



Cairo University

DEVELOPMENT AND REALIZATION OF PROJECTILES DIRECTING ALGORITHM FOR 3-D ATMOSPHERIC INTERCEPTION

By

Mahmoud Ahmed Mahmoud Tolba Ali Soliman

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Aerospace Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

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Key Words:

Interception; Prediction Angle; Kalman Filter; Exterior Ballistics; Projectile Trajectory

Summary:

This thesis aims to develop an efficient solution for the problem of intercepting a target flying in atmosphere by unguided projectiles. At first, the fire control algorithm introduced by John H. Blakelock in 1979 for planar interception was adapted for use by an earth-mounted launcher instead of a flying launcher. The projectile time of flight equation of this algorithm, given for a certain projectile type, was generalized for application to a generic projectile. The main output of this thesis is the development of an algorithm for the 3-D interception case utilizing Kalman filter tracking to estimate the target future position, while compensating for deviations in the projectile trajectory due to gravity, aerodynamic forces and the gyroscopic effect by applying corrections determined during previous offline simulations of the projectile trajectories. Estimates of the aerodynamic coefficients employed in such simulations were obtained from PRODAS[®]. Real-time HIL simulation of the interception algorithms was implemented on a microcontroller platform receiving target information from a host computer, which simulates target motion and tracker output. To provide a success measure for the interception, offline simulation of various interception scenarios was performed on the host computer while determining the miss-distances for a sequence of projectiles fired at a certain rate. Both real-time and offline simulations on the host computer were performed using MATLAB[®]. Results showed the capability of the developed algorithm to handle 3-D interception cases much more effectively as compared to the planar interception algorithm.

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Table of Contents

Acknowledgements	i
Table of Contents	iii
List of Tables	ix
List of Figures	xiii
Nomenclature	xvii
Abstract	xxi
1 Introduction	1
1.1 Background	1
1.2 Thesis Objectives	2
1.3 The Evolution of Fire Control	3
1.3.1 Target Tracking	3
1.3.2 Fire Control Computation	4
1.3.3 Projectile Trajectory Model	6
1.3.4 Projectile Aerodynamics	7
1.3.5 Mechanical Aiming Systems	8
1.4 Thesis Organization	8
2 Problem Formulation	11
2.1 The Interception Problem	11
2.1.1 Definition	11
2.1.2 Geometry	11
2.2 Layout of the Interception System	13
2.3 Building up the Interception System	14
2.3.1 Acquisition and Tracking System	14
2.3.2 The Interception Computing System	14

2.3.3	Launcher Pointing System	15
2.3.4	Launcher	15
2.4	Mathematical Modeling	15
2.4.1	Coordinate System	15
2.4.2	Target Model	16
2.4.3	Projectile Dynamic Model	17
2.4.3.1	Equations of Motion	18
2.4.3.2	Projectile Aerodynamics	20
2.4.3.3	Numerical Solution	20
2.4.4	The Atmospheric Model	21
2.4.5	The Tracking Model	22
2.4.5.1	The Tracking Geometry	22
2.4.5.2	The Tracking Filter	23
2.4.6	Launcher Model, Servo Drives and Launcher Controller	26
3	Launcher System Modelling, Controller Design and Simulation	29
3.1	System Mathematical Modeling	29
3.1.1	Mathematical Model of the Mechanical Subsystem	29
3.1.2	Mathematical Model of the Electrical Subsystem	31
3.1.3	Mathematical Model of the Electromechanical System	32
3.1.4	Speed Controller Structure	34
3.2	System Model Synthesis	34
3.2.1	Speed Loop Building	35
3.2.2	Position Loop Building	36
3.3	Control System Analysis	36
3.3.1	System Steady State Error	37
3.3.1.1	Speed Steady State Error	37
3.3.1.2	Position Steady State Error	38
3.4	Determination of the System Parameters	38
3.4.1	Servomotor Parameters	38
3.4.2	Parameters of the Mechanical Subsystem	39
3.4.3	Current Controller Parameters	39

3.5	Controllers Design	41
3.5.1	Speed PI Controller Design	41
3.5.1.1	Speed Controller Design Criteria	43
3.5.1.2	Determining the Values of the Speed Controller Parameters	43
3.5.2	Position Controller Design	43
4	Development of the Interception Algorithms	49
4.1	Introduction	49
4.2	A Geometric Interception Algorithm	49
4.2.1	Development of the Governing Equations	50
4.2.1.1	Lead Angle	50
4.2.1.2	Curvature Correction	52
4.2.1.3	Prediction Angle Equation	56
4.2.1.4	Relation between the Target Velocity and the Range . .	57
4.2.1.5	Projectile Time of Flight	58
4.3	The Interception Dome Algorithm	60
4.3.1	Lead Angle Correction	61
4.3.2	Curvature Correction	62
4.3.2.1	Elevation Drop correction	62
4.3.2.2	Projectile Drift	63
4.3.2.3	Prediction Angle Calculation	64
5	Interception System Simulation	65
5.1	Offline Software in the Loop Simulation	65
5.2	Hardware in the Loop Simulation	66
5.2.1	System Requirements	67
5.2.2	Platform Selection	68
5.3	HIL Realization	69
5.3.1	MATLAB Realization	69
5.3.1.1	Calculation	70
5.3.1.2	Data Transfer between MATLAB and the MCU	70
5.3.1.3	Messages Formatting	72

5.3.1.4	Setting the Execution Frequency	73
5.3.2	Microcontroller Realized Software Portion	73
5.3.2.1	Adaption of the Interception Algorithm for MCU	74
5.3.2.2	Microcontroller Initialization	74
5.3.2.3	Execution Management and Frequency Control	75
5.3.2.4	Data Transfer Handling Mechanism	76
5.3.2.5	Implementation of Software Locks and Flags	76
5.4	Software Testing and Assessment	77
5.4.1	Software Testing	78
5.4.2	Assessment and Conclusion	80
6	Results and Analysis	83
6.1	Interception Simulation Setup	83
6.1.1	Presentation of the Simulation Results	84
6.2	Geometric Interception Algorithm Results	85
6.2.1	Target Scenario No. 1	85
6.2.2	Target Scenario No. 2	86
6.2.3	Effect of the Initial Elevation Angle on the Interception Accuracy	88
6.3	Interception Dome Algorithm Results	89
6.3.1	Target Scenario No. 1	90
6.3.2	Target Scenario No. 2	91
6.3.3	Target Scenario No. 3	92
6.3.4	Target Scenario No. 4	96
6.3.5	Target Scenario No. 5	96
6.3.6	Target Scenario No. 6	97
6.3.7	Target Scenario No. 7	98
6.3.8	Effects of the Rate of Fire and the Target Speed on the Interception Miss Distance	101
6.4	Launcher Aiming Response	105

7	Concluding Remarks, and Recommendations for Future Work	109
7.1	Concluding Remarks	109
7.1.1	General Conclusions	109
7.1.2	Suitability of the Algorithms	110
7.1.2.1	The Geometric Interception Algorithm	110
7.1.2.2	The Interception Dome Algorithm	110
7.2	Recommendation for Future Work	111
	References	113
	Appendix A Projectile Properties and Trajectory Characteristics	117
A.1	Projectile Dimensions and Mass Properties	117
A.2	Projectile Aerodynamic Coefficients	118
A.3	Typical Projectile Trajectory Simulation	120
A.4	Projectile Trajectory Characteristics	121
	Appendix B Time of Flight Equation of the Geometric Interception Algorithm	127
B.1	The Time of Flight Equation	127
B.1.1	Derivation of the Equation	127
B.1.2	Empirical Determination of the Drag Coefficient	129
B.1.3	Determining the Projectile Drag Constant	131
	Appendix C Launcher Mount Dynamic Parameters	133
C.1	Mechanical System Parameters	133
C.2	Launcher Motion Requirements	134
C.3	Servo Drive Torque Requirements	134
C.3.1	Azimuth Servo Drive Torque Requirements	134
C.3.1.1	Azimuth Inertia Torque	134
C.3.1.2	Azimuth Frictional Torque	135
C.3.1.3	Maximum Azimuth Load Torque	135
C.3.1.4	Maximum Azimuth Servo Drive Torque	135
C.3.2	Elevation Servo Drive Torque Requirements	136
C.3.2.1	Elevation Inertia Torque	136

C.3.2.2	Elevation Frictional Torque	136
C.3.2.3	Maximum Elevation Load Torque	136
C.3.2.4	Maximum Elevation Servo Drive Torque	137
C.4	Servomotor and Power Inverter Selection	137
C.4.1	Servo Drive Specifications	137
C.4.2	Power Inverter Specifications	137
C.4.3	Servo Drive Performance Check	139

List of Tables

2.1	Properties of Middle Caliber Projectiles in Actual Widespread AAA Use .	18
2.2	Typical Spinner-98 Forces and Moments Expected Errors in the Supersonic Range [11]	20
3.1	Parameters of the Servomotor	39
3.2	Parameters of the Mechanical Subsystem	39
5.1	List of Serial Data Transfer Protocols [22]	67
5.2	Estimation of Drivers Memory Allocation Sizes	67
5.3	Main Features of Candidate Embedded System Platforms	68
5.4	Elapsed Time Measurement Values	73
5.5	List of Enabled Interrupts and their Priorities	75
5.6	List of Interrupt Request Routines IRQs	76
5.7	DMA's List Used in Data Transfer Handling	76
5.8	Software Locks and Flags List	77
5.9	Black Box Testing Comparison Results for the Geometric Interception Algorithm	80
5.10	Time Consumed for Hardware in the Loop Operations	80
6.1	Initial Conditions and Solver Parameters for the Offline Simulation of the Projectile Trajectory	84
6.2	Initial Conditions for Target Scenario No. 1 used in the Simulation of the Geometric Interception Algorithm	85
6.3	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 1 using the Geometric Interception Algorithm	86
6.4	Initial Conditions for Target Scenario No. 2 used in the Simulation of the Geometric Interception Algorithm	86
6.5	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 2 using the Geometric Interception Algorithm	88
6.6	Initial Conditions for Target Scenario No. 1 used in the Simulation of the Interception Dome Algorithm	90
6.7	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 1 using the Interception Dome Algorithm	90

6.8	Initial Conditions for Target Scenario No. 2 used in the Simulation of the Interception Dome Algorithm	91
6.9	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 2 using the Interception Dome Algorithm	91
6.10	Initial Conditions for Target Scenario No. 3 used in the Simulation of the Interception Dome Algorithm	92
6.11	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 3 using the Interception Dome Algorithm	92
6.12	Initial Conditions for Target Scenario No. 4 used in the Simulation of the Interception Dome Algorithm	96
6.13	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 4 using the Interception Dome Algorithm	96
6.14	Initial Conditions for Target Scenario No. 5 used in the Simulation of the Interception Dome Algorithm	97
6.15	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 5 using the Interception Dome Algorithm	97
6.16	Initial Conditions for Target Scenario No. 6 used in the Simulation of the Interception Dome Algorithm	98
6.17	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 6 using the Interception Dome Algorithm	98
6.18	Initial Conditions for Target Scenario No. 7 used in the Simulation of the Interception Dome Algorithm	99
6.19	Values of the Miss Distances for the Projectiles Fired during Target Scenario No. 7 using the Interception Dome Algorithm	101
6.20	Miss Distances Root Mean Square Value for each Group of Five Fired Projectiles during Target Scenario No. 1	102
6.21	Miss Distances Root Mean Square Value for each Group of Five Fired Projectiles during Target Scenario No. 2	102
6.22	Miss Distances Root Mean Square Value for each Group of Five Fired Projectiles during Target Scenario No. 3	104
6.23	Miss Distances Root Mean Square Value for each Group of Five Fired Projectiles during Target Scenario No. 4	104
6.24	Miss Distances Root Mean Square Value for each Group of Five Fired Projectiles during Target Scenario No. 5	104
6.25	Miss Distances Root Mean Square Value for each Group of Five Fired Projectiles during Target Scenario No. 6	105
6.26	Initial Conditions for the Target Scenario used to check Launcher Aiming	105

A.1	Main Dimensions, Mass Properties, and Initial Velocities of the Projectile	117
A.2	Aerodynamic Coefficients of the Projectile Versus the Mach Number . . .	118
A.3	Magnus Moment Coefficient C_{NPA} of the Projectile Versus the Mach Number and the Total Yaw Angle α_t	119
A.4	Projectile Trajectory Simulation Initial Conditions	120
A.5	Average Values for Projectile Drop, Time of Flight, and Mach Number end of range value for different Ranges (calculated for Elevation Angles from 0° to 85°)	122
A.6	Coefficients for Curve Fitting using Equation A.1	123
A.7	Coefficients for Curve Fitting using Equation A.2	123
C.1	Launcher Mount Mass Properties and Mechanical Parameters	133
C.2	Launcher Mount Motion Requirements	134
C.3	NX840EAK Servomotor General Specifications	138
C.4	NX840EAK Servomotor Electrical Specifications	138
C.5	DPM 50/80 DPM27050C Power Inverter General Specifications	138