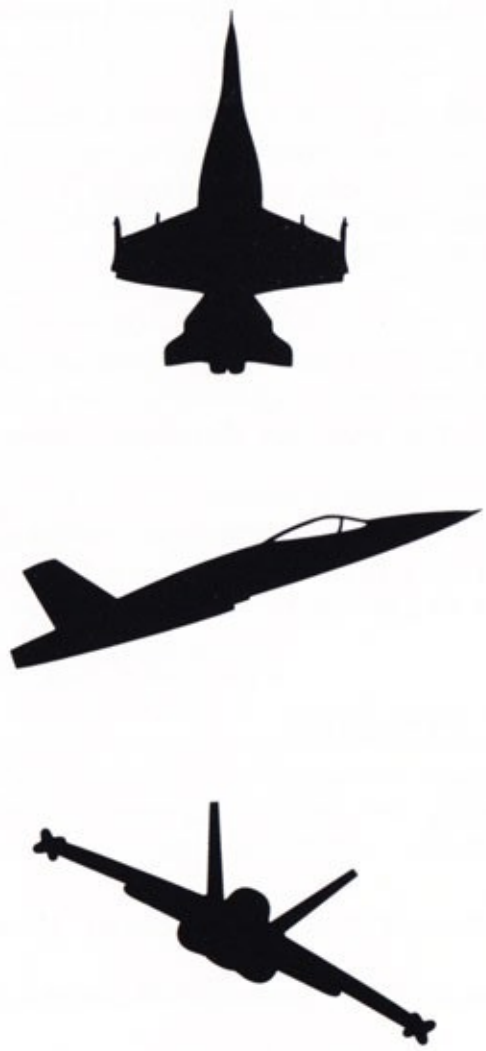
# SkyChase™



# Flight Manual

MAXIS


**MAXIS SOFTWARE**

953 Mountain View Drive, Suite #113
Lafayette, CA 94549
(415) 376-6434



ISBN # 0-929750-00-4

**Maxis Software License Agreement**

**Limited Warranty**
SkyChase is provided "as is" without warranty of any kind. Maxis warrants to the original purchaser of SkyChase that the diskette will be free from defects in materials and workmanship for ninety days from the date of purchase. Defective media returned by the purchaser during that ninety day period will be replaced without charge. Defective media can be returned and replaced any time after the 90 day period for a $7.50 handling charge.

**License**
As the original purchaser, you have the right to use SkyChase only on a single computer. You may physically transfer the program from one computer to another provided that the program is used only on one computer at a time. **You may not distribute copies of SkyChase or accompanying documentation to others.**



**Credits**
Original Concept and Design: Ralph Russell
Producer: Jeff Braun
Associate Producer: Akila Redmer
Programmer: Ralph Russell
Graphic Artist: Don Bayless
Documentation: Karen Jacobs
Contributions to Documentation: Jeff Braun, Ralph Russell, Akila Redmer, Mirrorsoft Ltd.

Play Testers: Dan Angeli, Sean Blair, Ray Boden, Keith Brumbaugh, Jon Trachtenberg

Special Thanks To: Stan Kalisher & Impulse, Inc. Minneapolis, MN
Jim Mackonochie, John Cook and the folks at Mirrorsoft Ltd. England

Package and Documentation Design: Richard Bagel **DESIGN**
Cover Illustration: Kurt West for Richard Bagel **DESIGN**

A message from the gang at Maxis,
"We have worked hard to provide quality software at a reasonable price.
Please do not support the piracy of software."

# WELCOME TO FIGHTERTOWN, USA

SkyChase is a sophisticated jet combat simulation that can accommodate one or two players. Modeled after Air Force and Navy flight training competitions, SkyChase provides the obstacles, tools, and most of all, the excitement, critical to jet combat. SkyChase effectively re-creates the classic pilot training scenario, where flyers, after passing each other in a "flyby maneuver", commence attacking their opponent until one of them is destroyed.

SkyChase has been developed to optimize flight speed, and to provide aerodynamically accurate jet performance. There has never been a flight simulation that can match the flight speed achieved by SkyChase.

The jets are wire-frame 3-D images, and fly over a grid-patterned ground. The grid, like the jets themselves, alters to simulate speed, elevation, and depth. The SkyChase jet fleet is comprised of renditions of actual American and Soviet planes. For those who put a premium on speed itself, SkyChase offers its own high performance "jet", the lightening-fast paper airplane.

SkyChase's "combat zone" is configured in the shape of an enormous cube, the perimeters of which are displayed graphically through the grid, radar controls, and the perimeter warning indicator light, and also numerically through an altimeter bar graph. Players are "situated" inside the cockpits of their aircraft, and therefore, will always be looking at a view of the interior of the cube through the jet pilot's window. When the jet is upside down, players will view a correspondingly inverted sky to ground relationship.

Head-to-head combat, throttle control, and a diverse arsenal of high-tech weaponry make for a high-tension, multi-skilled game. Players can choose a partner or challenge the computer itself to sharpen flying skills or to test their reflexes against the computer flying ace.

# NAVIGATING THE MENU SYSTEM

Press any key to get to the main menu. The menu system is composed of numbered selections, many of which will display submenus when chosen. Enter the number of the selection you want. Simply press the return key to restore the previous menu. The 0 key, return key, the joystick button and the "Enter" key on the numeric keypad all have the same function of restoring the previous menu and, eventually, of starting the game.

# MAIN MENU OPTIONS

## Game Selections

## Two Player (Human v. Human)

2 joysticks are required.

## One Player ( Human vs. Computer)

The computer assumes the right player's role. The options can be set for the computer player with the Computer Skill setting. The right player settings will apply to the computer in this mode.

Options that can be set independently for the computer player include the following:

Jet Selection
Fuel Selection
Ammunition
Missile Store
Missile Lock Threshold
Bullet Hit Threshold
G-force blackout threshold

The computer will always use "Pitch and Roll Combined" for his "joystick".

## One Player ( With no right window)

This option is the same as the other one player mode with the exception that the computer's screen is blanked out. This provides more challenging competition, since you won't be able to see what the computer is doing in advance. In addition, you will notice that your jet performance is substantially improved.

## Zero Player (Computer vs. Computer)

This is a demonstration mode you can show your friends. When this mode is selected, the menus can be used to set parameters for both computer players. When "Run Demo" is selected on the main menu, preset parameters will be used.

## Left and Right Player Selections

Each player can choose his or her own setting preferences. This allows one player to handicap the other in order to even out the play.

## Jet Select

Take some time to review the aircraft fleet up close while you're making your jet selection; once combat begins, chances are things will be happening too fast and at too great a "distance" to appreciate their distinctive features.

Throttle and rotation limits are different for each jet.

A) Each jet's maximum velocity is set.
B) Each jet's maximum roll rate is limited to a specific value.
C) The maximum rate of change for each jet's pitch is similarly limited. The limit when going into a climb is the same as the jet's roll rate limit. The limit when going into a dive is approximately one half.

| Jet | Throttle limit | Max speed for level flight | Maximum roll rate degrees/sec | Maximum upward pitch change rate degrees/sec | Maximum downward pitch change rate degrees/sec |
|---|---|---|---|---|---|
| F18 | 11 | 1234 | 50 | 50 | 25 |
| F14 | 13 | 1462 | 45 | 45 | 25 |
| F15 | 12 | 1348 | 45 | 45 | 25 |
| F16 | 12 | 1348 | 50 | 50 | 25 |
| M31 | 15 | 1691 | 35 | 35 | 20 |
| M27 | 14 | 1577 | 40 | 40 | 20 |
| PA | 15 | 1691 | 50 | 50 | 25 |

## Fuel Select

Each 550 gallon increment lasts approximately 3-7 minutes depending on the amount of power required for flight. With 8800 gallons, or the maximum amount of fuel, combat can last for up to one hour. Firing a missile uses a small amount of your fuel. Getting hit uses a lot of your fuel. Hitting your opponent adds the same amount of fuel back to your tank.

## Ammunition

Each player can select the number of bullets to be carried on board. Press 1 for no bullets, 9 for unlimited bullets and 2-8 for selecting a specific number of bullet rounds.

The number of bullets fired per minute increases as the overall game speed increases. If you are using the 8x8 grid for example, which increases game speed, you will want to add more bullets.

Bullets are not very effective in close range because, unlike actual jet combat where targets remain the same size regardless of distance, SkyChase jets literally grow as they get closer and shrink with distance. As a result, striking the exact center of your target (see Bullet Hit Threshold) with the tiny bullets becomes proportionately more difficult in relation to increased jet size. The distance to the target cannot be to great, because the target will be out of bullet range.

## Missile Store

Each player may select the number of missiles to be carried on board. Missiles are effective at close range when using the HUD (Heads Up Display) missile lock feature.

## HUD display

When the jets are close enough to deploy the missiles, the HUD (Heads Up Display) for missile locking will appear in the center of the screen. The crosshairs show the direction that your craft is pointing. A box will also appear in front of the opponent's jet to indicate where the missile should be fired to hit the jet. There is a line drawn between the crosshairs and the box. The idea is to position the box as close as possible to the crosshairs, by making the line as small as possible. The distance that the crosshairs needs to be from the box to get missile lock can be selected with the missile lock threshold setting.

The HUD has auditory cues for the player. The beeping tone indicates that missile lock is near. The steady tone indicates that missile lock has been achieved.

When the HUD has been successfully activated, the "missile lock" indicator will flash green. If the opponent's HUD is locked onto your jet, the "enemy missile lock" indicator will turn red. If both players have each other in missile lock, both indicators will light up. Under these conditions, fired missiles will automatically hit the opponent's jet.

## Missile Lock Threshold

Missile lock threshold represents the spatial interval within which missiles will automatically adjust directions to strike their targets. That interval is measured in pixels between the crosshairs and the box, (a pixel equals the space of one dot on the computer screen), and players may select thresholds ranging from 1-40 pixels. A choice of 1 pixel, for example, would mean that the center crosshairs and the HUD box would need to overlap exactly to achieve a hit; with 40 pixels, a line of that length connecting the center crosshairs and the HUD box would represent the range in which a fired missile would achieve a hit.

The HUD only becomes active when an opponent is within missile range. Missile lock is achieved when the HUD is positioned over the crosshairs within the missile lock threshold range. The larger the number, the easier it is to get missile lock on your opponent. Double clicking the joystick button fires a missile when an opponent is within range.

## Bullet Hit Threshold

The Bullet Hit Threshold setting determines the size of the area within which you can score a hit with the jet's machine guns. The selections are small, medium and large. Small represents a one pixel dot on the center of the jet that must be hit by a bullet to register a kill. Medium represents a 9 pixel area and large represents a 25 pixel area. Collision detection for bullets is two dimensional, making it easier to hit a jet that is far away because it is smaller, and thus, more likely to fall within the hit area.

## Trigger Timing

Holding the joystick button down causes continuous machine gun fire. When the HUD is displayed the missile can be fired by pressing the Joystick button twice, quickly, in succession. The missile trigger is distinguished from the bullet trigger by the length of the interval between the 2 clicks of the joystick button. This delay can be set for Fast, Medium or Slow.

## G-Force Effect

Gravity forces effect the pilot by affecting blood flow to the brain. There are two kinds of G-forces: negative G's, which accrue when a plane descends and forces blood into the head, and positive G's, which accrue when a plane ascends or turns sharply, forcing blood out of the head.

Your body and plane can tolerate many more positive than negative G's. Excessive negative G's cause the blood vessels in your eyes to rupture, or Redout. Blackout occurs if the effects of positive G's are too strong, causing you to lose control of the jet. SkyChase's G-force limit is 9 G's for both positive and negative G-forces. When you blackout, the G-Force meter will flash and the "autopilot" will take over the jet and return it to a straight and level course. Once the jet is flying straight and level, the blackout will terminate and, within two seconds, the pilot will regain control. To reach 9 G's you must roll to 90 degrees or change pitch at the maximum limit.

The amount of time required at 9 G's to blackout can be adjusted for each player. The amount of time required to blackout can be set to low, medium, high or unlimited.

## Grid Select

SkyChase displays a grid on the ground. The number of cells in the grid effects the overall speed of the game. Game speed increases with fewer cells and decreases with more cells. The fastest game is achieved by selecting the 8x8 grid and the slowest, the 64x64 grid. The grid is projected on the ground to supply perspective.

The combat takes place over the grid. The outside perimeter is a small distance from the outside of the grid.

## Computer Skill

The Computer can be adjusted to different levels of difficulty. Players can choose from one of four levels—Easy, Average, Difficult and Ace—which correspond to increasing levels of maneuverability. The computer skill option is only applicable to single player or computer vs. computer modes.

## Flyby Control

The Flyby mechanism which initiates all jet combat is automatically activated at the beginning of each round. Players can also select flyby as a means of resuming combat following any kill, or can bypass flyby and merely resume combat from jet positions at the time of the kill.

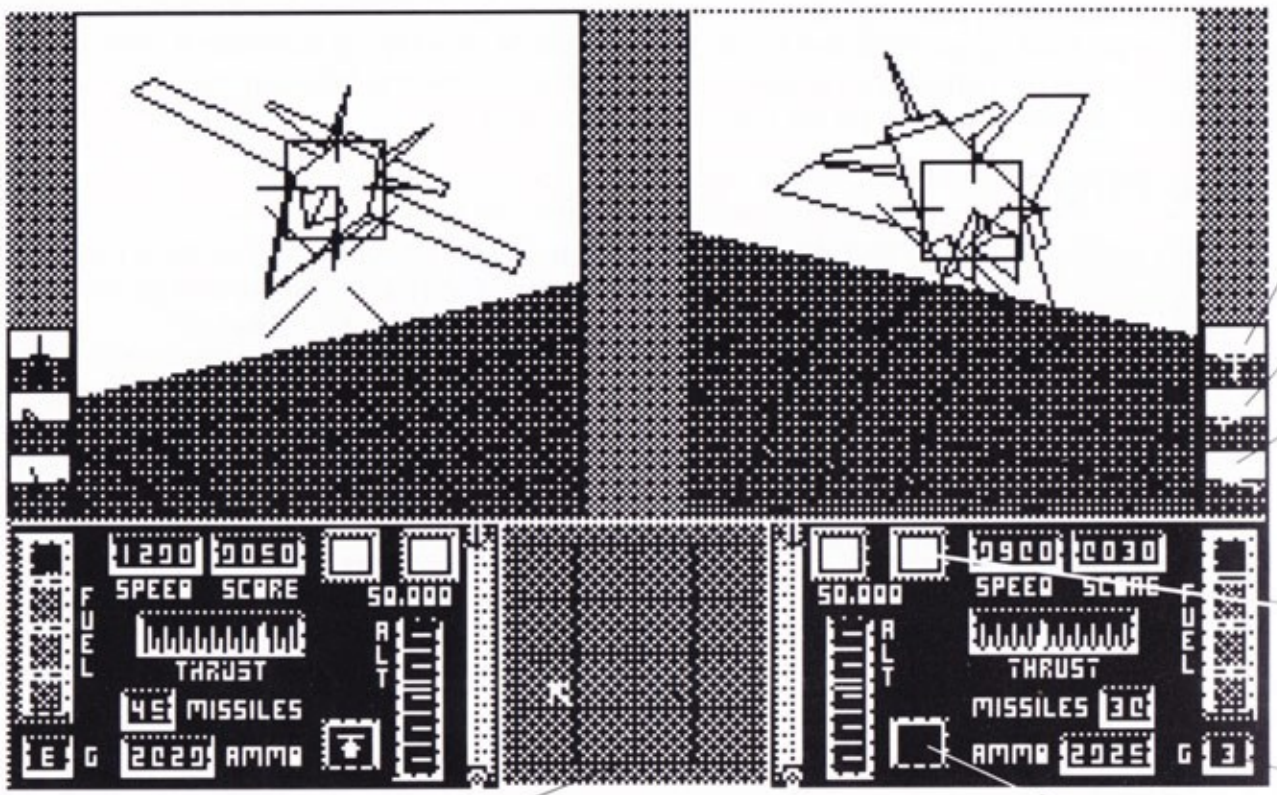
## Sound Control

The game sounds can be turned off if desired.

## Music Control

The game music is only played when the option menus are being displayed; it too may be disconnected.

# COCKPIT INSTRUMENTATION




Left Player

Right Player

## Radar

The radar provides an overview of the combat zone, allowing the player to determine an opponent's position. The arrows on the radar screen represent the jets; the red arrow is the left jet and the white arrow is the right jet. The boarders are colored to remind you which is which. The arrows can appear in 16 different positions to represent the heading of each jet. When the arrows overlap, the arrow on top is the higher jet. The relative altitudes of the jets are better represented with the altimeter.

## Altimeter

There are 2 bars on the Altimeter. The green bar reflects the pilot's altitude and the red bar, the opponent's altitude. This gauge allows you to determine if your opponent is above or below you. Exceeding the ceiling of 50,000 feet will cause a crash. The 50,000 ft. indicator will flash to warn you that the ceiling is near.

## Score

The score is displayed with the gauge.

## Thrust

The thrust is a constant force that represents the force of the jet engine. The thrust value will increase as the throttle is increased and decrease when the throttle is decreased. The jet's rate of turn will decrease as it's speed increases and the rate of turn will increase as it's speed decreases.

## Heading (top box)

Indicates the direction the aircraft is pointing in from side to side, i.e. north, east, south or west. This indicator shows the top view of the jet. The heading gauge matches the direction of the arrow on the radar.

## Pitch (middle box)

Indicates the angle the aircraft is pointing in from nose to tail, i.e. climbing or diving positions. This indicator shows the side view of the jet.

## Roll (bottom box)

Indicates the angle the aircraft is pointing in from wing to wing, i.e. turning or banking. This indicator shows the rear view of the jet.

## Speed

The speed represents the air speed in MPH.

## Missile Lock Indicators

One flashes green when your missile lock indicator is on; the other flashes red when the opponents indicator is locking on you.

## G-Force Indicator

The indicator shows the current G factor. Pilots will black out at 9 G's. The indicator turns red at 9 G's and flashes bright red while you are blacked out.

## Perimeter Indicator

Lights up to warn that your aircraft is in danger of colliding with the perimeter of the cubed-shaped combat arena. If you hit the perimeter your jet will blow up.

## Bullets Remaining

Represents the number of bullets left.

## Missiles Remaining

Represents the number of missiles left.

## Screen Outline

The screen outlines are color coded red and white to correspond with the arrows on the radar screen for easier recognition of players' jets.

# AIR COMBAT

## Flyby

The flyby is a fair way of starting an aerial combat and is initiated automatically. Pilot controls are suspended until the jets approach and pass each other head on. After the flyby, combat begins with all pilot controls activated.

# WEAPONS

## Machine Guns

Holding the joystick button down causes continuous machine gun fire. The Bullet Hit Threshold setting determines the hit area within which you can score a hit. The hit area is 2-dimensional making it easier to hit a jet that is farther away because it is smaller, and thus, more likely to fall within pixel range. Bullets are not very effective in close range, because it's harder to hit the small target area on such a large wire frame jet image.

## Smart Missiles

Double clicking the joystick button fires a missile when the opponent is within range. The missile can be activated when the jets are within range, with the crosshairs appearing on the center of the screen. The missile will actually turn toward the opponent as it is flying. The missile lock range is set by the missile threshold. When you fire a missile, you see it rushing away from the nose of your aircraft. Your opponent will see the same missile, if he is facing it.

## Using Sound

The jet sound gets higher pitched as the jets approach and lower as they move farther away. This "doppler effect", the change in the pitch of sound in relation to speed and proximity, provides players with an audio clue about the relative positions of the jets.

The missile, missile lock, bullet, and explosion sounds are in stereo, with the right and left channels reflecting the sounds of the right and left players. (Amiga version only.)

## Computer Pilot

The computer pilot, which is always the right player, will follow an invariable series of strategies:

- If the opponent is out of missile range but within machine gun range, the computer will fire the guns.
- The computer will resort to machine guns within missile range when it runs out of missiles.
- The computer pilot will always attempt to fly directly towards the calculated missile lock coordinates.
- The computer will always fire when it has the opponent in missile lock.
- If you fly in a large circle by staying in a rolled position, the computer will follow you exactly.
- The computer, even in Ace mode, can be considered handicapped in that its pitch is limited to a maximum of 60 degrees. In the easy and medium modes the pitch and roll limits are restricted even more.

Novices may wish to disarm the right computer player to even out your odds and train more effectively.

## Goals

The game continues until the jet's fuel is exhausted. The player with the most points wins.

## Points

Points are given for the following:

1- Opponent fires missile
10- Destruction of opponent with machine guns or missile
10- Opponent crashes on ground, ceiling or perimeter
10- Mid-Air collision (both players get 10 points)

## Combat Zone

The perimeter of the cube, or combat zone, is just outside of the grid area. The radar screen will display a solid black square within a green field and flash the perimeter warning light to let you know that you are approaching a wall. The perimeter includes the ceiling as well as the four walls and ground.

## Pausing

Pressing upper or lower case "P" during play will cause the game to pause. Just press the joystick trigger button or any key to resume play.

## Quitting

Press upper or lower case "Q" to quit the game during play. You will then return to the copyright screen; press any key to get to the main menu. To return to other software applications turn your computer off and reboot.

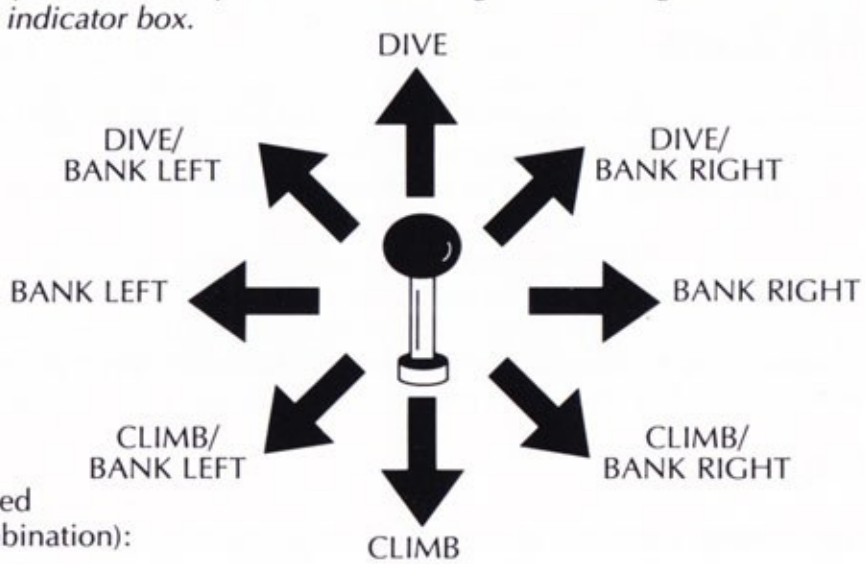
# FLYING

## Turning, Climbing and Diving

*When the aircraft is turned in any horizontal direction, i.e. north, south, east or west, you are adjusting its heading. Heading direction is displayed in the heading indicator box and the radar screen.*

*When the nose of the aircraft is raised or lowered, you are adjusting its pitch, causing it to move up or down. The degree of pitch is shown in the pitch indicator box.*

*When the aircraft is rolled, or rotated to one side, the combination of air pressure and velocity will force the plane into a banking turn. The degree of roll is reflected in the roll indicator box.*




Use the joystick to manipulate pitch and roll

(your heading will be effected by these two factors in combination):

Top position = Nose Down (Dive)
Right position = Banking turn to the right
Left position = Banking turn to the left
Bottom position = Nose Up (Climb)

## Joystick Select

The four diagonal positions can be set in one of two ways:

Option 1: The high speed roll. This is a banked turn, or roll, occurring at such a high speed of rotation that the jet will actually proceed in a straight line until released from it; upon release from the high speed roll, the aircraft will continue to bank at the angle it is released from. This ability to make faster, sharper turns makes the high speed roll an excellent offensive tool.

Option 2: Pitch and roll combined. This combines the pitch and roll of the two positions adjacent to the diagonal; for example, the bottom right corner would produce a roll which climbs to the right. The pitch and roll combination produces a kind of corkscrew motion and, because it makes it very difficult for an opponent to follow, is an excellent defensive tool.

## Throttle

The throttle controls the thrust, or jet engine force, of the aircraft. The throttle of each player's jet can be set during flight. The throttle will always be set in the middle during the flyby but will conform to the player's preferences following the activation of pilot control. Remember that higher throttle settings consume fuel faster.

The jet's rate of turn will decrease as it's speed increases. Likewise, the jet's rate of turn will increase as it's speed decreases. This accurately reflects the actual performance of a jet, just as a car turns more sharply when it is going slow than at high speeds. To turn at the fastest rate, therefore, slow down before turning.

AMIGA Commands

Left Shift key = increase in left players throttle.
Left "ALT" key= decrease in left players throttle.
"." key on keypad= increase in right players throttle.
Enter key on kepad = Decrease in right players throttle.

(See system card for other versions' throttle key commands.)

## Jet Speed and Performance

Two variables control the overall speed and performance of the combat; throttle setting and grid size. For the slowest game, choose the 64x64 grid with a low thrust setting; for the fastest game, choose the 8x8 grid with the highest thrust. You can use a high throttle setting to offset low speeds in a grid with many squares, or use a low throttle setting to compensate for higher speeds in a grid with few squares. Selection of the paper airplane will also increase the overall game speed.

Another factor that will improve performance is choosing the "One Player (With no Right Window)" option when playing the computer.

## A HISTORY OF DOGFIGHTS IN JET COMBAT

The history of the dogfight, head-to-head air combat issuing in the destruction of one of the participants, is nearly as long as the history of airplanes themselves. Dogfights have been around since World War I; but in fact, most strategists of that time felt sure that dogfights would never outlast the Great War. Leading military strategists, at almost every stage of aircraft development, have felt that the new high speed technologies—whether it be the propeller drive of the World War II Spitfire, or the supersonic power of the Vietnam era's F4 Phantom jet—would render the dogfight impractical and obsolete.

Dogfights, of course, have survived to the present day as one of the most perilous, and strategically critical, parts of our national defense. Yet, if dogfights are no less hazardous now than they were during the World War I era, that is perhaps the only feature which has remained unchanged. A World War I flying ace would have closed in on his opponent from the cockpit of a two- or even three-winged plane providing maximum lift, since engineers and strategists felt that maneuverability, more than speed, was crucial to combat success.

By the 1930's, bitter experience had taught air combat designers that great maneuverability was all but useless against a higher speed aircraft that could overtake a plane before it had time to execute a defensive maneuver. This realization permanently changed the course of air combat design; now the premium was on sheer speed and power. The first breakthrough in flight speed came with propeller driven planes like the Spitfire, which can be credited with the Allied victory in World War II's pivotal Battle of Britain.

The development of jet flight, and later, supersonic speeds seemed to lend credence to the idea that dogfights were destined to become a relic of "conventional" air combat. After all, how could two jets engage in head-to-head combat at velocities faster than the speed of sound? Engineers of the F4 Phantom, in 1953, were so confident that dogfights were history that they left guns out of the design completely, relying on missiles alone instead.

Supersonic speed brought unquestioned technical superiority, but it brought a host of new challenges as well. High speed flight subjected pilots to dangerous "G" forces, up to 9 times the force of gravity,

which caused loss of consciousness through oxygen deprivation. Along with immediate physical hazards were mental ones; controlling the new, sophisticated jets required that additional levels of expertise and attention be lavished on proliferating numbers of gauges and dials, diverting pilots dangerously away from the combat at hand.

Today, jet fighter pilots must undergo extensive training and study to ensure that they remain the masters, and not the victims, of the specialized machines they fly. At Top Gun, the U.S. Navy Flight School, and at Red Flag, the Flight School of the U.S. Air Force, would-be jet pilots train with jet simulation tools much like SkyChase; in fact, SkyChase is modeled directly on Flight School combat jet training maneuvers.

# JET DETAILS

## McDonnell Douglas F-18 Hornet

The Hornet is a lightweight multi-mission aircraft produced in several versions: 1) the carrier-based multi-role fighter; 2) the twin seat trainer; and 3) the land-based attack fighter. It first flew in 1978. The aircraft uses a single 20 mm gun, and has a total of nine external weapons stations, allowing a wide range of air-to-air and air-to-ground weapons to be fitted.

Engine: Twin General Electric F404-400 augmented turbofans; 16,000 lb thrust each.
Length: 56 ft
Wingspan: 37 ft 6 in (without missiles); 40 ft 4.75 in ( with two missiles)
Height: 15 ft 3.5 in
Weights: Empty 20,583 lb; loaded (air-to-air) 33,642 lb; loaded (ground attack) 48,253 lb; maximum loaded (catapult limit 50,064 lb)
Max Speed: Mach 1.8 (1,190 mph), air-to-air loaded, at altitude
Service Ceiling: Over 49,000 ft

## Grumman F-14 Tomcat

A variable geometry (swing wing) two seater carrier-based fighter, the Tomcat first flew in 1970. It carries a 20mm gun, and can house four AIM-54 Phoenix, AIM-7 Sparrow or AIM-120 Amraam air-to-air missiles on fuselage pallets. Additional four air-to-air missiles (including Sidewinders) can be fitted on wing pylons.

Engines: Two 20,900 lb Pratt & Whitney TF3—412A
Length: 62 ft 8 in
Wingspan: 38 ft 2 in (68 degree sweep); 64 ft 1.5 in (20 degree sweep)
Height: 16 ft
Weights: Empty 37,500 lb; loaded (air-to-air combat) 55,000 lb; loaded maximum 72,000 lb
Max Speed: Mach 2.34 (1,564 mph) at altitude; Mach 1.2 (910 mph) at sea level
Service Ceiling: Over 56,000 ft

## McDonnell Douglas F-15A Eagle

The Eagle was selected as the US Air Force's response to the MiG 25 in 1969, with the first prototype flying in 1972. It was developed almost solely as an air superiority fighter, although ground attack capabilities were explored from the mid-70s. It has a single 20mm gun, and would typically be armed with four AIM-7 Sparrow missiles, and has provision for four AIM-9 Sidewinder missiles. Other armament includes conventional and smart bombs, stand off General Electric Gepod multi-barrel 30 mm cannon and a range of ground attack missiles.

Engines: Twin 23,930 lb Pratt & Whitney F100-100 after burning turbofans
Length: 63 ft 9 in
Wingspan: 42 ft 9.75 in

Height: 18 ft 7.5 in
Weights: Empty 28,000 lb; loaded (air-to-air combat), 41,500 lb; loaded maximum 56,500 lb
Max Speed: Mach 2.5 (1,653 mph), over 36,000 ft, AIM-7 Sparrow armament only.
Service Ceiling: 65,000 ft

## General Dynamics F-16A Fighting Falcon

The F-16A is a lightweight multi-role combat aircraft designed for both air-to-air combat and ground attack. First prototypes flew in 1976. The aircraft carries a 20 mm gun, and can have a wide range of air-to-ground and air to air weaponry fitted in stand-off position In air combat mode it would typically be equipped with Sidewinder heat seeking missiles.

Engine: One 23,830 lb Pratt & Whitney F100-PW-200 augmented turbofan
Length: 47 ft 7.7 in
Wingspan: 31 ft (without missiles); 32 ft 10 in (with missiles)
Height: 16 ft 8.5 in
Weights: Empty 15,137 lb; loaded (air-to-air missiles only) 23,357 lb; loaded maximum 35,400 lb
Max Speed: Mach 2.05 (1,350 mph) at 40,000 ft; Mach 1.2 (915) at sea level.
Service Ceiling: Over 50,000 ft

## Mikoyan/Gurevich MiG 27

The MiG 27 is the ground attack version of the MiG 23 and, like the 23, has variable geometry. Basic armament is a 23 mm multi-barrel gun, with a mix of air-to-air and air-to-ground missiles and conventional bombs carried in stand-off positions. First prototypes flew in 1970.

Engine: One 25,353 ob Tumanksii R-29 series augmented turbofan
Length: 53 ft 5 in
Wingspan: 46 ft 9 in (16 degree sweep); 26 ft 9.5 in (72 degree sweep)
Height: 14 ft 4 in
Weights: Empty 22,000 lb; loaded (no external weapons) 34,170 lb; maximum 44,310 lb
Max Speed: Mach 1.6 (1,050 mph) at high altitude; Mach 1.1 (762 mph) at sea level; Mach 0.95 (723 mph) at sea level, loaded
Service Ceiling: 50,000 ft

## Mikoyan/Gurevich MiG-31 'Foxhound-A'

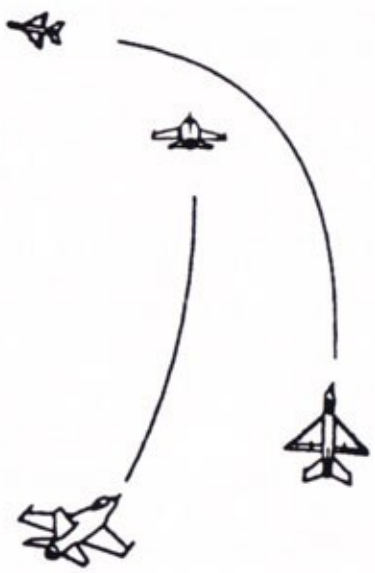
Faced with the requirement for a new long-range interceptor able to detect, track and destroy low-visibility B-1 bombers carrying out their attacks at low levels, the Soviet Union appears to be developing the fast, heavily armed but short-legged MiG-25. Looking at the likely shape of the requirement and the potential of the original design, however, it seems that a much altered MiG-25, with more efficient engines, new missiles, an improved radar and control system, and with large external fuel tanks for increased range, could form the basis for the worlds most powerful interceptor. First flown in 1974-75, the Foxhound sports two 32,000 lb thrust turbojet engines that allow it to reach speeds in excess of Mach 2.4 and attain a service ceiling of 75,000.

Engine: Two 32,000 Lb thrust turbojets
Length: 75 ft 8 in
Wingspan: 46ft
Max Speed: Mach 2.4
Service Ceiling: 75,000

## Maxis Paper Airplane

# AIR COMBAT MANEUVERS

The maneuvers which follow are those which are actually employed by fighter pilots in combat situations. To perfect your technique, you may wish to practice these maneuvers initially at low speeds.

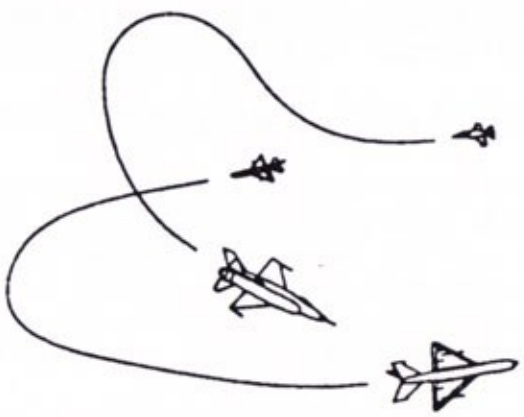


## Break

*Aircraft A, under attack from the rear, turns hard, forcing aircraft B to overshoot. Aircraft A is then able to turn back onto the tail of aircraft B. The success of the break is dependent on the relative turn rates of the two aircraft, as a high turn rate aircraft like the F16 or F18 could successfully break from a MiG 27, but the latter would have difficulty returning the break maneuver.*

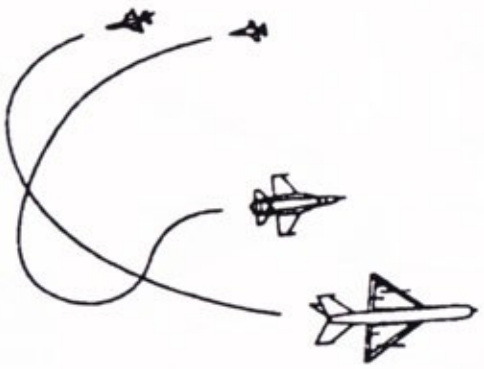
## Scissors

*The scissors is basically a series of breaks, each aircraft in turn forcing an overshoot by its enemy. It can continue until one or the other aircraft initiates an alternative maneuver.*



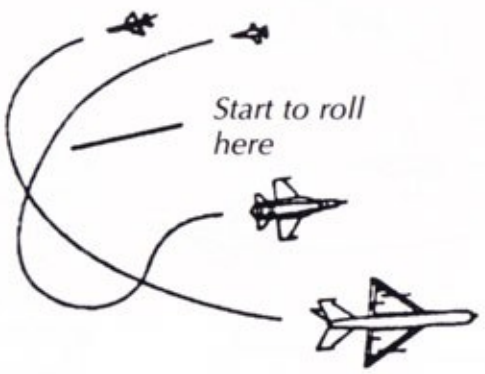
## High G Yo-Yo

*Reacting to a break maneuver by aircraft A, aircraft B executes a shallower turn than A, but at the same time climbs. The combination of the shallower turn and climb is intended to leave B on A's tail after A executes a sharper turn. Our MiG 27 facing an F16 would do well to consider this option.*



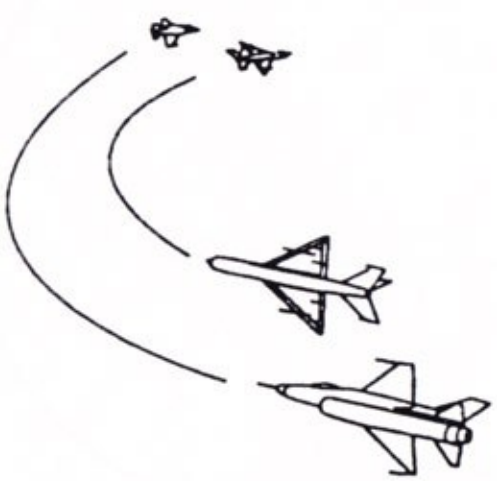
## Low G Yo-Yo

*A poorer performance aircraft can use this diving alternative to the High G Yo-Yo. As A turns sharp B executes a shallower turn and dives, bringing its nose up behind A's tail.*



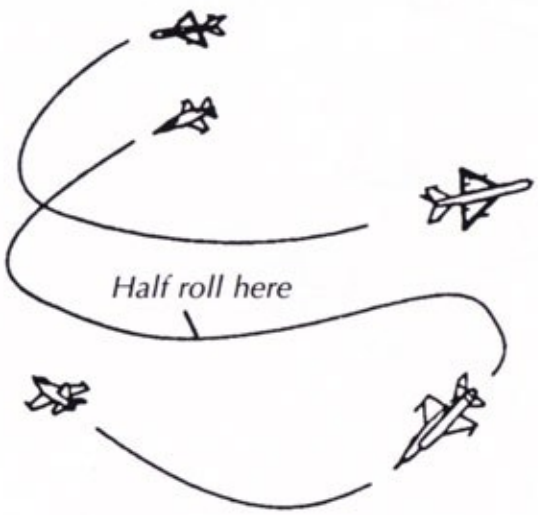

## Flip Yo-Yo

*This time B rolls as it enters the low G yo-yo dive. This means it pulls fewer negative Gs, and allows it to pick up speed faster as it comes back into a climb. If A pulls up sharp it is however possible for B to overshoot because of excessive speed buildup.*



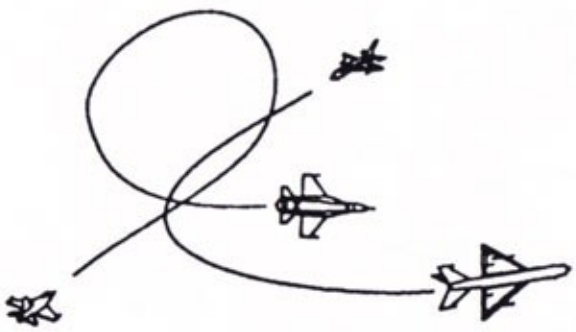
## Lag Pursuit

*As A attempts a Break, B positions itself behind and below its target, turning at the same rate, and keeping speed down by moving into a slight climb every now and then.*



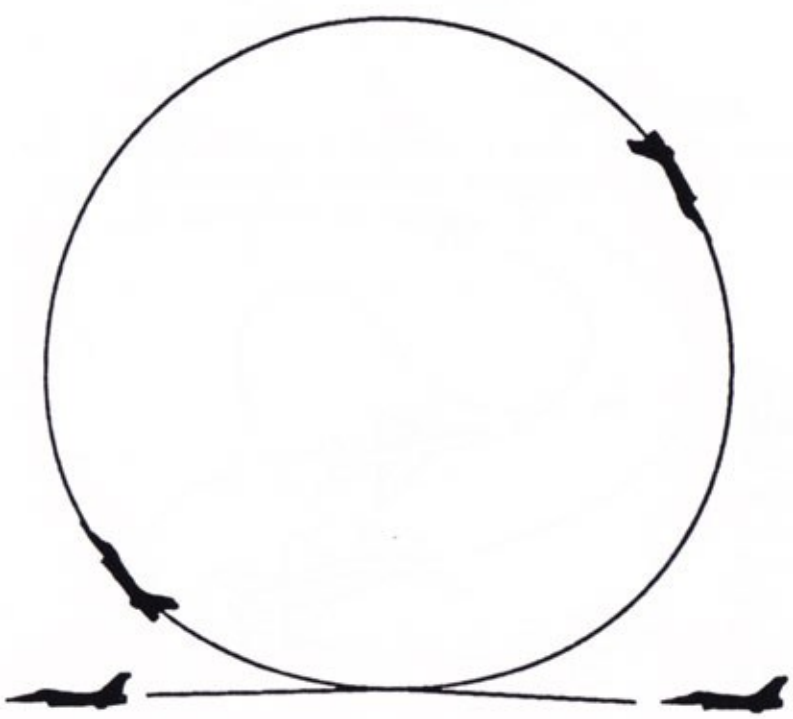

## Split S

*Attacker B has moved in to close to A during a Break. A rolls over and pulls into a dive before B can respond. Rolling first means that the Gs pulled are positive, allowing A to accelerate better. Note that this maneuver, successfully executed, allows combat to be broken off.*



## Head On

*First class gunnery wins in this confrontation, but if neither hits as the aircraft close, the "winner" of the maneuver is the aircraft with the tightest turning circle. Both must turn, and here B's tighter arc allows it to outpace A.*

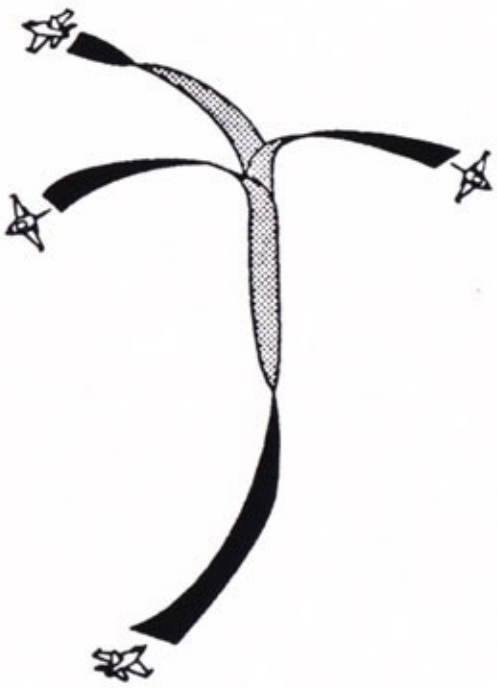


## Vertical Loop

*By pulling up into a loop you can return the aircraft to the same flight path, behind a pursuer, provided the pursuer does not react at all. More typically it can be used to confuse the opponent prior to executing a second maneuver.*

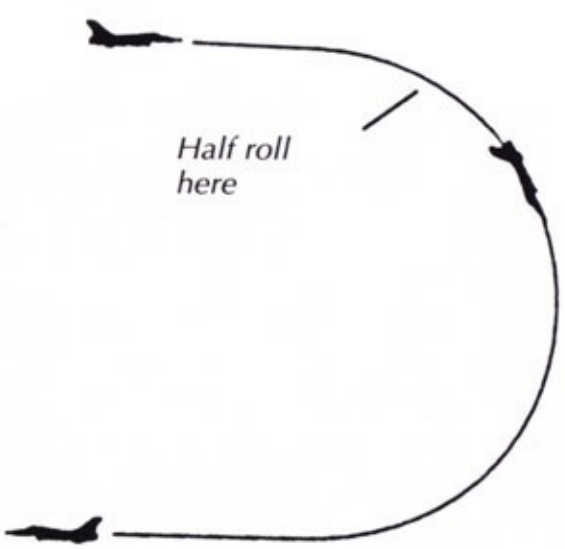
## Immelmann

*The classic Immelmann is a combination half loop and roll, leaving the aircraft flying in the opposite direction from the one it started in, and at a higher altitude. In its tightest execution it is commenced by a vertical climb and simultaneous roll, followed by a roll back onto the level at the top of the climb. Less powerful aircraft will have to execute it in easier stages.*



## Dive Loop

*As the aircraft is put into a dive it executes a half roll, pulling positive Gs and allowing a tighter turn; then it pulls onto the level at the bottom of the dive. It is related to the Immelmann, but performed "in reverse".*




MAXI -001-101