
In this 1980 photo, the Highly Maneuverable Aircraft Technology subscale research vehicle makes a research flight. The aircraft helped pave the way for many high-tech, high-performance aircraft, including unmanned air vehicles.

NASA PHOTO

# Turning time ahead

## HiMAT's flight marked the dawn of unmanned highly maneuverable aircraft technology

By Erik Simonsen

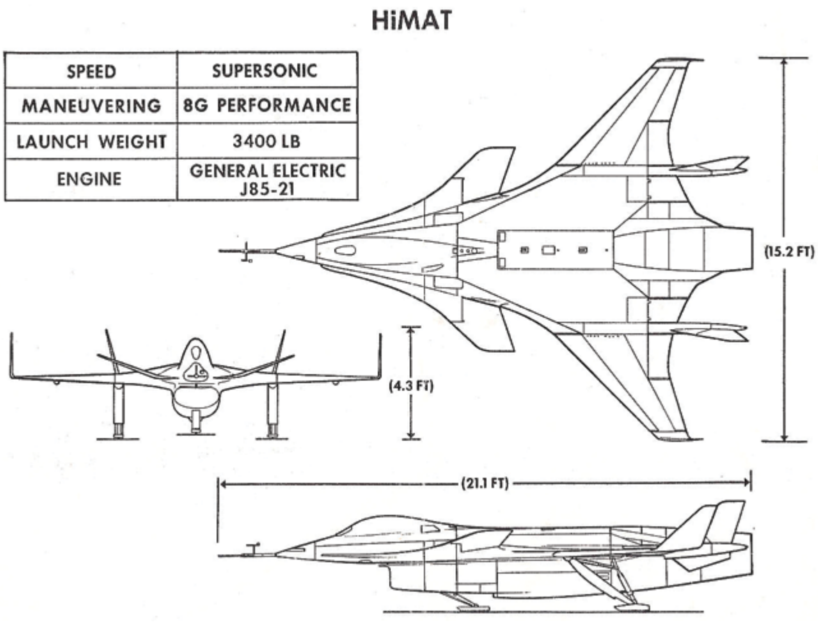
Today, a single pilot-operator can direct several high-performance autonomous unmanned aircraft. In 1975, the Highly Maneuverable Aircraft Technology (HiMAT) program initiated the first steps in this new technology.

That year, Rockwell International took a giant leap into the world of unmanned aircraft. Under HiMAT, Rockwell was awarded a $17 million contract from NASA and the (U.S.) Air Force Flight Dynamics Laboratory for two Remotely Piloted Research Vehicles. Flight vehicles No. 1 and No. 2 were delivered in March and June of 1978. The unmanned futuristic design was a 0.44 scale of a full-size fighter, offering a low-cost and low-risk solution.

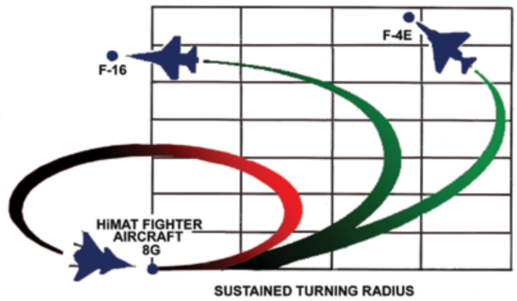
The HiMAT program was initiated to explore high-speed maneuverability and test new lightweight composites, which made up 30 percent of the vehicle's total weight of 3,400 pounds (1,540 kilograms). Mike Robinson, now in international business development with Integrated Defense Systems' Advanced Systems organization, was the HiMAT project engineer. "The core of the HiMAT program was to show the benefits of composites, and in particular aeroelastic tailoring to attain optimal aerodynamic conditions (lift and drag) at several very different design conditions," Robinson said. "On a higher level, it was one of the first really serious unmanned vehicles that presaged much of today's Unmanned Combat Air Vehicle work."

The primary flight objective was to verify HiMAT's sustained turning radius at air-combat altitudes—a turning radius that was half that of the F-16. HiMAT was designed to maintain 8G (eight-times-the-force-of-gravity) turns above 25,000 feet (7,620 meters) at Mach 0.9, and 6G turns at Mach 1.2 at 30,000 feet (9,140 meters). The airframe was constructed to withstand +12G/-6G at subsonic speeds and +10G/-5G while supersonic. Its top-end structural limit was 18Gs.

The design also featured close-coupling of the canard and wing, with "aeroelastic tailoring"—which permits optimum airfoil camber through controlled bending of the wing surface. Les-




ERIK SIMONSEN GRAPHICS




**Above:** **A schematic look at the Highly Maneuverable Aircraft Technology research vehicle, including its dimensions.**

**Top right:** **As depicted in this chart, the Highly Maneuverable Aircraft Technology vehicle had a sustained turning radius less than that of frontline fighters of its era.**

sons from this were later applied to the NASA/Grumman X-29 Forward Swept Wing program from 1984 to 1988, and from 2002 to 2005 on the NASA/Boeing F/A-18 Active Aeroelastic Wing program.

HiMAT's maneuvering performance was further enhanced with an airframe configuration that was inherently unstable and artificially stabilized with digital fly-by-wire. This was one of the key data points that brought Rockwell and German aircraft manufacturer Messerschmitt-Bolkow-Blohm together for what became the X-31A Enhanced Fighter Maneuverability program that explored extreme high-alpha (high-angle-of-attack) flight regimes during the early 1990s. HiMAT's exotic design, with a 22.5-foot length and 15.6-foot wingspan (6.9 meters and 4.8 meters, respectively), was powered by a modified General Electric J-85-21 engine with afterburner, giving the vehicle a top speed of Mach 1.6.

History was made on July 27, 1979, as HiMAT was released from a NASA NB-52B at 45,000 feet (13,700 meters) over the Edwards Air Force Base range in California. The pilot, in a ground-based cockpit, used a throttle, stick and rudder pedals, and received visual cues from a nose-mounted camera on HiMAT. Pilot commands were telemetered to an onboard computer, then fed via the digital fly-by-wire system to the control surfaces. To aid the pilot in the first few flights, HiMAT carried lead ballast to achieve a normal center of gravity and to help familiarize researchers with HiMAT's handling.

The first flight lasted for 22 minutes. The program eventually completed 26 successful test flights in the transonic and supersonic flight regimes. Programs of this type are a stepping stone for further exploration, resulting in a compilation of data and knowledge. HiMAT proved to be a tremendous starting point in the realm of high-speed unmanned flight.

Last month, Boeing Advanced Systems submitted its Unmanned Combat Air System–Demonstrator (UCAS-D) proposal to the U.S. Navy's Naval Air Systems Command. A downselect is slated for July; and in 2013 UCAS-D will demonstrate the feasibility of autonomous aircraft carrier operations. Boeing's X-45N will be offered, with a high level of sophistication in manufacturing techniques and autonomous mission flight time. The Boeing entry is further enhanced by the 64 mishap-free flights of the X-45A demonstrator flight-test program, which concluded in 2005. ■

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**The Highly Maneuverable Aircraft Technology research vehicle is shown attached to a wing pylon on a NASA NB-52B during a 1980 test flight. The HiMAT used sharply swept-back wings and a canard configuration to test possible technology for advanced fighters.**