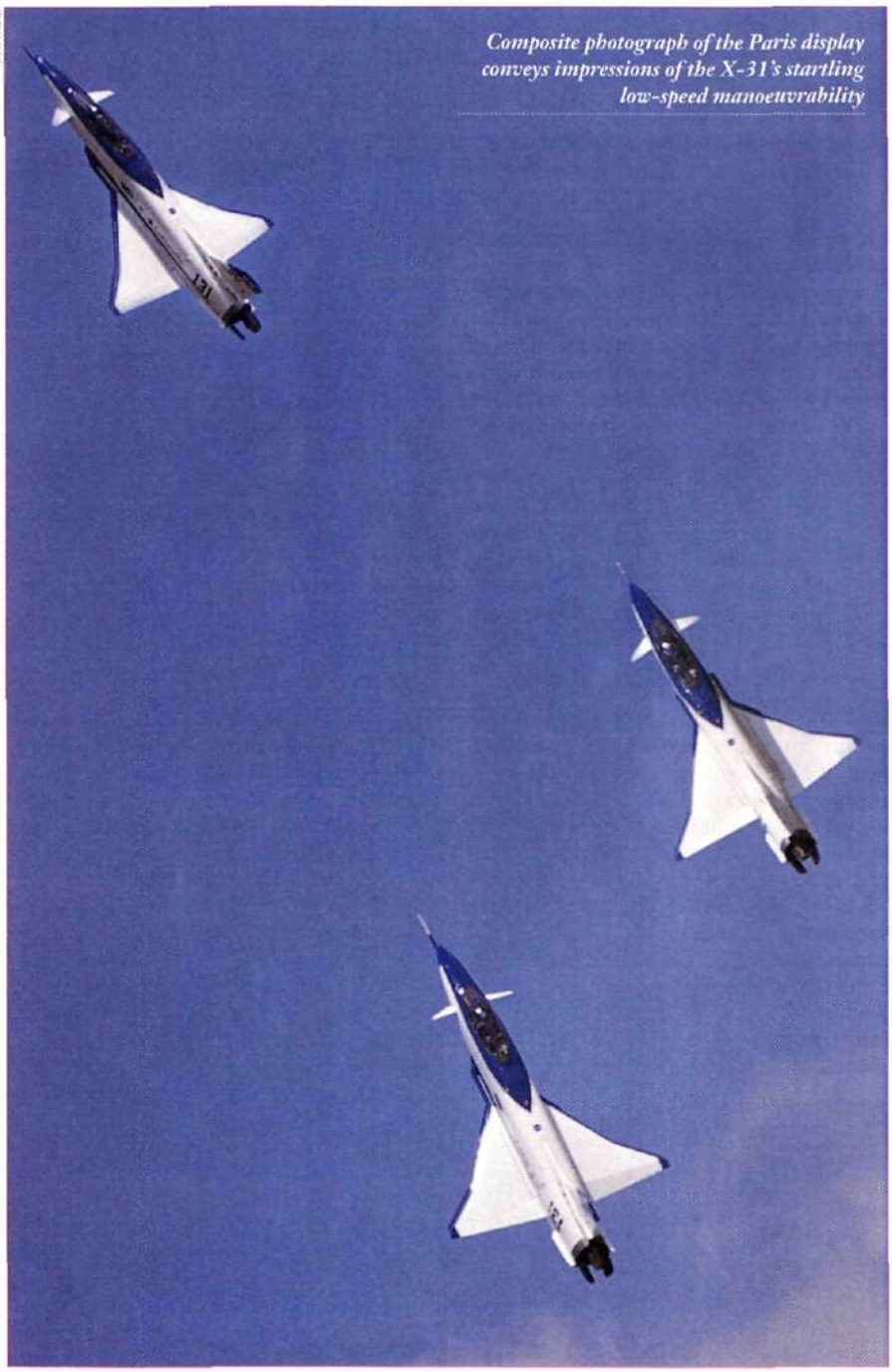

Mike Wilson

Composite photograph of the Paris display conveys impressions of the X-31's startling low-speed manoeuvrability

Turning heads

The X-31 captured the imaginations of those who saw it flown at Paris, but does it have a future?

GRAHAM WARWICK/**PARIS**

A spectacular flying-display performance by the Rockwell/Daimler-Benz Aerospace X-31A Enhanced Fighter Manoeuvrability (EFM) demonstrator has rekindled debate over the combat benefits of thrust vectoring. Few watching the Paris air-show routine could doubt the results of 1994's tactical-utility evaluation — that the X-31 is virtually unbeatable in close-in combat — but sceptics continue to question the value of such slow-speed manoeuvrability when the current fighter-design emphasis is on beyond-visual-range combat.

The manoeuvres demonstrated at Paris were made possible by multi-axis thrust-vectoring, which allowed the X-31 to be flown to post-stall angles of attack exceeding 70°. The same manoeuvres were used by X-31 pilots to defeat a NASA McDonnell Douglas F-18 in 78 out of 94 close-in air-combat engagements during a tactical-utility demonstration, completed in December 1994, which Rockwell maintains "...established that all future close-in fighters will have thrust-vector control".

To demonstrate the wider benefits of multi-axis thrust vectoring, Rockwell is seeking US Navy funds to conduct simulated aircraft-carrier landings with the X-31. An initial series of flights, completed in January, proved that precision approaches could be performed at speeds down to 80-90kt (150-170km/h) using thrust vectoring, Rockwell says.

DROP THE HOOK

Simulations indicate that landing speeds of 65-70kt are achievable using thrust vectoring, obviating the need for an arrestor hook, according to Dr Leslie Lackman, general manager of Rockwell's North American Aircraft division. The flight trials were conducted with the X-31 in its "quasi-tailless" mode, with the digital fight-control system reprogrammed to simulate removal of the fin. In this mode, directional control is provided by the aircraft's thrust-vectoring paddles.

Simulated carrier approaches were flown down to 100ft (30m), and demonstrated acceptable handling qualities, says Lackman. The flight trials were funded by the US Air Force/Navy Joint Advanced Strike Technology (JAST) programme office and included simulated bombing runs to evaluate the utility of thrust vectoring for air-to-ground missions.

Although flight-testing of the X-31 has been completed, US research into thrust vectoring continues. The USAF will soon begin flight tests of a McDonnell Douglas F-15 equipped with axisymmetric thrust-vectoring nozzles under the Advanced Control Technology for Integrated Vehicles (ACTIVE) programme. The F-15 has been equipped with Pratt & Whitney pitch/yaw balanced-beam nozzles (PYBBNs) for flight tests to evaluate the cruise benefits of thrust-vectoring.

The ACTIVE effort is a follow-on to 1994's