Rotary spin balance platform configuration in the Langley Research Center full-scale tunnel permits the testing of large tunnel models in 360-deg. spin modes. The system is used primarily in military stall spin programs. While on the platform, numerous aerodynamic parameters affecting a spin can be measured on the test aircraft, here a McDonnell Douglas F-4.

Hampton, Va.—Military aircraft stall-spin research program at National Aeronautics and Space Administration's Langley Research Center is centering on the use of complex avionics and flight control systems now on board advanced combat aircraft to keep them from spinning in spite of pilot actions.

"We are now working on a [spin] departure prevention system, trying to enable the pilot to do whatever he wants to do with the stick [but following] that up with control system logic that will prevent him from entering the spin," said Joseph R. Chambers, head of the Dynamic Stability Branch of Langley's Subsonic/Transonic Aerodynamics Div.

Work at Langley recently was done on the Grumman F-14 and on the control systems of the General Dynamics F-16 and Northrop YF-17 air combat fighters, as examples.

Work with the F-16 and YF-17 was to evaluate basically whether the avionics concept would work and if there are maneuvers that would circumvent such systems, Chambers said.

Tests indicate the avionics systems will work in preventing aircraft spins, but they also indicated that some maneuvers could break the spin prevention logic, Chambers said. Work on the concept is continuing in Langley's differential maneuvering simulator facility.

"In the years to come we will have aircraft much more refined for high angle of attack [flight]," Chambers said.

He said the systems in the F-16 and YF-17 are working well.

Langley's military stall-spin program, funded substantially by the Defense Dept. is carried on at a substantially higher level than the general aviation program. Primary Langley tools for the military research are:

- Spin-tunnel tests for research on the spin itself.
- Free-flight full-scale tunnel tests where aerodynamics at high angles of attack can be evaluated.
- Radio-controlled drop model tests utilizing more complex and larger models than the hobby-size aircraft used in the general aviation program.
- Static and dynamic wind-tunnel tests utilizing such hardware as a 360-deg. spin platform where large models can be continually rotated in the wind tunnel air flow in a spinning condition.
- Theory evolved from computer studies.

Simulator work to evaluate pilot factors.

Langley's military radio-controlled drop-model program will be improved later this year with the addition of computerized ground system that will accept extensive control system feedback from the in-flight model. The system will bring Langley's drop-model capability more in line with that of the Flight Research Center at Edwards AFB, Calif.

Langley's military program has been relatively successful in using the same test vehicles for obtaining both theoretical and experimental results.

"We have defined that it is possible to calculate stalls and the first turn of a spin using theories. We find if we use rotary spin balance data [we can calculate] flat spins obtained at high angles of attack around 90 deg.," Chambers said.

The theoretical problem at the present time is determining the transition point between the "departure" toward the spin and the steady spin, according to Chambers.

Further Langley efforts will be aimed at spanning the gap between the departure and the smooth steady spin itself.

Efforts aimed at designing future combat aircraft that are aerodynamically spin resistant have centered upon the Northrop F-5 and T-38 at Langley.

These aircraft have not had a spin accident in over four million flight hours, Chambers said.

This is in contrast to the McDonnell Douglas F-4. More than 100 U. S. Phantoms have been lost in recent years due to spin-related accidents, according to Chambers.

At first, it was believed that the good T-38/F-5 spin characteristics were a result of the aircraft's wing design. Various wing designs, including a Soviet MiG-21 delta wing configuration, were tried on the T-38/F-5 fuselage in wind tunnel tests to obtain spin data.

The wing theory proved not to be correct, however, and it was finally determined by Langley that it is the nose cross section of the T-38/F-5 that gives it excellent spin characteristics.

Research is continuing at Langley on the T-38/F-5 for future application.

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