mil/Portals/1/P
Publications/mcwp3_16_4.pdf](https://www.marines.mil/Portals/1/Publications/mcwp3_16_4.pdf)



U.S. Marine Corps



How do we reconcile the difference and apparent contradiction of whether or NOT “rotation of the earth” needs to be taken into account?

- 1) Other than the mention of the terms “rotation of the earth” and “Coriolis”, there is absolutely no instruction in the doc for “HOW TO” account for the rotation of the earth, why?
- 2) The rotation of the earth is a theory, and just as in the equation cited in the US Army doc Report 1371 and titled The Production of Firing Tables for Cannon Artillery allows for the variable of alleged rotation of the earth to be zero (0) leaving the entirety of the equation unaffected, and it is the same with this doc produced by the US Marine Corps.

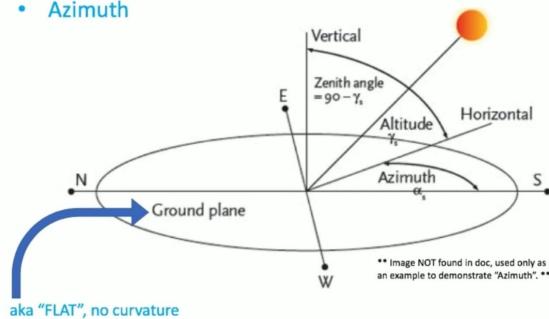


Doc #44



Concept discussed in doc:

- Azimuth



** Image NOT found in doc, used only as an example to demonstrate “Azimuth.” **



Doc #44