

# Fighter ag

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Undeniably popular, public air displays – where fighter pilots and manufacturers aim to out-stunt each other – have the effect of distorting what really matters in modern air combat. Air Power Association President, **Air Marshal (ret'd) Greg Bagwell CB CBE** sets the record straight...



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**W**ho can forget the immortal *Top Gun* quote: “I feel the need, the need for speed”? However, I’m sorry to tell you that this iconic movie grossly misrepresents the finer art of air combat, where employing Maverick’s questionable tactics would end up with you on the dreaded “alternates board”. And the high-agility airshow routines beloved of today’s fighter manufacturers are almost as misleading as Hollywood’s take on aerial combat.

Firstly, we should separate the two rather distinct phases of an air-to-air engagement. The first is the beyond-visual-range (BVR) portion, where aircraft engage in a supersonic game of 3D chess, and the second (which is the one that *Top Gun* and air displays try to emulate) is the close-in fight or the basic fighter manoeuvres (BFM) phase.

While I will touch on each in turn, for those who want a more academic schooling, I thoroughly recommend the book that was handed to me as I began my F/A-18

# ility

“I feel the need, the need for...”



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**1:** The sport of kings. Pilots of F-15C air superiority fighters battle to gain the upper hand in a close-turning BFM exercise. These Eagles are operated by the 122nd Fighter Squadron, part of the Louisiana Air National Guard's 159th Fighter Wing 'Bayou Militia'. **2:** A USAF F-15D pilot sports a Joint Helmet Mounted Cueing System (JHMCS, commonly called the 'J-hamix'). Allied with modern close-in missiles, the helmet-mounted sight has done much to overhaul the rules of BFM manoeuvres. **3:** An RAF Typhoon pilot's helmet showing the symbology system that enables the pilot to see information from their instruments displayed on the visor. The ability of the pilot to see critical data even when they are looking out of the cockpit provides a powerful edge during close-in combat. **4:** An F-22A manoeuvres at high level over Nevada. The Raptor's level of superiority is such that the rest of the world's fighter manufacturers are all battling for their aircraft to be deemed 'second only to the Raptor', and fighter pilots dream of being one of the handful who can better the jet in dissimilar air combat training. **5:** An RAF Typhoon loaded with two Advanced Short-Range Air-to-Air Missiles (ASRAAM) under each wing. This is the fighter's primary weapon for close-in engagements and offers instantaneous cueing using the fighter's radar or pilot's helmet sight. Crown Copyright

exchange tour: *Fighter Combat: Tactics and Manoeuvring* by Robert L. Shaw. Here you will learn about turn rate versus radius, and two-circle and one-circle fights – no self-respecting TOPGUN instructor would be seen without a copy on their shelf.

## Supersonic Top Trumps

Before I discuss the two phases, it's important to recognise that fights are rarely fair or even. Indeed, knowledge of the relative performance characteristics of each aircraft and their weapon systems are vital if you want to exploit your advantages and avoid your weaknesses – more supersonic Top Trumps than chess. Knowing the optimal ranges, speeds, heights and missile fly-outs of your aircraft and those of your adversaries are key factors in deciding your tactics. Also, it is extremely rare for combat to be fought between single protagonists, and multiple aircraft tactics bring in additional factors. But for the sake of simplicity, let's stick to a 1-v-1 scenario.

Theoretically, all engagements start some distance apart, that distance being governed by the detection ranges of each of the protagonists. As soon as an aircraft detects or is vectored on to another potentially hostile aircraft they will begin to try to gain a positional and energy advantage, while trying to establish the identity or intention of the other aircraft. Sometimes the rules of engagement will demand a visual identification, in which case the aircraft will close until the second phase of BFM begins. However, if the rules allow, and the other aircraft has been identified as a 'bandit', then the aim will be to engage in a way that maximises the probability of a kill, while minimising

the chances of being killed. Real combat is all about gaining an advantage, where the simple aim is to achieve the optimal launch of your missile (which is affected by weapon performance, launch speed and altitude), at the same time as increasing your distance/immunity from your opponent.

## The missile edge

Obviously, the advent of active missiles, which do not require the launch aircraft to continue illuminating the target with its onboard radar, has resulted in a 'fire and forget' tactic, where after launch you quickly change your direction to increase your distance from your foe. In modern air combat it is not unusual for ▶



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aircraft to never close to visual combat. So, all those fancy moves you see at airshows really are just for show and the desperate end game of a BVR engagement gone wrong.

But, sometimes, and for a variety of reasons, aircraft do end up closing into visual range, and this is when your BFM skills are tested. Nevertheless, if one aircraft can close unseen by the other, this can become a rather one-sided fight.

The first thing to recognise is that the principles of BFM have diminished recently because of technology. The original 'science' of BFM manoeuvres was all about gaining a positional advantage to achieve a firing solution with your guns, and, more often than not, a gun fixed to the longitudinal axis of your aircraft. Here the use of best turn rates (instantaneous and sustained), preservation of energy and the use of gravity were all about gaining 'nose authority' (pointing at them rather than them pointing at you), because that was where your gun pointed too.



A Raptor pilot jousts with an F-15C from the 65th Aggressor Squadron over the Nellis ranges in Nevada. This unit's deactivation in 2014, plus the decreasing ability to 'bring in' Red Air from combat-coded units, sparked a shortfall in available aggressors at Nellis to support Weapons School and Red Flag activities. Jamie Hunter

However, the advent of close-in missiles (radar and infrared-guided), and off-boresight targeting through helmet-mounted sights, has made these tactics increasingly obsolete, although still widely practised. Placing a crosshair in your visor on your opponent just by turning

your head – rather than your aircraft – and launching a missile that immediately homes in on that aim or source is so much simpler than manoeuvring your nose/gun on to them.

So, the air combat moves that we see in the movies and at airshows are increasingly irrelevant today, although relative performance and energy are still key to optimising the employment of your weapons, while evading those of your enemy. So speed still has its place, but in *Top Gun 2* it might be more appropriate for Maverick to say: "I feel the need, the need for a fused sensor, off-boresight, agile, energy efficient, long-range, high-probability-of-kill, hardened and secure weapon system with exceptional self-defence aids and low signature." His wingman would agree, provided he hadn't been replaced by an AI chip. I am of course making the leaping assumption that even Maverick is needed, but that's another article. **AFM**

**NEXT MONTH: Self-protection systems**



**Above:** A Royal Australian Air Force F/A-18A from No 3 Squadron flies in formation with an F-2 and F-15J from the Japan Air Self-Defense Force during one of the Cope North exercises. Manoeuvres like these offer a valuable opportunity for dissimilar air combat training, honing fighter pilots' skills against unfamiliar opposition. LAC Craig Barrett/Commonwealth of Australia **Below:** F-35Cs from the US Navy's Strike Fighter Squadron (VFA) 101 and F/A-18E/Fs attached to the Naval Aviation Warfighter Development Center (NAWDC) fly over the Fallon Range Training Complex, Nevada. Since July 2015, NAWDC has handled the navy's air combat training and tactics development, including **TOPGUN**. US Navy/LCDR Darin Russell

