LEADING EDGE
GRAHAM WARWICK

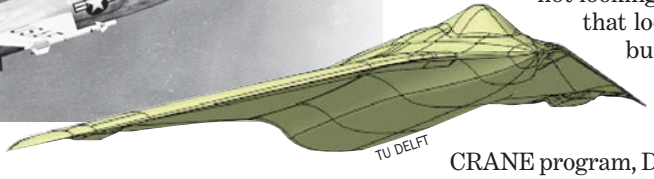
ALL X, NO PLANE IS HOW PROGRAM manager Alexander Walan characterizes DARPA's recent efforts to build and fly experimental aircraft. After a spate of projects being terminated before reaching flight, he hopes to reverse that trend with his program to fly a subsonic X-plane designed around active flow control.

Walan manages the new Control of Revolutionary Aircraft with Novel Effectors (CRANE) program, which aims to fly by mid-2024 a large-scale X-plane

Flow in Control

DARPA wants to see how active flow control could **reshape aircraft**

LOCKHEED MARTIN



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with a configuration enabled by active flow control (AFC). Three contracts for a yearlong conceptual design phase are to be awarded in early July.

AFC involves adding energy into the boundary-layer airflow to maintain, recover or improve vehicle performance. Fluidic or plasma actuators can replace conventional mechanical flight controls and reduce observability, enhance efficiency, increase maneuverability or achieve other benefits.

Previous applications of AFC include boundary layer control using wing blowing to reduce the landing speed of carrier-based aircraft such as the North American RA-5C Vigilante. But such previous uses have involved adding AFC to already-frozen designs to fix problems. For example, flap blowing was added to the Lockheed F-104 during development to make it easier to land.

There also have been flight tests of AFC to reduce wing download on tiltrotors in hover, minimize wake turbulence from targeting pods, stabilize weapon release from a bay at Mach 2, and increase rudder effectiveness to enable a smaller tail. More recently, there have been flights in the U.S. and UK of subscale models using fluidic AFC for flight control of tailless aircraft.

The goal of CRANE is to "bring AFC out of the lab and into large-scale flight," Walan says. "We thought the technology had evolved to the point where a full-scale flight demonstration was feasible. We had a suite of mature technology, proven CFD [computational fluid dynamics] code, wind-tunnel and subscale demonstration . . . so we thought there was enough underlying engineering and science behind it . . . [to] have a flying vehicle within a five-year window."

And actually flying this X-plane is important to DARPA. Despite its rich history of experimental aircraft from the 1970s to the 1990s, Walan says, "it's been since 2007 [the A160 Hummingbird] that DARPA has flown anything it could rightly call an X-plane."

Walan's list excludes several hypersonic demonstrators, the X-47B unmanned combat aircraft and X-60 air-launched and -recovered drone but reflects the termination of DARPA's Ares, LightningStrike and Tern programs without taking planned X-planes to flight. "We felt DARPA had atrophied a bit," he says. "So that's what we are trying to do with CRANE: Get back into the pure X-plane experimental realm."

The focus of CRANE is to demonstrate a clean-sheet aircraft that incorporates AFC as the primary design consideration. DARPA is looking for novel configurations for a manned or unmanned X-plane weighing between 1,000 lb. and 10,000 lb. and capable of maneuvering and flying at high subsonic speed. "We are not looking to do a prototype or something that looks like an operational airplane, but we are looking for high-risk, high-payoff ideas," says Walan.

Rather than specify what DARPA was seeking from the CRANE program, DARPA said: "We want novel planforms and geometries, and then you, industry, can show us what that airplane can do that is different." In the extended, one-year Phase 0 of CRANE, each contractor will design multiple different concepts to explore the trade space for AFC-enabled vehicles.

Another goal of CRANE is to "inject disruption into the design process," Walan says. By giving contractors a year to go from contract award to conceptual design, rather than the usual 3-6 months, they can "really work the tools and process almost as much as the configurations early on" to come up with more novel aircraft.

"We asked folks to start with multiple configurations with different benefits," he says. "Three months into Phase 0, we'll probably downselect from three or four ideas per contractor to one or two. This time next year, we'll start downselecting from multiple contractors and multiple ideas, to one or more that will go forward to a preliminary design review."

In terms of performance metrics for CRANE, "we're looking at improvements in efficiency, maneuverability, takeoff-and-landing performance or weight," Walan says. "The X-plane may be heavier than a relevant airplane. We may have dual control surfaces at first. But what we want to do is push the envelope and quantify the potential benefit for a transition airplane down the road."