Monday, December 3rd 2001 – Britains Younger Engineers Poster Presentation, House of Commons, London, UK

Stealth Aircraft – Manoeuvrability Without Control Surfaces?

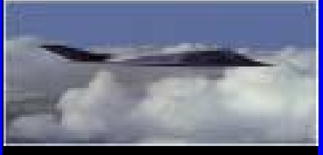
Can improvements be made to the stealth characteristics of future military aircraft?

Introduction

B2 Stealth Bomber

Stealth became very much the watchword of military aircraft design teams across the world during the last century. As air defence systems became increasingly more advanced there was a real need to improve the invisibility to radar of all new combat aircraft. The F-117 Stealth Fighter and the B2 Stealth Bomber have definitely been successes and one only has to look at the mechanically thrust vectored F-22 Raptor to notice the direction in which military aircraft designers are heading.

What is Stealth?

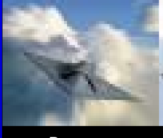


F-117 Nighthawk

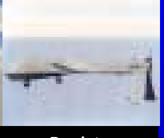
Invisibility and silence. This sounds like a simple explanation but how can aircraft designers make a full size fighter aircraft appear the size of a golf ball on an enemy radar screen? There are many ways:

- Geometric modifications to aircraft shape e.g. diamond wing planform, blending, faceting
- Engine exhaust position e.g. exit over fuselage, cant tailplanes outward
- Reduce engine exhaust temperature e.g. mix hot exhaust gas with colder engine bypass air
- RAM (Radar Absorbent Material)
- Fluidic thrust vectoring

Unmanned Air Vehicles - UAVs



Pegasus



Predator

Remotely piloted UAVs are seen as the future of the aerospace industry. Examples of UAVs include the Northrop/Grumman Pegasus and the USAFs Predator. UAVs missions include:

- Reconnaissance
- Surveillance
- Target acquisition
- Air to air combat and ground attack

UAVs can be employed in high threat areas, minimizing the risk to human life e.g biological or chemical contaminated environments. Invisibility to enemy radar is an obvious requirement.

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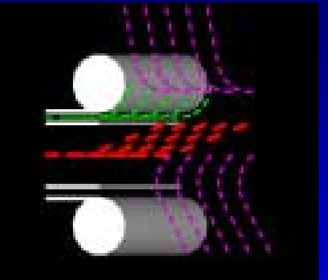
Fluidic Thrust Vectoring Theory



Fluidic Thrust Vectoring Concept

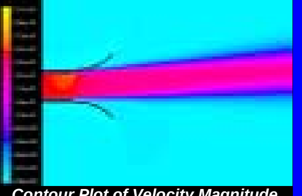
A fluidic thrust vectoring system is seen as a desirable alternative to mechanical control methods, especially for stealth applications. Due to the lack of moving parts, a fluidic system results in a radar cross-section signature (measure of aircraft visibility) much lower than that of a conventional aircraft.

⇒ The high speed secondary air flow lowers the pressure across the curved surface.

⇒ Entrained air is restricted on this side of the jet.

⇒ The primary air flow is vectored and the resultant force can be used to control aircraft flight.

Preliminary Results



Contour Plot of Velocity Magnitude
Secondary Jet Velocity = 26m/s

Smoke Visualisation
Secondary Jet Velocity = 26m/s

The figures above show computational and visual results obtained for the same experimental rig configuration. It can be seen that the computational results are similar to the visual results i.e. the thrust vector angles appear to be of the same order of magnitude for the same secondary air jet velocity.

Future Challenges

- Obtain accurate vectored force measurements
- Find optimum fluidic thrust vectoring rig configuration
- Investigate effect of coflowing airstream on jet vectoring
- Extend work into transonic flight regime

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