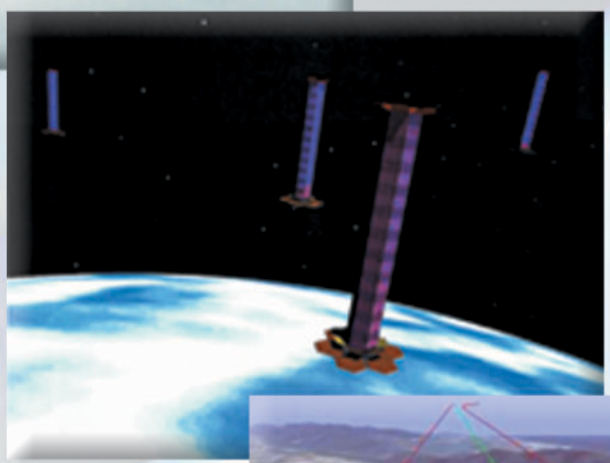
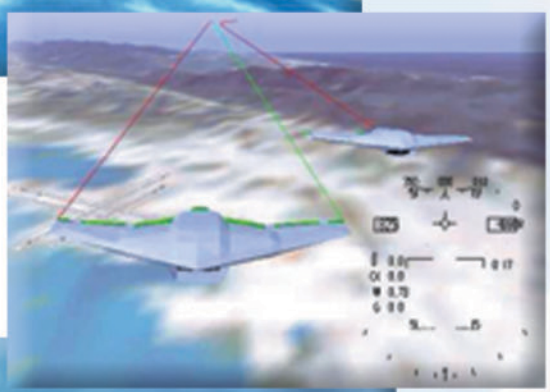
CONTROL SCIENCE CENTER OF EXCELLENCE



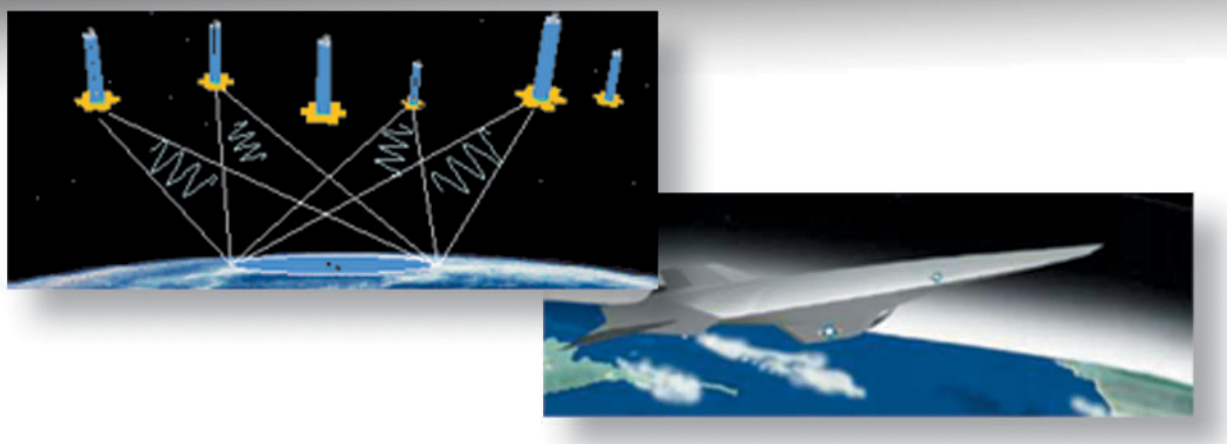


Control Science for the Air and Space Force of the 21st Century

Air Vehicles Directorate
Air Force Research Laboratory

INTRODUCTION TO THE

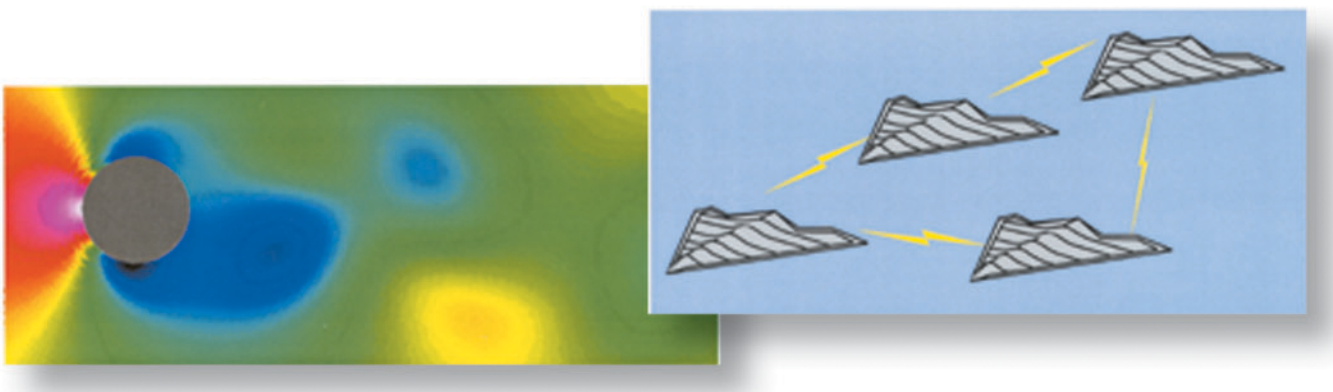
Control Science Center of Excellence



Wright-Patterson Air Force Base has been the center of aerospace technology development since the Wright brothers first developed airplanes at their nearby Dayton, Ohio bicycle shop and test flew their designs at Huffman Prairie, now a part of the base. The Air Force Research Laboratory, headquartered at Wright-Patterson AFB, maintains this tradition as one of the largest complexes in the world dedicated to excellence in the aerospace sciences. The Control Science Center of Excellence, a part of AFRL's Air Vehicles Directorate, is the Laboratory's leader in the development of the control technologies necessary to maintain the United States Air Force as the preeminent aerospace power.

The Control Science Center of Excellence is staffed by a highly-professional cadre of award-winning civil service scientists and Air Force officers who form the technical core of the Center's competencies. This core is augmented by numerous visiting scientists who provide a fresh perspective to the Center's tasks. This partnership ensures that the Center maintains its technical preeminence.

The Center's research tasks cover a wide spectrum of aerospace science applications. From air vehicles to trans-atmospheric vehicles and satellites, the Control Science Center of Excellence is tasked with developing and transitioning advanced control technologies for all aspects of the 21st century air and space force.



AIR FORCE RESEARCH LABORATORY

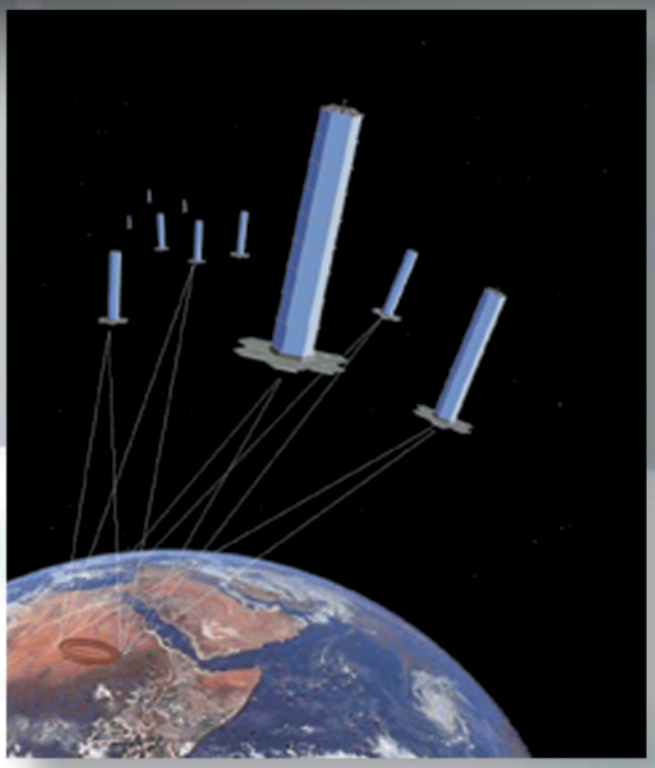
Current Research in Control Science

UAV Control

Future UAVs will be required to operate autonomously yet cooperatively. Hierarchical decentralized controllers are being developed that combine guidance, real-time planning and multi-vehicle task coordination. These controllers will enable UAVs to coordinate threat avoidance, target search, classification, and attack, and battle damage assessment tasks. Also, dynamically-coupled formation controllers will allow drag-reducing flight formations and will enable in-flight refueling for UAVs. Lastly, intelligent controllers will be able to learn from its experiences and revise the UAV's trajectories based on those lessons.

Trans-Atmospheric Vehicle Control

Successful demonstrations of adaptive and reconfigurable control systems on fighter aircraft has prompted the transition of this technology to the more hostile and uncertain hypersonic flight regime. Unlike manually controlled aircraft, hypersonic Reusable Launch Vehicles and Future-Strike aircraft will rely on autonomous guidance systems for trajectory control. Current research focuses on the development of adaptive guidance systems that modify trajectory commands on-line. These systems are designed to compensate for the inner-loop control system's inability to recover the nominal closed-loop response in the presence of severe control effector failures or damage.

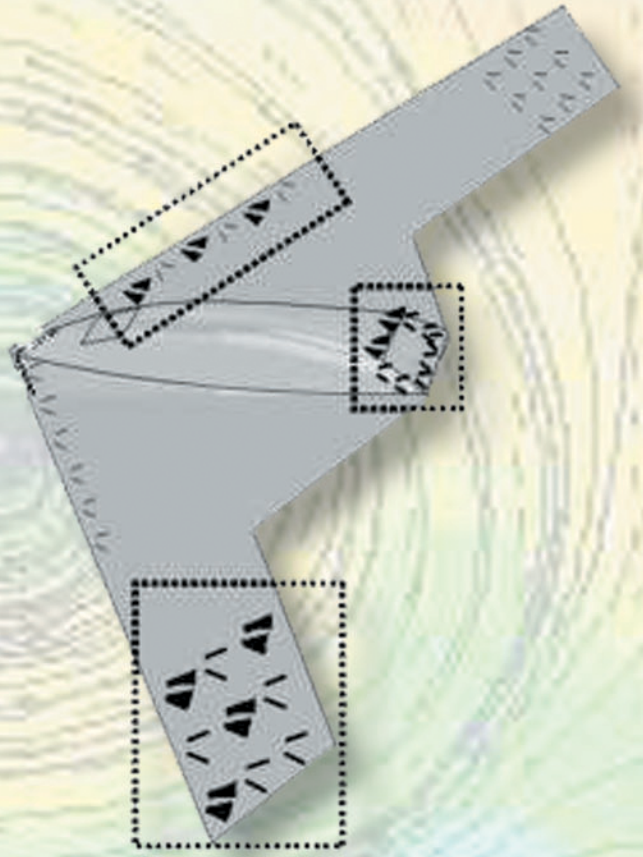


Microsatellite Control

A new application of feedback control involves controlling and coordinating formations of microsatellites for distributed aperture sensing missions. Control techniques must maintain the relative geometry of a formation in the presence of orbital perturbations and within the limits of the on-board propulsion system, while a coordinating strategy must provide for reconfiguration of the formation to allow satellites to be added to the formation and missions to be changed. This technology affords greater flexibility and affordability for space-based assets when compared to the current state of the art.

Reactive Flow Control

Recent flow control efforts have demonstrated the ability of small-scale devices to effect large-scale changes through natural amplification. Further, the ability to reactively control flow fields by sensing their state then employing these mechanisms is within reach. The Center's reactive flow control effort is advancing the state of the art by integrating these techniques with closed-loop control theory. Applications of this technology include flow separation control, drag reduction, and ultimately the ability to use these small devices in place of traditional aircraft control surfaces.



Expertise of the Center

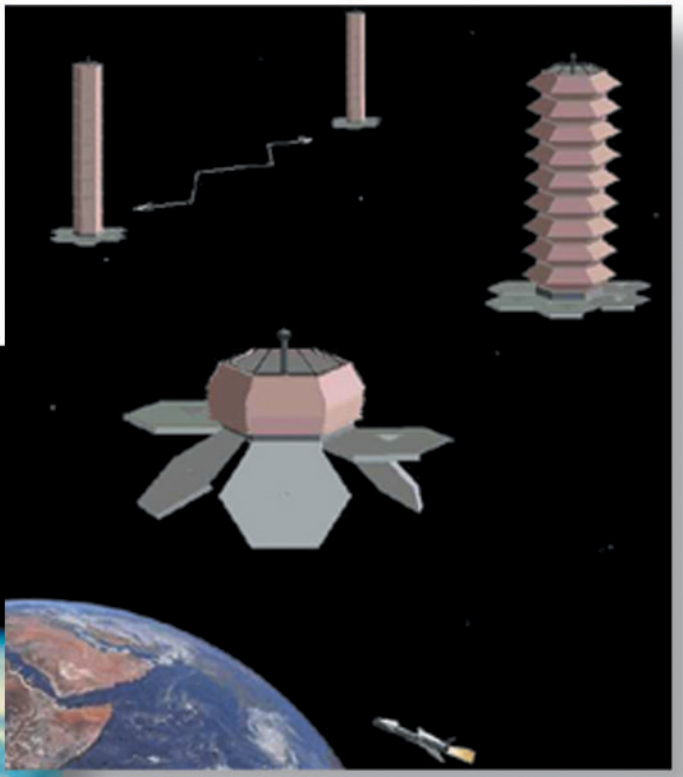
The Control Science Center of Excellence has historically focused on cutting-edge control science issues of importance to the U. S. Air Force and the aerospace industry. The Center's technical excellence has been recognized through AFOSR Star Team designation and the Air Force Chief of Staff Award. Also, many of the Center's members have been individually recognized for technical excellence through society fellow designation, technical committee and advisory board membership, and numerous awards from throughout the defense and aerospace community.

Technology Transition

The Center is committed to not only leading the development of control technology but also transitioning its products to the aerospace community. This task is accomplished both through technical publications—including 50 archival journal articles and over 100 conference papers during 1998-2000—and through partnerships with academia and industry.

The Center's most recent success in technology transition is the RESTORE program. The control system demonstrated under the RESTORE program has become the baseline control system for the DARPA/USAF/Boeing UCAV technology demonstration project. The RESTORE control system is completely adaptive and reconfigures the control system to maintain performance for parameter variations, failures, and damage. RESTORE is just the latest example of the Center's commitment to transition its technologies to the benefit of the aerospace industry.

Control Science Center of Excellence



Our Commitment

We are committed to the aggressive development of advanced control technology and its transition to both industry and the warfighter to improve total weapons system lethality, survivability, agility, performance and affordability. Our ability to develop and apply control technologies to a wide spectrum of aerospace applications is critical to ensuring that the United States Air Force remains the preeminent aerospace power.

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