REQUEST FOR PROPOSALS

EXTENDED CAPABILITY AUTONOMOUS FLIGHT VEHICLE

The objective of this project will be to gain insight into the challenges and satisfaction involved in the design of a complex, aerospace system. Particular emphasis will be placed on the interaction between system performance, product development time, integration of new technology and cost. This project will include numerous phases of the design process and will expose you to many of the conflicting requirements encountered in a system design. You will experience the challenges of working as part of a design/build team, and develop an appreciation for conflicting requirements and limited resources.

The primary purpose of this project is to provide insight into the design process and to help you identify those aspects of the design process which most significantly influence the integration of new technology in the design and fabrication of the product. This project will also allow for the opportunity to validate the results of your engineering design efforts through the fabrication and testing of a technology demonstrator.

OPPORTUNITY

Flight vehicles have evolved into complex systems with demanding and conflicting operating requirements. While the earliest aircraft relied solely on the "human" pilot to monitor important flight data (attitude, airspeed, altitude, etc.) and then act as controller; future flight vehicle systems will rely on inanimate sensors and computer based control. Even in today's aircraft the human "operators" often just monitor the operation for certain phases of the flight and they assume a small role in the actual control of the system. The use of fully autonomous control for unmanned airborne vehicles (UAV's) is now a reality and these developments will continue as improved, low-cost sensors and computers are developed.

This project will represent a continuing attempt on the part of AE441, Inc. to design and fabricate an autonomous flight vehicle. The baseline mission is to duplicate the first flight of Orville Wright in a heavier-than-air craft but do so with a fully autonomous system. The extended mission is a more complex and fully autonomous flight using an on-board GPS system. This project will involve the concept definition, engineering design study and prototype validation of this autonomous flight vehicle. This vehicle must be light-weight, robust and very low-cost. It will be used to develop and demonstrate technologies for a variety of future aircraft missions. This aircraft must be designed to use relatively inexpensive and readily available technology and be able to taxi, take-off and land in a completely automated fashion.

PROJECT REQUIREMENTS

1. Develop a design for an autonomous UAV system and document this design in the form of a detailed design proposal. The greatest measure of merit will be associated with meeting all project scheduling and cost goals and demonstrating a robust and feasible design. System modeling, performance predictions and simulation of the system and its operation are critical components of the design proposal. The proposal should detail all of the avionics hardware and operation requirements for both the baseline and extended missions. The proposal should not only detail the design of the vehicle but must identify the most critical technical, operation and economic factors associated with the design. The results of this design effort must be presented in a Critical Design Review, to special invited guests, and a Summary Presentation open to the public.

2. Fabricate a technology demonstrator for the system described by the proposal. The aircraft must be capable of demonstrating the baseline autonomous mission for the vehicle and verifying the durability of the proposed design. The results of this phase of the effort must be included in the Design Proposal and presented at the Summary Presentation.

3. Develop a validation test plan and be prepared to demonstrate the operation of their vehicle. Flight tests will be performed on a "to be determined date" at a "to be determined" location and test planning will be the responsibility of the design team.

4. Establish a procedure for collecting and reporting engineering time and cost accounting records for the entire project.

SPECIAL CONSIDERATIONS AND SYSTEM PERFORMANCE REQUIREMENTS:

1. For the baseline mission the aircraft must be able to taxi, take-off, climb to an altitude of at least 5 ft. then land following a straight line path in a completely autonomous fashion. The flight portion of the mission should be greater than 120 ft ,the same as Orville. For the extended mission the aircraft must be able to take-off, climb to an altitude of 400 ft. and fly at a predetermined heading a 2 mile outbound leg and then return to the launch point.
2. The aircraft must be powered by an electric motor driven propulsion system. The motor/s must be selected from a special "family" of motors. It must be able to perform 10 successive baseline "missions" on a single battery charge.
3. The prototype should be able to remain flightworthy after being "dropped" on its landing gear on a hard surface from a height of 3 ft.
4. All equipment (computers and sensors) must be installed in a manner so they will not be damaged in a 60 ft/sec uncontrolled encounter with a hard surface at any attitude.
5. All subsystems used for the operation of the aircraft (propulsion system and avionics) must installed in a fashion that it can be completely removed and then replaced in 20 minutes by two people using only "normal" hand tools.
6. The aircraft must be able to operate from damp, irregular grass surfaces with grass at least 3" deep and in the presence of winds up to 10 mph.

SPECIAL CONSIDERATIONS FOR THE TECHNOLOGY DEMONSTRATOR

The technology demonstrator should satisfy the following:

1. The total cost of the system may not exceed $200, excluding motor, batteries, avionics provided by AE441 Inc. and the back-up RC control system. Primary airframe components must be fabricated using available CAD/CAM equipment.

2. A backup remote control system must be integrated into the aircraft but cannot interfere with its autonomous operation. The back-up remote control system must be selected from a list of available resources and will not enter into the cost of the airframe.

3. The design/build team will be provided access to a number of single board computers, sensors, actuators. These include an ultrasonic ranging sonar, two(2) rate gyros, two(2) types of electronic compasses, a single solid-state pitch/roll/heading sensor. Any additional electronic components must be purchased under the $200. limit.

The technology demonstrator will not be required to perform the extended mission. It will not carry the actual on-board GPS system but must carry a "dummy" system to simulate the volume and weight requirements for the GPS and associated support equipment.