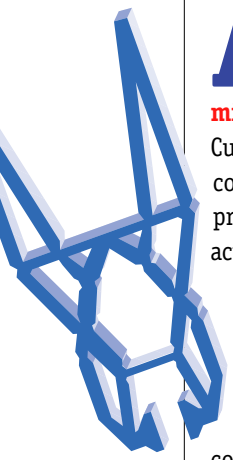
# fy, Improve Aircraft

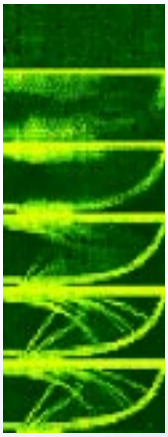
## Jointless, Unibody Constructed Units



A Compliant Mechanism with jointless unibody construction

**Actuators, the basic components which enable the mechanical operation of USAF systems, allow key weapon subsystems such as missile tail fins and aircraft flaps to operate.** Current actuators have many parts with many connecting joints. Using traditional design and production methods produces strong and stiff actuator mechanisms.

However, a new methodology is emerging to design compliant mechanisms — jointless, unibody constructed units. These units are cheaper and easier to manufacture and offer more advantageous performance of how a finite element code starts from a blank design space and, in a series of steps, converges on a design solution for a compliant mechanism. The process, pictured to the right, adapts the mechanism shape based on a set of desired load and displacement conditions that describe specific structural operations. The final design in this simple example can be used to create the jointless, compliant tool shown above left.



The same process can design compliant actuators for a wealth of USAF smart structure applications, such as mission adaptive wings and vibration suppression systems. The code and step process was created by AFOSR-funded researchers at the University of Michigan.

Illustration: Catalyst Creative Partnership

## Technology Transition Spotlight

**In each issue, *Research Highlights* will feature a recent technology transition that benefits Air Force operations.**

**Customer** ..... Electronics Systems Center (ESC) at Hanscom AFB has adopted the new "multi-frame most probable hypothesis" (MFMPH) tracking system approach to multi-sensor and multi-target tracking for an AWACS first-step upgrade for broad area surveillance. (The system, developed for ESC, won the "Best of Breed" national competition held by Mitre Corporation to determine the nation's best tracking system for AWACS.) The new tracking system will be deployed on five AWACS planes by mid-1999. Lockheed Martin of Owego, N.Y. is in charge of the transition and further development. The Boeing Company is the prime contractor.

**Benefit** ..... The new tracking system significantly improves AWACS surveillance capability by increasing the tracking capacity, fidelity, maneuver detection, tracking accuracy (kinematic information), and sensor fusion while decreasing computational throughput requirements compared to existing tracking systems.

**Basic Research** ... The new approach to multi-sensor and multi-target tracking is based on solving the central data association problem for multi-frame processing, which is formulated as an NP-hard combinatorial optimization problem called a multi-dimensional assignment problem, to the noise level in the problem. The new tracking system integrates estimation (filtering) and scoring (likelihood ratios) with data structures designed specifically for this MFMPH tracking system. This work is also the subject of two U.S. patents and one pending patent.

**Performer** ..... A research team led by Dr. Aubrey B. Poore of Colorado State University and Thomas N. Barker of IBM-Federal Systems (now Lockheed Martin) developed the initial approach. Dr. Poore's team continues the basic research program with transitions focusing on other Air Force Programs. AFOSR program manager:

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