SBIR 06.2 PHASE I - AWARD DETAILS	
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PROPOSAL NUMBER	A062-006-0333
TITLE	Low Reynolds Number, High-Lift Airfoil Design for VTOL UAVs
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KEYWORDS	supervisory control, UAVs, delegation, human-automation interaction
ABSTRACT	A complementary, theoretical and experimental effort to design and verify high-lift, low pitching-moment airfoils for VTOL UAVs is proposed. In Phase I, an accurate, rapid, test capability will be validated over the range of Reynolds numbers from 50,000 to 500,000 by investigating the E 387 airfoil, the low Reynolds number calibration standard, in The Pennsylvania State University Low-Speed, Low-Turbulence Wind Tunnel. The E 387 airfoil exhibits almost all the pertinent phenomena over the Reynolds number range of interest, making it a sensitive test case, particularly with respect to turbulence effects, a key issue for VTOL UAVs. The section characteristics measured with transition free and fixed will be compared with results from other low-turbulence wind tunnels and with predictions from the Eppler and XFOIL/MSES codes. The initial specifications for the airfoils to be designed in Phase II will be defined in cooperation with U.S. Army personnel. In Phase II, the experimental results will be used to refine existing airfoil design and analysis methods and for CFD code validation. A set of airfoils will be tailored to VTOL UAV applications and experimentally verified. The slotted, natural-laminar-flow (SNLF) airfoil concept will be adapted to VTOL UAV applications.

BENEFITS	The performance and handling of VTOL UAVs is driven by airfoil aerodynamics. The majority of UAV manufacturers are forced to use existing airfoils because of budgetary constraints. The situation is exacerbated by the measured characteristics of most of these airfoils, which were obtained in unsatisfactory wind tunnels, using debatable test techniques, often at inappropriate Reynolds numbers. The tailoring of airfoils to VTOL UAV applications will improve the endurance, range, payload, and handling of these vehicles. The slotted, natural-laminar-flow (SNLF) airfoil concept, in particular, holds promise for dramatic performance increases. Potential commercial applications of the resulting airfoils and the airfoil design methodology include small wind turbines (< 75 kW), cooling-tower fans, aircraft propellers, model aircraft, and fixed-wing UAVs. Airfoils, low Reynolds number, high lift, vertical takeoff and landing, uninhabited aerial vehicles, wind tunnel A06-007 Smart Information Flow Technologies, d/b/a SIFT Delegation in LoA3 Space We propose a framework and testbed for structured examination of possible delegation approaches, using a three-dimensional model of delegation characteristics: authority, abstraction, and aggregation. The testbed uses Playbook(R), a sophisticated tool for commanding automation in multiple regions of this delegation space. The ability to exert experimental control over various possible delegation approaches to obtain direct evidence of the costs and benefits of an approach will be a vast improvement over ad-hoc design techniques in use today. We propose a range of metrics to assess the effects of a given delegation approach on common human-automation system issues, such as over- and under-reliance, out-of-the-loop performance, loss of situation awareness and inappropriate workload. This project will produce a theoretical framework and testbed implementation that allows a structured examination of appropriate levels of automation for a given scenario, environment and operator. Beyond the utility as a experimental testbed, the tools underlying the testbed will be applied as configuration tools to dynamically control the available automation in complex environments (UVs, intelligent agents, etc.).