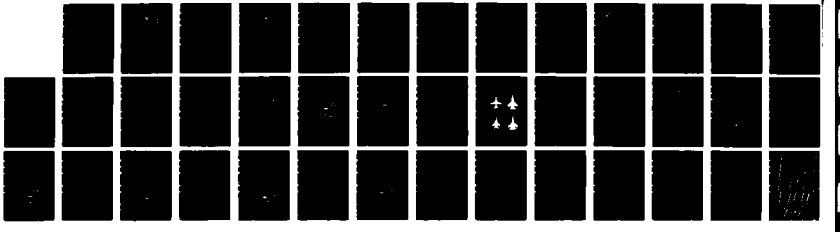
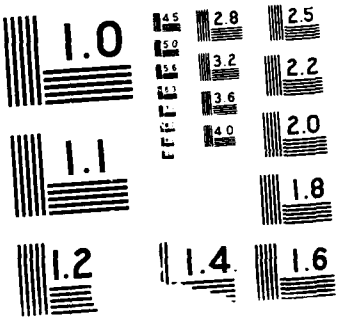
AD-A194 311 PROPOSAL FOR A NEW AGGRESSOR AIRCRAFT(U) AIR COMMAND AND STAFF COLL MAXWELL AFB AL C W NAAS APR 88 ACSC-88-1945 1/1

UNCLASSIFIED F/G 1/3.1 NL




1.0
1.1
1.2
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0

AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

PROPOSAL FOR A NEW
AGGRESSOR AIRCRAFT

Major Craig W. Naas, 88-1945

"insights into tomorrow"

DISCLAIMER

The views and conclusions expressed in this document are those of the author. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the United States Government. The author has not had special access to official information or ideas and has employed only open-source material available to any writer on this subject.

This document is the property of the United States Government. It is available for distribution to the general public. A loan copy of the document may be obtained from the Air University Interlibrary Loan Service (AUL/LDEX, Maxwell AFB, Alabama, 36112-5564) or the Defense Technical Information Center. Request must include the author's name and complete title of the study.

This document may be reproduced for use in other research reports or educational pursuits contingent upon the following stipulations:

- Reproduction rights do not extend to any copyrighted material that may be contained in the research report.

- All reproduced copies must contain the following credit line: "Reprinted by permission of the Air Command and Staff College."

- All reproduced copies must contain the name(s) of the report's author(s).

- If format modification is necessary to better serve the user's needs, adjustments may be made to this report--this authorization does not extend to copyrighted information or material. The following statement must accompany the modified document: "Adapted from Air Command and Staff College Research Report (number) entitled (title) by (author)."

- This notice must be included with any reproduced or adapted portions of this document.

REPORT NUMBER 88-1945

TITLE PROPASAL FOR A NEW AGGRESSOR AIRCRAFT

AUTHOR(S) MAJOR CRAIG W. NAAS, USAF

FACULTY ADVISOR MAJOR RONALD R. DUFRESNE, ACSC/3823 STUS/32

SPONSOR COLONEL DOUG MELSON, 57FWW/AT

Submitted to the faculty in partial fulfillment of requirements for graduation.

AIR COMMAND AND STAFF COLLEGE
AIR UNIVERSITY
MAXWELL AFB, AL 36112-5542

8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS			
	PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION N

11. TITLE (Include Security Classification)

PROPOSAL FOR A NEW AGGRESSOR AIRCRAFT

12. PERSONAL AUTHOR(S)

Naas, Craig W., Major, USAF

13a. TYPE OF REPORT	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
		1988 April	37

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The F-5 aircraft is no longer capable of simulating the adversary threat. Therefore, a replacement aggressor aircraft must be found. This project examines the threat presenting the most difficult challenge in the air combat arena and then compares the threat to possible replacement aggressor aircraft. Analysis of the adversary has determined the MIG-29 to be the most difficult challenge in the air combat arena. Comparison of the possible replacement aircraft has shown the F-18 Hornet to be the single best choice to simulate the MIG-29 Fulcrum and replace the F-5. This study proposes the F-18 Hornet be chosen as the new aggressor aircraft.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☐ UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED

PREFACE

The need for realistic training is recognized in the United States Air Force. The formation of the aggressor squadrons is a product of this need. The aggressors are currently unable to perform their mission of providing realistic adversary training because the F-5 aircraft is no longer able to adequately simulate the threat. The adversary threat has improved significantly and if the USAF fighter pilot is to combat the threat he must train with equipment which realistically simulates the threat. A replacement aircraft is required to ensure continued effective aggressor training.

I would like to acknowledge the advice and editorial expertise of Major Ron Dufresne in completing this project. I also thank my wife for her support throughout and my daughter's understanding when daddy could not play.

ABOUT THE AUTHOR

Major Craig W. Naas, USAF, is a senior pilot with over 2900 hours of flying time. He is a 1975 graduate of the United States Air Force Academy. Following graduation, Major Naas attended pilot training at Vance AFB, Oklahoma. Upon recieving his wings he remained at Vance as a T-38 instructor pilot. In April 1980, Major Naas entered F-4 training at MacDill AFB, Florida. His first operational assignment was to the 335th Tactical Fighter Squadron Seymore-Johnson AFB, North Carolina flying the Digital Modular Avionics System (DMAS) ARN 101 modified F-4E aircraft. Major Naas flew the F-4E in the air superiority role while assigned to the 36th Tactical Fighter Squadron as a flight commander from December 1983 to December 1984. Major Naas' assignment prior to attending Air Command and Staff College, was George AFB, California as a flight commander and instructor pilot in the 21st Tactical Fighter Training Squadron flying the F-4E. Major Naas is a graduate of Squadron Officers School, Air Command and Staff College by seminar, Pilot Instructor Training, F-4 Instructor Course, and Air Command and Staff College (Class of 88).

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

TABLES

FIGURES

EXECUTIVE SUMMARY

Part of our College mission is distribution of the students' problem solving products to DOD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

"insights into tomorrow"

REPORT NUMBER 88-1945

AUTHOR(S) MAJOR CRAIG W. NAAS, USAF

TITLE PROPOSAL FOR A NEW AGGRESSOR AIRCRAFT

I. Purpose: To determine the single best aircraft to perform the aggressor mission.

II. Problem: The Northrop F-5E aircraft due to age, technical limitations, and limited performance characteristics no longer provides adequate simulation of the adversary threat in the air combat arena.

III. Data: The mission statement of the USAF aggressors requires an aircraft able to simulate the threat. The USAF determined four factors essential for effective aggressor training in the air combat arena. From the aggressor mission statement and the essential factors a list of potential replacement aircraft was determined. An analysis was first performed to determine the adversary aircraft presenting the most difficult challenge in the air combat arena. Upon completion of the threat analysis, the potential replacement aircraft were compared versus the threat aircraft. The comparison of potential replacement aircraft and the threat aircraft resulted in the selection of the single best aircraft to perform the aggressor mission.

IV. Conclusions: The aggressors require an all aspect beyond visual range (BVR) lookdown/shootdown high performance aircraft to perform their mission. The MIG-29 Fulcrum is the adversary aircraft presenting the most difficult challenge in the air combat arena. The F-18 Hornet best combines size, capabilities, and performance characteristics to simulate the adversary threat and perform the aggressor mission.

V. Recommendations: The F-18 be adopted as the replacement aggressor aircraft.

GLOSSARY

ACMI	- Air Combat Maneuvering Instrumentation
AEW&C	- Airborne Early Warning and Control
AMRAAM	- Advanced Medium-Range Air-to-Air Missile
ANG	- Air National Guard
AT	- Angle Track
BVR	- Beyond Visual Range
g	- Force of Gravity
HUD	- Head-Up-Display
IADS	- Integrated Air Defense System
IR	- Infra-Red
IRSTS	- Infra-Red Search and Track System
MR	- Medium-Range
MRA	- Medium-Range with Active Guidance
PD	- Pulse-Doppler
SR	- Short-Range
STT	- Single Target Track
TAC	- Tactical Air Command
TACR	- Tactical Air Command Regulation
TWS	- Track While Scan
USAFR	- United States Air Force Reserve

Chapter One

AIRCRAFT REQUIREMENTS

INTRODUCTION

> The course and outcome of aerial combat are affected by various factors. Most important among them are the correlation of opposing sides' forces, the quantity of armaments, and proficiency of personnel. Fighter pilots should quickly and adequately respond to any changes in the situation (16:12).
>
> Aleksandr Pokryshkin
> Marshall of the Air Force

The commander of the Soviet Air Forces believes these to be the most important ideas of aerial combat today (16:12). The USAF is committed to having the best trained and most highly skilled pilots possible and has developed and maintained "Aggressor squadrons" to provide this capability. The Aggressors currently fly the Northrop F-5E aircraft using adversary tactics and doctrine. The F-5E has been an excellent aircraft for this purpose in the past, but age, technical limitations, and its performance characteristics have reduced its effectiveness (14:93).

PURPOSE

This paper proposes to determine the single aircraft best qualified to perform the aggressor role in the future according to the following criteria. First, it will determine aggressor aircraft requirements based on mission statement. Second, the analysis will determine possible aircraft meeting aggressor aircraft requirements. Third, this paper will determine current/future threat aircraft characteristics. Fourth, it will compare possible replacement aircraft with similar threat characteristics. Finally, it will determine the single best aircraft to perform the aggressor mission.

ASSUMPTIONS

Due to the limited scope of this project, the aircraft under consideration will be restricted to aircraft in service, in production, or near production with prototypes flown and data available for comparison. Additionally, this paper will not address acquisition or maintenance costs. The sole intent is to identify the one best aircraft to support the aggressor mission.

REQUIREMENTS

The USAF Aggressor mission stated in Tactical Air Command Regulation (TACR) 23-78 should provide the necessary criteria to determine aircraft requirements.

> The mission of the aggressor squadrons is: To provide dissimilar threat air combat tactics to TAC, USAFR, and ANG aircrews; and to participate in TAC directed tactics developments and evaluations. Provide Red Force threat to support realistic training in Red Flag/Maple Flag and other exercises... (22:1).

The aggressor mission can be broken down into three distinct areas relating to aircraft requirements. First, the aggressors are to provide dissimilar threat air combat tactics. Adversary aircraft are currently estimated to have increased performance characteristics and lookdown/shootdown all aspect capability (15:145-147). Secondly, the aggressors will participate in tactics development and evaluations. Tactics and their effective employment are fundamental to achieving air superiority (18:70). According to General Robert D. Russ, Commander, TAC, "The most significant principle of warfare learned since World War I is that ... a nation must be able to achieve air superiority" (18:70). Therefore, to adequately support tactics development and evaluations, the aggressors require an aircraft capable of current adversary technology. The final aircraft related element of the aggressor mission is to provide realistic adversary training in support of Red Flag, Maple Flag, and other exercises.

> The mission of Red Flag is to maximize the combat readiness, capability, and survivability of participating units by providing realistic training in a combined air, ground, and electronic threat environment while providing for a free exchange of ideas between forces (21:1).

Red Flag accomplishes its mission through a highly sophisticated integrated air defense system (IADS), realistic

targets, and complex combined forces scenarios. The aggressors are a major component of the IADS providing the adversary threat aircraft and tactics (14:93). To support Red Flag in providing realistic training, the aggressors must fly aircraft comparable to current adversary aircraft (14:93). Therefore the future aggressor aircraft must have lookdown/shootdown all aspect capability and increased performance characteristics.

In addition to these general aircraft requirements, four specific requirements were identified by the USAF in 1972 to provide competent aggressor training (9:826). The aggressor aircraft were to have the following minimum capabilities. First, the aircraft must be capable of carrying captive missiles to provide accurate employment simulation. Second, they must possess an operational fire control system for realistic target acquisition and ordnance employment. Third, the aircraft must be equipped with gun camera or head-up-display (HUD) recording capability to provide documentation and validation. Finally, they must be air combat maneuvering and instrumentation (ACMI) system capable to utilize the instructional and analytical abilities of this system and more effectively participate in future Red Flag scenarios (9:826;14:95).

Aircraft meeting these requirements will be limited to aircraft in service, in production, or near production, with prototypes flown and data available for comparison. This is intended to eliminate analysis based on planned or projected performance and aids in reducing conflicting evidence. Several aircraft were not considered because production is not near or was cancelled as in the cases of the Northrop F-20 and Dassault-Breguet Super Mirage 4000. The Swedish JAS-39, French Rafael B, and Super Phantom modernized F-4 were not considered because of insufficient data due to delays in testing. Other aircraft were eliminated based on their failure to meet the minimum requirements including the McDonnell Douglas F-4E, Isreali KFIR, and French F-1. The following aircraft are capable of meeting the requirements, or would require only minor modifications in the case of the foreign aircraft:

1. Dassault-Breguet Mirage 2000C,
2. Panavia Tornado ADV,
3. Grumman F-14 Tomcat,
4. McDonnell Douglas F-15 Eagle,
5. General Dynamics F-16 Falcon,
6. McDonnell Douglas F-18 Hornet.

These six aircraft will be analyzed and compared to the adversary determined to pose the most difficult threat in aerial combat. An analysis of four Soviet aircraft will determine the adversary threat used for comparison in determining the replacement aircraft.

Chapter Two

THE ADVERSARY

INTRODUCTION

A comparison of possible replacement aggressor aircraft will be made in relation to the adversary aircraft posing the most difficult threat. This analysis will result in the single best future aggressor aircraft.

DETERMINING THE THREAT

The Soviets are considered to possess the most advanced potential threat. Therefore, an analysis of Soviet aircraft will be made to determine the adversary threat to be used for comparison. Soviet technology has produced four aircraft that incorporate significant increased performance characteristics with all aspect lookdown/shootdown capability. These are the MIG-23 Flogger, SU-27 Flanker, MIG-29 Fulcrum, and MIG-31 Foxhound. A comparison of size, performance, and capabilities will show which adversary aircraft is the most difficult challenge in the air combat arena. A discussion of each aircraft will provide the necessary data for comparison.

MIG-23 FLOGGER

The MIG-23 Flogger is an all weather, single-seat, single-engine, variable geometry wing air combat fighter/interceptor (5:246). First deployed in 1973 an estimated 2,100 MIG-23 interceptors form the backbone of the air defense force and air combat elements of the tactical air forces (5:246). Several variants are flown by all of the non-Soviet Warsaw Pact air forces and have been exported to at least ten other nations (20:85). The MIG-23 is described as the first Soviet aircraft with a demonstrated ability to track and engage targets flying below its own altitude. The Flogger has a limited lookdown/shootdown capability (20:85). Equipped with the J-band High Lark radar and the AA-8 Aphid Infra-red (IR) dogfight air-to-air missile and the medium-range radar guided or heat seeking AA-7 Apex air-to-air missiles, the Flogger is all aspect

capable (20:85). In conjunction with all aspect, beyond visual range (BVR) capability, the MIG-23 can achieve speeds of Mach 2.35 at altitude and Mach 1.2 at sea level (20:85). This gives the Flogger the ability to quickly close for head-on targets or to run down its adversary from astern. The manually variable wing provides the Flogger with 16, 45, or 72 degrees of wing sweep in flight or on the ground (20:86). However, the Flogger is not considered to be highly maneuverable (20:86). It can generate an instantaneous turn rate of 12 degrees/second with wing sweep at 45 degrees or 11 degrees/second with 72 degrees wing sweep (23:24). The MIG-23's high speed, all weather avionics, and all aspect BVR capability make it a good interceptor. A lack of maneuverability and a limited lookdown/shootdown capability are to its disadvantage in the air combat arena (19:36).

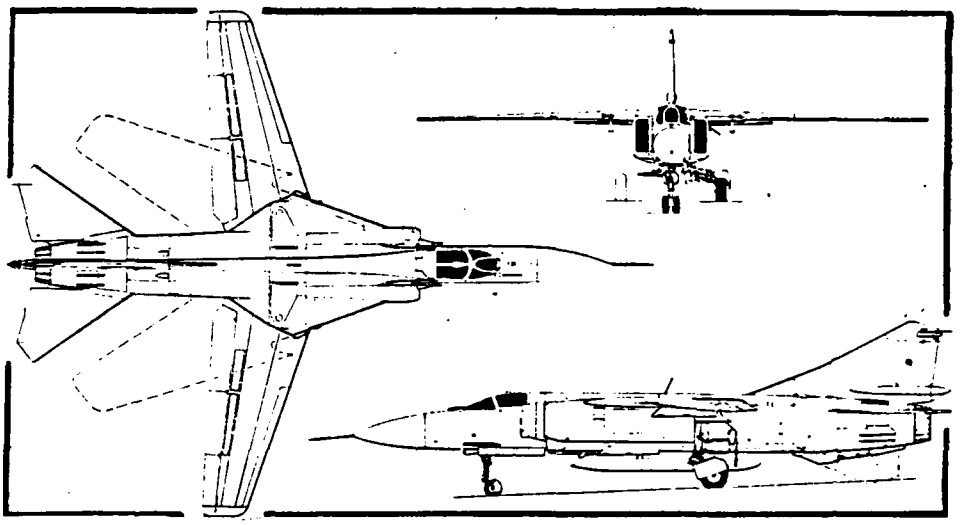


FIGURE 1: MIG-23 Flogger

MIG-31 FOXHOUND

A significant improvement in technology over the MIG-23, the MIG-31 Foxhound is a dual seat, twin engined interceptor aircraft derived from the MIG-25 Foxbat (20:86). It is the first Soviet interceptor to offer true lookdown/shootdown and multiple target engagement capability (20:86). Designed as an interceptor, specifically to counter the US B-1B, the MIG-31 possesses high speed and is an excellent air intercept weapons platform (7:75). Former Assistant Secretary of Defense Donald Latham stated, "in his opinion the MIG-31 is superior to any existing US fighter with better avionics, a better C3

[communications, command, and control] system to work into, a better air-to-air missile and greater speed and combat range" (20:87). Key to this superiority is its pulse-Doppler radar coupled with eight AA-9 Amos BVR all aspect air-to-air missiles (20:87). With a maximum speed of Mach 2.4 at altitude, all weather all aspect BVR capability, and a combat radius of 1,305 miles the Foxhound is a formidable adversary (19:36). However, the MIG-31's relatively low thrust to weight ratio of .63 to 1 and high wing loading equivalent to the F-104G significantly reduce its ability to maneuver in the air combat arena and are considered limiting factors (19:36).

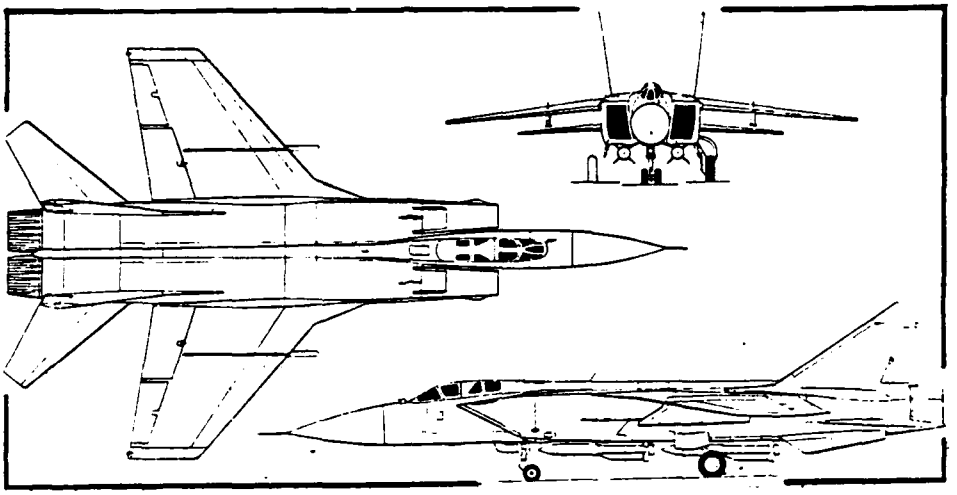


FIGURE 2: MIG-31 Foxhound

MIG-29 FULCRUM

Continuing to advance technologically, the Soviets designed and developed the MIG-29 Fulcrum for the counter air role (20:86). The Fulcrum is described as a twin-engined, single-seat, all weather all aspect BVR fighter aircraft (20:86). The MIG-29 is fitted with a large pulse-Doppler lookdown/shootdown radar providing capability against low flying targets (20:86). This gives the Fulcrum freedom from the outmoded ground control interception techniques restricting Soviet air defenses in the past (20:86). Intended primarily as a counter air fighter, it is likely to have a full dual role combat/attack capability (20:86). Equipped with an internally mounted 30mm gun, the MIG-29 can carry six AA-10 Alamo radar guided medium-range air-to-air missiles or a combination of AA-10 Alamo and heat seeking AA-8 Aphid or AA-11 Archer IR dogfight short-range air-to-air missiles (15:140). This combination of avionics and ordnance gives the Fulcrum impressive

weapons capabilities in the air combat arena (15:140). Also fitted on the MIG-29 is an infra-red search and track system (IRSTS) which provides a passive search and track capability (15:141). With a thrust-to-weight ratio of 1.4 to 1, The MIG-29 is capable of a sustained turn rate of 16 degrees/second and an instantaneous turn rate of 21 degrees/second pulling 7-9g (15:146). Maximum speed is 2.3 Mach at altitude and 1.2 Mach at sea level (20:86). The Fulcrum's advanced design and high thrust-to-weight ratio give it a measure of maneuverability and excess thrust available for climbing and acceleration equal to, if not better than, the best Western combat aircraft (15:146). The MIG-29, which embodies a number of technological advances, will soon form the backbone of the Soviet tactical air forces (15:147).

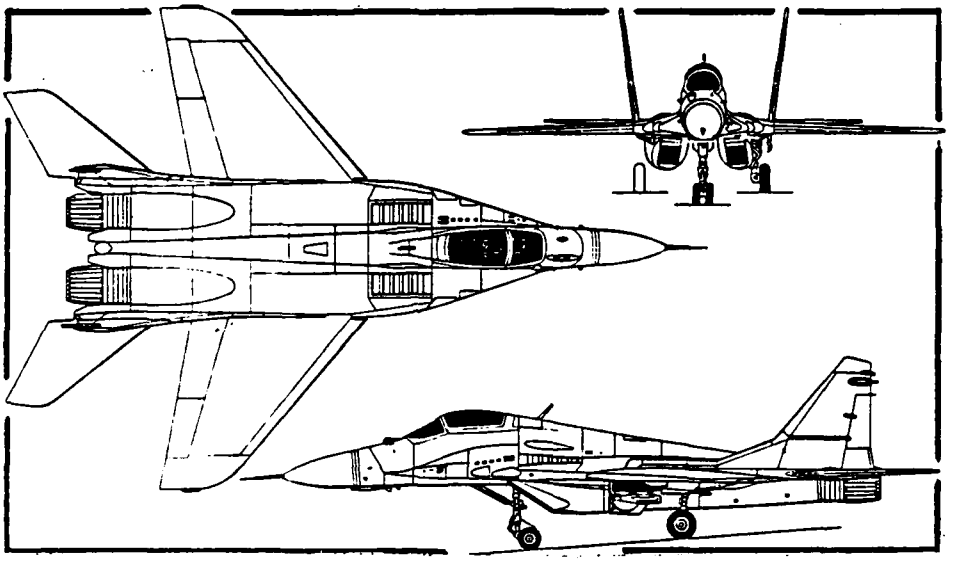


FIGURE 3: MIG-29 Fulcrum

SU-27 FLANKER

Comparable to the MIG-29 in advanced design and performance, the SU-27 Flanker is described by the US Department of Defense as a supersonic all weather all aspect counter air fighter with lookdown/shootdown weapons systems and BVR air-to-air missile capability and a possible secondary ground attack role (12:338). Its large pulse-Doppler radar and heavy armament of AA-10, AA-8, or AA-11 air-to-air missiles give it formidable potential against low flying aircraft and cruise missiles, particularly when deployed with Soviet airborne early warning and control (AEW&C) aircraft (6:262). Similar

in capabilities to the Fulcrum, the SU-27 is considerably larger than the MIG-29. The Flanker possesses greater range and armament loads with the ability to carry up to 10 air-to-air missiles and an internally mounted 30mm gatling type gun (6:262). With a thrust-to-weight ratio of 1.27 to 1 the Flanker is able to sustain a 17 degree/second rate of turn and has an instantaneous turn rate of 23 degree/second at 7-9g (17:18). Maximum speed at sea level is Mach 1.1 and Mach 2.35 at altitude (20:87). The Flanker is believed to have been designed to counter the F-15 and F-14 (19:37).

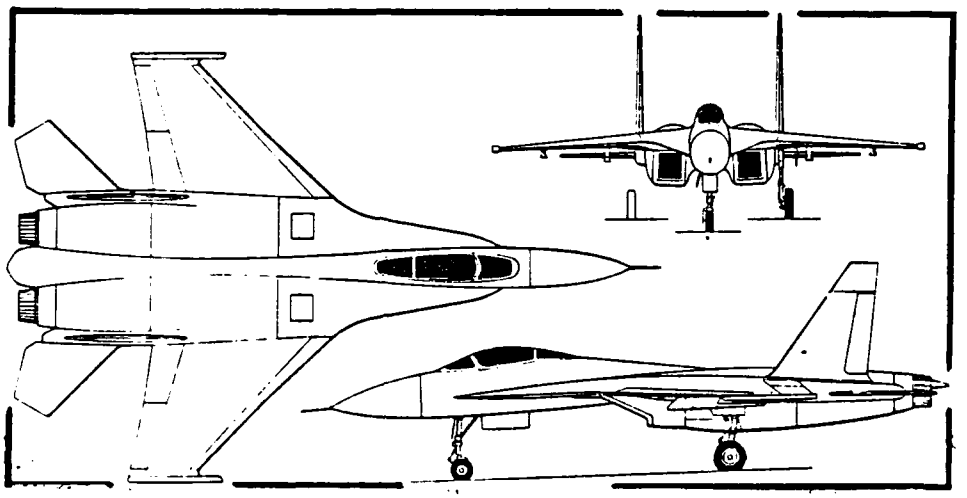


FIGURE 4: SU-27 Flanker

COMPARISON CHART OF ADVERSARY AIRCRAFT

	MIG-23	MIG-31	MIG-29	SU-27
Size (ft)				
Length	55	78	51	67
Width	27 (Swept) 47 (Spread)	46	34	41
Thrust-to-weight-ratio	.81:1	.63:1	1.4:1(1)	1.27:1
Speed (Mach)				
Altitude	2.35	2.4	2.3	2.35
Low Level	1.2	(2)	1.2	1.1
Turn Rate (deg./sec.)				
Sustained	6	N/A(2)	16	17
Instantaneous	12	N/A(2)	21	23
Radar (nm)				
Search	46	90	130	90
Track	29	45	100	45
Type	(3)STT/AT	TWS	TWS	TWS
Armament				
Radar Missiles	(4)MR/SR	MR/MRA	MRA	MR/MRA
IR missiles	MR/SR	MR/SR	MR/SR	MR/SR
Gun	23mm	30mm	30mm	30mm
BVR Capable	Yes	Yes	Yes	Yes
Lookdown/ shootdown	Limited	Yes	Yes	Yes

Footnotes

1. With combat ordnance and 50% fuel
2. Unclassified source not available
3. STT/AT -- Single target track/Angle track
   TWS -- Track while scan
4. MR -- Medium range
   MRA -- Medium range with active guidance
   SR -- Short range

TABLE 1: Comparison of Adversary Aircraft

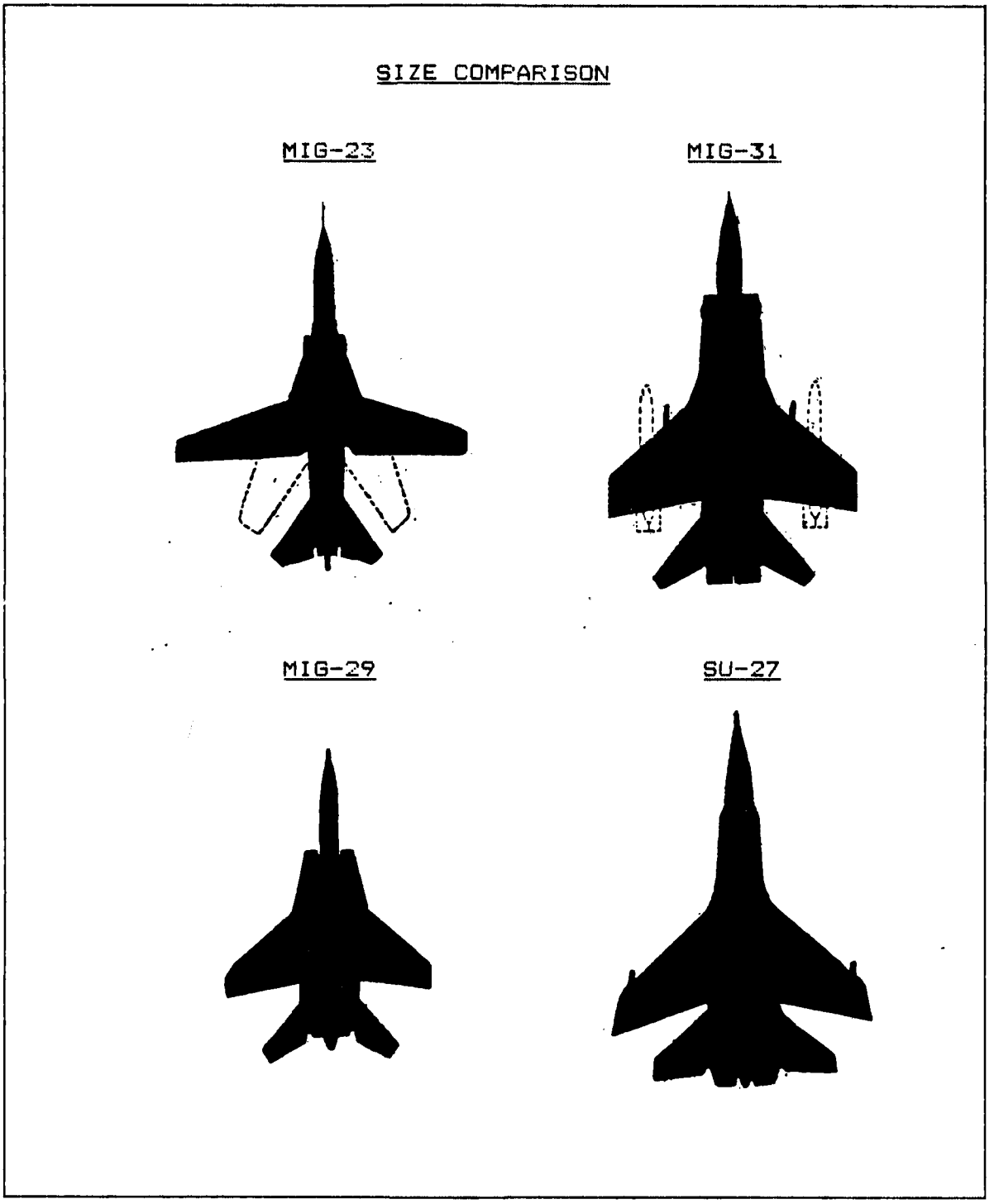


FIGURE 5: Size Comparison

THREAT AIRCRAFT COMPARISON

Several factors indicate the MIG-29 is the most difficult threat to engage in the air combat arena. First, the MIG-23 does not possess true lookdown/shootdown capability and, although high speed, is severely limited in its ability to maneuver during air combat. Second, the MIG-31 is an excellent weapons platform designed to defend against the US B-1B and having the Soviet's first true lookdown/shootdown capability. However, the Foxhound's high wing loading and low thrust-to-weight ratio present significant handicaps to maneuvering. Third, the large size of the SU-27 should make electronic and visual acquisition easier than the smaller MIG-29. General Robert D. Russ, Commander, TAC stated, "The first rule of all air combat is to see the enemy first" (18:71). Finally, the MIG-29's thrust-to-weight ratio of 1.4 to 1 gives the Fulcrum the ability to accelerate and maintain maneuvering potential better than the SU-27. Therefore, the smaller size and greater thrust-to-weight ratio of the MIG-29 presents the most difficult challenge in the air combat arena. A comparison of the MIG-29 and the possible replacement aircraft will determine the best aggressor aircraft.

Chapter Three

AIRCRAFT DATA AND COMPARISON VERSUS THREAT

INTRODUCTION

An analysis of potential aggressor aircraft versus the MIG-29 will determine the single best replacement aggressor aircraft. The six potential replacement aircraft are: Dassault-Breguet Mirage 2000C; Panavia Tornado ADV; Grumman F-14 Tomcat; McDonnell Douglas F-15 Eagle; General Dynamics F-16 Falcon; and McDonnell Douglas F-18 Hornet. The potential aircraft will be compared in size, performance characteristics, and capabilities to the MIG-29 threat.

MIRAGE 2000C

The Dassault-Breguet Mirage 2000C is a single engine, single-seat, all weather all aspect delta wing air defense fighter (13:45). It has a pulse-Doppler radar system giving it lookdown/shootdown capability when configured with the Matra Super 530 radar guided medium-range air-to-air missile (13:45). The Mirage 2000C also carries the Matra Magic 550 IR air-to-air missile and two 30mm DEFA cannon (13:45). The aircraft is capable of Mach 2.2 at altitude and Mach 1.05 at sea level (13:45). The Mirage has a thrust-to-weight ratio of .92 to 1 and a fly-by-wire flight control system to improve air combat maneuverability (13:46). Capable of 9g's in the combat configuration, the aircraft possesses excellent low speed maneuverability and high speed performance (3:254). The Mirage 2000C's delta wing design and .92 to 1 thrust-to-weight ratio provide instantaneous turn rates of 20 degrees/second and sustained turn rates of 11 degrees/second (1:194). It is equipped with an advanced HUD providing thrust available and an outstanding lead computing gun sight (3:254). The Mirage 2000C is considered to be an excellent air-to-air weapons platform with good maneuverability in the air combat arena.

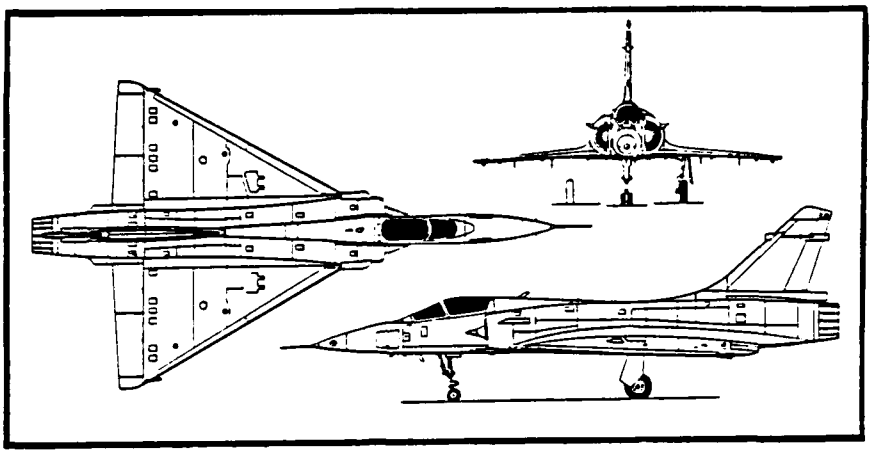


FIGURE 6: Mirage 2000C

MIRAGE 2000C DATA vs MIG-29

	2000C	MIG-29
Size (ft)		
Length	47	51
Width	30	34
Thrust-to-Weight Ratio	.92:1	1.4:1
Speed (Mach)		
Altitude	2.2	2.3
Low Level	1.05	1.2
Turn Rate (deg./sec.)		
Sustained	11	16
Instantaneous	20	21
Radar (nm)		
Search	60	130
Track	35	100
Type	PD	PD/TWS
Armament		
Radar Missiles	2 x Matra 530	AA-10 (1)
IR Missiles	2 x Matra 550	AA-8/AA-11 (2)
Gun	30mm	30mm
BVR Capable	YES	YES
Lookdown/shootdown	YES	YES

Footnotes:
1. Six maximum or various combinations
2. May be loaded as single type or in combination

TABLE 2: Mirage 2000C and MIG-29 Comparison

COMPARISON

A comparison of the performance data shows the Mirage is smaller in size and, although a good aircraft, is unable to match the MIG-29. The lower thrust-to-weight ratio and lower turn rates indicate the Mirage 2000C will not be able to sustain its ability to maneuver or possess the MIG-29's ability to gain or hold the advantage in the air combat arena.

PANAVIA TORNADO ADV

The Panavia Tornado ADV is a two-seat, twin-engined all weather variable geometry wing air defense interceptor (5:123). It is equipped with a pulse-Doppler radar and HUD giving it all aspect lookdown/shootdown capability when combined with the BAe Sky Flash medium-range radar guided air-to-air missile (5:123). The aircraft also carries IR AIM-9L Sidewinder and an internally mounted 27mm cannon (5:123). The variable geometry wings program automatically enabling specific excess power at transonic speeds and maximized turning capability at subsonic speeds (5:123). An estimated thrust-to-weight ratio of .85 to 1 at combat weight, the Tornado has a maximum speed of Mach 2.2 at altitude and Mach 1.3 at sea level (5:123). The lower thrust-to-weight ratio does not allow for extended maneuvering and the automatic variable geometry wing provides visual evidence of aircraft maneuvering potential. The Tornado experiences a high loss of maneuvering potential when engaged in a turning fight relative to non-swing wing or higher thrust-to-weight ratio aircraft.

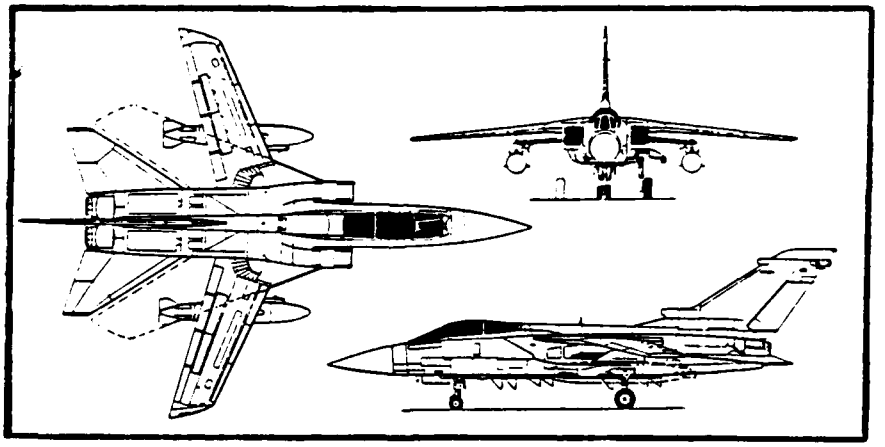


FIGURE 7: Tornado ADV

TORNADO ADV DATA vs MIG-29

	Tornado ADV	MIG-29
Size (ft)		
Length	59	51
Width (Swept)	28	34
(Spread)	46	
Trust-to-Weight Ratio	.85:1 (1)	1.4:1
Speed (Mach)		
Altitude	2.2	2.3
Low Level	1.3	1.2
Turn rate (deg./sec.)		
Sustained	9 (1)	16
Instantaneous	15 (1)	21
Radar (nm)		
Search	100	130
Track	40 (1)	100
Type	TWS	PD/TWS
Armament		
Radar Missiles	4 x BAe Sky Flash	AA-10 (2)
IR Missiles	2 x AIM-9L	AA-8/AA-11 (3)
Gun	27mm	30mm
BVR Capable	YES	YES
Lookdown/shootdown	YES	YES

Footnotes:
1. Estimated
2. Six maximum or in combination
3. May be loaded single type or in combination

TABLE 3: Tornado ADV and MIG-29 Comparison

COMPARISON

Similar in size to the MIG-29 the Panavia Tornado is at an extreme disadvantage in the air combat arena. With a low thrust-to-weight ratio and a g limit of +7.5, the Tornado is no match for the MIG-29. In a maneuvering engagement the Tornado would be unable to adequately simulate the MIG-29.

F-14 TOMCAT

The Grumman F-14 Tomcat is a two-seat, twin-engined, all weather variable geometry wing all aspect air superiority fleet defense interceptor (6:420). It is equipped with a long range

pulse-Doppler track while scan (TWS) radar capable of tracking 24 targets simultaneously (3:244). The Tomcat has true lookdown/shootdown capability using the AIM-7F Sparrow or AIM-54 Phoenix radar guided air-to-air missiles (3:244). The F-14 also carries the AIM-9L Sidewinder all aspect IR air-to-air missile and an internally mounted 20mm gatling cannon (1:636). The Tomcat is able to carry eight missiles in varying combinations of radar guided and heat seeking giving it impressive ordnance capability in the air combat arena (1:635). The F-14 has a thrust-to-weight ratio of .78 to 1 but has surprising performance due to the automatic variable geometry wings which tend to optimize lift and drag as sensed for varying flight regimes (1:601). The Tomcat is able to generate instantaneous turn rates of approximately 20 degrees/second and sustained turn rates comparable to the Mirage 2000C of 11 degrees/second (1:194;6:420). The F-14 has a maximum speed of Mach 2.34 at altitude and Mach 1.2 at sea level, due in part to the swing wing design (6:420). The TF-30-414 engines installed on the F-14 are susceptible to stall and are considered to be a liability in performance (1:618). Former Navy Secretary John F. Lehman Jr. referring to the TF-30/F-14 combination, called it "probably the worst engine/airframe mismatch we have had in many years" (1:618). One other drawback to the F-14 is the automatic variable geometry wings which in a dogfight can visually indicate the aircraft's maneuvering potential.

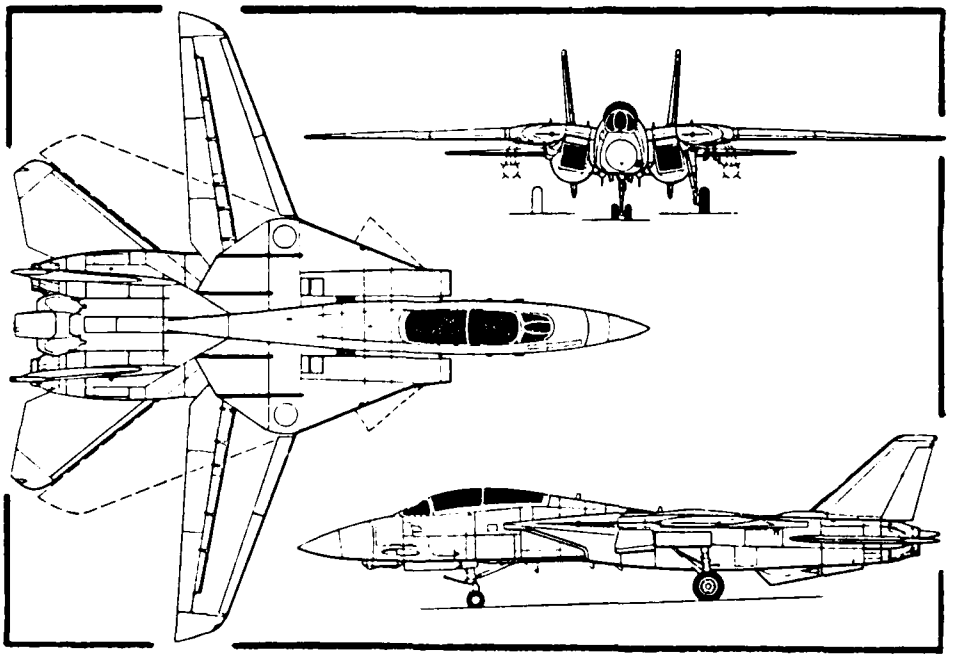


FIGURE 8: F-14 Tomcat

COMPARISON

When compared the F-14 is considerably larger than the MIG-29. Both aircraft possess excellent air-to-air systems with a slight edge to the Tomcat because of its longer range radar and Phoenix missile. In the maneuvering arena the MIG-29's much greater thrust-to-weight ratio and superior instantaneous and sustained turn rates would be difficult for the F-14 to simulate.

F-14 TOMCAT DATA vs MIG-29

	F-14	MIG-29
Size (ft)		
Length	63	51
Width	38 (Swept) 64 (Spread)	34
Thrust-to-Weight Ratio	.78:1	1.4:1
Speed (Mach)		
Altitude	2.34	2.3
Low Level	1.2	1.2
Turn Rate (deg./sec.)		
Sustained	11 (1)	16
Instantaneous	20 (1)	21
Radar (nm)		
Search	113	130
Track	90	100
Type	PD/TWS	PD/TWS
Armament		
Radar Missiles	6 x AIM-54 (2) 6 x AIM-7F (2)	AA-10 (3)
IR Missiles	2 x AIM-9L	AA-8/AA-11 (4)
Gun	20mm	30mm
BVR Capable	YES	YES
Lookdown/shootdown	YES	YES

Footnotes:
1. Approximately
2. Maximum quantity of each type not in combination
3. Six maximum or in combination
4. May be loaded single type or in combination

TABLE 4: F-14 and MIG-29 Comparison

F-15 EAGLE

The McDonnell Douglas F-15 Eagle is a single-seat, twin-engined, all weather all aspect air superiority fighter (6:453). The key to this aircraft's success in the air combat arena is the superb combination of avionics, aerodynamics, and power (1:103). The heart of the F-15 and the foundation of its combat efficiency is a long range multi-mode pulse-Doppler radar with a maximum detection range in excess of 100 miles (1:103). The maneuverability of the F-15 is a combination of relatively low wing loading and a high thrust-to-weight ratio of 1.25 to 1 (1:103). The Eagle is capable of instantaneous turn rates of approximately 22 degrees/second and sustained turn rates of 15 degrees/second (1:194). With a maximum speed of 2.3 Mach at altitude and 1.2 Mach at low level, the Eagle possesses excellent speed characteristics for interception and engagement (6:453). The F-15's armament includes an internally mounted 20mm gatling cannon and external armament of up to 4 AIM-7M Sparrow medium-range radar guided air-to-air missiles and AIM-9M Sidewinder short-range IR air-to-air missiles (6:453). The combination of radar, HUD, and bubble canopy give the Eagle unmatched target detection ability (1:100). The F-15 is a relatively large fighter aircraft with a wingspan of almost 43 feet and a length of over 63 feet (6:453). The large size was necessary to accommodate the radar and avionics package as well as maintain the desired low wing loading for maneuverability (6:453). The large size of the Eagle is considered a disadvantage because the aircraft presents a relatively large return allowing for earlier electronic and visual acquisition in the air combat arena.

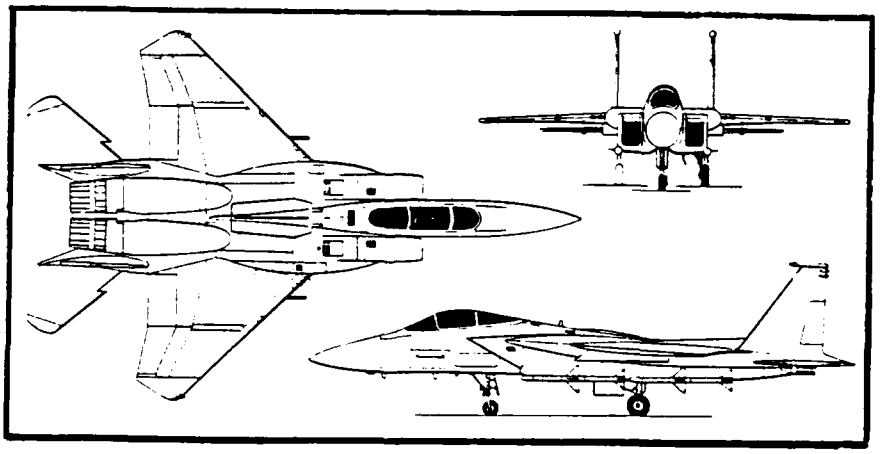


FIGURE 9: F-15 Eagle

F-15 EAGLE DATA vs MIG-29

	F-15	MIG-29
Size (ft)		
Length	64	51
Width	43	34
Thrust-to-Weight Ratio	1.25:1	1.4:1
Speed (Mach)		
Altitude	2.3	2.3
Low Level	1.2	1.2
Turn Rate (deg./sec.)		
Sustained	15	16
Instantaneous	22	21
Radar (nm)		
Search	100+	130
Track	85	100
Type	PD/TWS	PD/TWS
Armament		
Radar Missiles	4 x AIM-7M	AA-10 (1)
IR Missiles	4 x AIM-9M	AA-8/AA-11 (2)
Gun	20mm	30mm
BVR Capable	YES	YES
Lookdown/shootdown	YES	YES

Footnotes:
1. Six maximum or in combination
2. May be loaded as single type or in combination

TABLE 5: F-15 and MIG-29 Comparison

COMPARISON

Similar in performance to the MIG-29, the F-15 is much larger. Both aircraft possess impressive armament and fire control systems to employ ordnance. The incorporation of bubble canopies, HUD systems, and advanced avionics improve early target acquisition and identification for both aircraft. The larger size of the F-15 makes its acquisition more probable at longer ranges visually and electronically than the smaller Fulcrum. In the air combat arena the Eagle's size would make simulating the MIG-29 very difficult.

F-16 FALCON

The F-16 Falcon is a fixed wing high performance single-seat, single-engine, multi-mission fighter (6:408). The Falcon's advanced technology includes a blended wing body and fly-by-wire flight control system.(6:408) Equipped with a pulse-Doppler radar, the F-16 has the capability to lookdown and acquire targets, but is currently not equipped with a radar guided air-to- air missile limiting its low altitude shootdown capability (1:408). The Falcon is planned to carry the advanced medium- range air-to-air missile (AMRAAM) AIM-120 when it is developed and deployed (1:177). Present armament includes an internally mounted 20mm gatling cannon and the capability to carry up to 6 AIM-9M Sidewinder IR air-to-air missiles (1:177). The F-16 was designed to be highly maneuverable in the air combat arena. The fly-by-wire flight control system ensures the pilot cannot over-stress the aircraft or exceed a maximum angle-of-attack (AOA) of 25 degrees (1:194). This, combined with a 1.1 to 1 thrust-to-weight ratio, produces instantaneous turn rates of approximately 23 degrees/second and sustained turn rates of 16 degrees/second (1:194). Aircraft performance is such that the F-16 has been described as virtually "unbeatable" in simulated air combat by the Royal Netherlands Air Force (1:194). The Falcon is also an effective strike aircraft (1:194). Developed as a light weight fighter, the F-16 has excellent performance characteristics and its small size make visual acquisition difficult. The high maneuverability of the Falcon in a turning engagement is offset by its relatively short range radar and lack of a radar guided missile for true lookdown/shootdown capability.

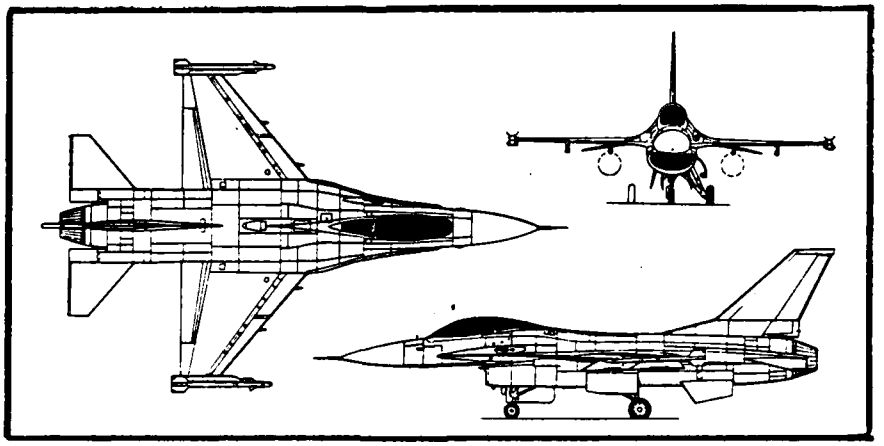


FIGURE 10: F-16 Falcon

F-16 FALCON DATA vs MIG-29

	F-16	MIG-29
Size (ft)		
Length	48	51
Width	31	34
Thrust-to-Weight Ratio	1.1:1	1.4:1
Speed (Mach)		
Altitude	2.0+	2.3
Low Level	1.0+	1.2
Turn Rate (deg./sec.)		
Sustained	16	16
Instantaneous	23	21
Radar		
Search	50	130
Track	30	100
Type	PD	PD/TWS
Armament		
Radar Missiles	None (1)	AA-10 (2)
IR Missiles	6 x AIM-9L	AA-8/AA-11 (3)
Gun	20mm	30mm
BVR Capable	NO (1)	YES
Lookdown/shootdown	NO (1)	YES

Footnotes:
1. Can be simulated
2. Six maximum or in combination
3. May be loaded as single type or in combination

TABLE 6: F-16 and MIG-29 Comparison

COMPARISON

In comparison to the MIG-29, the F-16 is very close in size and performance characteristics. Although the MIG-29 has a higher thrust-to-weight ratio, the advanced fly-by-wire and blended wing body technology of the F-16 give it nearly equal performance. The F-16 radar is limited in range to 30 miles in the lookdown mode acquiring fighter size targets and does not have true lookdown/shootdown capability due to the prolonged development of the AMRAAM (1:145). These two factors may limit the F-16's ability to simulate adversary tactics involving autonomous operations and BVR missile employment. Overall, the MIG-29 and F-16 are very capable and comparable fighters in the air combat arena.

F-18 HORNET

The F-18 Hornet is described as fast, highly maneuverable, and an outstanding dogfighter (4:40). The Hornet is a single-seat, twin-engined, all weather all aspect multi-mission aircraft (6:453). The lethal advantage of the F-18 lies in its advanced pulse-Doppler long range radar's ability to detect targets out to approximately 80 nautical miles (1:238;4:40). Up to ten targets can be tracked simultaneously, even while searching the area for others (1:238). The Hornet carries up to ten air-to-air missiles and an internally mounted 20mm gatling cannon (1:253). Up to six AIM-9M Sidewinder IR air-to-air missiles and four AIM-7M Sparrow or AIM-120 AMMRAAM medium-range radar guided air-to-air missiles are carried by the F-18 giving it true all weather all aspect BVR lookdown/shootdown capability (1:253). The Hornet has a thrust-to-weight ratio of slightly better than 1.1 to 1 with air combat loads and fuel weights (1:257). This allows the F-18 to achieve instantaneous turn rates of approximately 25 degrees/second and sustained turn rates of 15 degrees/second (1:194). The Hornet is able to out accelerate virtually anything else in the world from .8 Mach to 1.2 Mach (1:257). With a maximum speed in excess of 1.8 Mach at altitude and greater than 1.0 Mach at low level, the F-18 has the requisite speed in the air combat arena. (1:453).

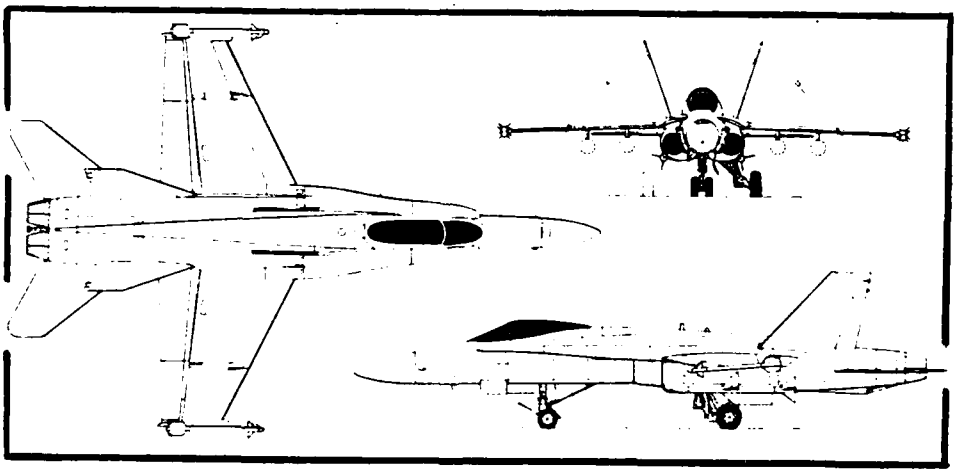


FIGURE 11: F-18 Hornet

F-18 HORNET DATA vs MIG-29

	F-18	MIG-29
Size (ft)		
Length	56	51
Width	37	34
Thrust-to-Weight Ratio	1.1+:1	1.4:1
Speed (Mach)		
Altitude	1.8+	2.3
Low Level	1.0+	1.2
Turn Rate (deg./sec.)		
Sustained	15	16
Instantaneous	25	21
Radar (nm)		
Search	80	130
Track	40	100
Type	PD/TWS	PD/TWS
Armament		
Radar Missiles	4 x AIM-7M	AA-10 (1)
IR Missiles	4 x AIM-9M	AA-8/AA-11 (2)
Gun	20mm	30mm
BVR Capable	YES	YES
Lookdown/shootdown	YES	YES

Footnotes:
1. Six maximum or in combination
2. May be loaded as single type or in combination

TABLE 7: F-18 and MIG-29 Comparison

COMPARISON

Comparison between the MIG-29 and the F-18 yields few substantial differences. Both aircraft are highly maneuverable, all aspect, all weather, BVR fighters. The MIG-29 enjoys a slight advantage in sustained turn performance as does the Hornet in instantaneous turn rates. The Fulcrum is faster at altitude while the F-18 has excellent acceleration. Additionally, the F-18 has outstanding slow speed handling characteristics in a dogfight. Although the MIG-29 has a greater thrust-to-weight ratio than the F-18, the Hornet's advanced design makes its performance characteristics very close to the MIG-29's. From their twin-tailed design to advanced weapons systems and heavy ordnance loads, the MIG-29 and F-18 are nearly identical in the air combat arena.

Chapter Four

CONCLUSION

Analysis of the possible aircraft versus the MIG-29 establishes the F-18 to be the single best choice. The F-18 provides the capabilities, performance characteristics, and proper size to perform all phases of the aggressor mission. As each aircraft was compared to the MIG-29, their weaknesses became apparent. First, the Mirage 2000C's lower thrust-to-weight ratio and delta wing design are limiting factors in sustained maneuvering performance as is its shorter range radar versus the more capable MIG-29. Second, the Panavia Tornado ADV lacks the thrust and turning performance to simulate the MIG-29. Additionally the Toranado's swing-wing design and larger size were considered disadvantages. Third, the F-14's low thrust-to-weight ratio, swing-wing design and large size do not adequately simulate the MIG-29. Fourth, the F-15's size presents a relatively large return for electronic and visual acquisition which is not characteristic of the MIG-29. Fifth, The F-16 lacks the longer radar range and lookdown/shootdown capability of the MIG-29. Finally, although the F-18 is slower at altitude and slightly larger than the MIG-29, it is the single best replacement aggressor aircraft.

SUMMARY

Several factors have led to the need for a replacement aggressor aircraft. Foremost, The USAF is committed to providing the best training. Additionally, the aggressor squadrons were formed to provide realistic threat training in the air combat arena. Finally, the Northrop F-5E is an aging aircraft and no longer adequately simulates the current threat in the air combat arena. This project focused on the aggressor mission, determining the threat, and finding the best replacement aircraft. Analysis has shown the MIG-29 Fulcrum is the most challenging threat in the air combat arena, and the F-18 Hornet is the best aircraft to simulate the threat. The narrow scope of this project has precluded analysis of cost for acquisition, conversion, or logistics of the possible replacement aircraft. The sole intent of this paper was to provide an analysis of the threat and determine the single best aircraft to simulate that threat.

RECOMMENDATION

This project's analysis of the aggressor mission, the current adversary threat, and possible replacement aircraft be used as an input for the determination of the aggressor replacement aircraft. The capabilities of the F-18 show it to be the best choice in the absence of cost factors.

"You train like you fight, and you fight like you train".

Randy "Duke" Cunningham
Naval ACE in Vietnam

BIBLIOGRAPHY

A. REFERENCES CITED

Books

1. Bonds, R., Editor. The Great Book of Modern warplanes. New York, New York: Portland House, 1987.

2. Cunningham, R. Fox Two. Mesa, Arizona: Champlin Fighter Museum, 1984.

3. Gunston, B., Editor. The Illustrated History of Fighters. New York, New York: Simon & Shuster Inc., 1983.

4. Nicholas, Ted, G. US Military Aircraft Data Book, 1987. Fountain Valley, California: Data Search Associates, 1987.

5. Taylor, J. W. R., Editor. Jane's All the Worlds Aircraft. New York, New York: Jane's Publishing Co. Inc., 1985-1986.

6. Taylor, J. W. R., Editor. Jane's All the Worlds Aircraft. New York, New York: Jane's publishing Co. Inc., 1986-1987.

Articles and Periodicals

7. Coyne, J. P., Editor. "Frontal Aviations One-Two Punch." Air Force Magazine, March 1985, pp. 74-75.

8. Geiger, C. J., Capt, USAF (Ret). "New Soviet Aircraft: The RAMS." Marine Corps Gazette, May 1983, pp. 20-22.

9. Graset, P. "Dissimilar Air Combat Training--A Revolution in Realism." International Defense Review, June 1975, pp. 823-827.

10. Greeley, B. M. Jr. "Advances in Soviet Aircraft Drive ATF Development Effort." Aviation Week and Space Technology, Volume 125: 20+, (November 10 1986), pp. 20-21.

11. Housman, Damian. "Fleet Fighters." International Combat Arms, Volume 5, Number 2, (March 1987), pp. 40-42.

CONTINUED

12. Howard, P., Editor. "Sukhoi SU-27 Flanker Fighter In Close-Up." Jane's Defence Weekly, Volume 8, Number 7, (August 22 1987), pp. 338-339.

13. Lenorovitz, J. M. "French Push Mirage 2000 Export Sales." Aviation Week and Space Technology, Volume 114: 77+, (June 8 1981), pp. 77-79.

14. Mordorff, Keith,F. "Air Force Aggressor Squadrons Move to Improve Combat Training." Aviation Week and Space Technology, Volume 123: 93+, (August 19 1985), pp. 93-96.

15. Panalev, Georg. "MiG-29 Fulcrum, Details to Date." International Defense Review, Volume 20, Number 2, (November 2 1987), pp. 145-146.

16. Pokryshkin, A., Marshal, USSR. "Fighter Aviation Tactics." Soviet Military Review, Number 2, February 1987, pp. 12-13.

17. Robinson, Clarence A., Jr. "Soviets Deploying New Fighters." Aviation Week and Space Technology, November 28, 1983, pp. 18-21.

18. Russ, R. D., General, USAF. "Spreading the Firepower, Extending the Battlefield." Air Force Magazine, April 1987, pp. 70-73.

19. Sweetman, B. "New Soviet Combat Aircraft--Quality with Quantity." International Defense Review, Volume 17, Number 1, (1984), pp. 35-38.

20. Taylor, J. W. R., Editor. "Jane's Aircraft Update." Air Force Magazine, March 1986, pp. 85-86.

Official Documents

21. Tactical Air Command. TACR 23-24, Organization and Mission Field, 4440 Tactical Fighter Training Group (Red Flag). Langley AFB, Va.: HQ TAC/XPM, 20 June 1986.

22. Tactical Air Command. TACR 23-78, Organization and Mission Field, Aggressor Squadrons. Langley AFB, Va.: HQ TAC/XPM, 5 December 1983.

Unpublished Materials

23. Taylor, Roger E., Maj, USAF. "Aggressors: Future Proposal." Research study prepared at the Air Command and Staff College, Air University, Maxwell Air Force Base, Alabama, 1986.

Other Related Sources

24. Author's own experience as a fighter pilot.

END

DATED

FILM

8—88

Dtic