Statement of Work for a Research Flight Control Computer

1 Introduction

The Aeroflightdynamics Directorate (AFDD), an organization within the U.S. Army Aviation & Missile Research, Development & Engineering Center (AMRDEC), is chartered with advancing knowledge and innovative technology in rotorcraft aeromechanics, flight controls, handling qualities, and human-system integration.

In 2003 AFDD and Sikorsky Aircraft Corporation conducted a flight research program under the aegis of the National Rotorcraft Technology Center (NRTC) that proved the effectiveness of modernized control laws (MCLAWS) to provide improved handling qualities for operations in degraded visual environments (DVE) by use of an attitude-response-type control law. This research was conducted on an EH-60L BLACK HAWK and made use of an in-house-developed system called partial authority flight control augmentation (PAFCA) that had at its kernel a VME-based research flight control computer (RFCC) driving the EH-60L's high-bandwidth stability augmentation system (SAS) actuators and low-bandwidth trim servos.

AFDD is embarking on a new program to enhance the original attitude axes MCLAWS with vertical axis control laws. This improved system will be used to improve military helicopter performance specifications for handling qualities requirements such as those codified in the aeronautical design standard ADS-33E-PRF.

In addition, the original RFCC, based on the VMEbus form factor, will be replaced with a new computer that will be based on the CompactPCI (cPCI) form factor.

2 Scope

This statement of work (SOW) applies to the new Research Flight Control Computer (RFCC).

3 Requirements

3.1 Computer Characteristics

The computer shall have intelligent I/O capability to maximize data throughput to and from the corresponding intelligent I/O devices.

3.1.1 CPU

PowerPC architecture capable of 1 GFLOP minimum. The PowerPC CPU shall be supported by the VxWorks 6.x operating system.

3.1.2 Memory
One (1) GB volatile (e.g., SDRAM) minimum.

Two hundred fifty-six (256) MB non-volatile (e.g., FLASH) minimum.

3.1.3 Disk Storage
Thirty-two (32) GB of solid-state disk storage minimum for data archiving.

3.1.4 Operating System
Wind River VxWorks 6.x.

3.1.5 Application Software
The application will consist of about 10,000+ lines of C source code.

The application C source code will be built using the MATLAB/Simulink Coder that converts Simulink block diagrams (models) to C source code.

The minor frame rate for the application software shall be 400 Hz minimum.

The major frame rate for the application shall be a one-fourth (1/4) fraction of the minor frame rate, 100 Hz minimum.

3.2 Environmental

3.2.1 Form Factor
The form factor shall be 3U CompactPCI (cPCI). The first phase of the project shall use an industrial-grade, 3U, 19-inch rackmount chassis to host the cPCI single board computer and auxiliary cPCI modules. At some point in the future, not yet known exactly, the cPCI modules will be migrated to a completely enclosed, military-grade, ATR-type chassis.

3.2.2 Power
Power to the RFCC chassis can be either 28 VDC or 115 VAC 60 Hz. For the 19-inch rackmount chassis, 115 VAC 60 Hz power is preferred.

3.2.3 Temperature
The temperature range shall be “Extended,” or “Military” -40 deg C to +85 deg C, as a minimum.

3.2.4 Conformal Coating
In order to protect against moisture, dust, and chemicals, the computer card assemblies shall be conformal coated with an appropriate material.

3.3 Signal Interfaces
The various signal interface types given below shall be capable of intelligent I/O handling with the CPU.

3.3.1 Analog Input
Twenty-four (24) channels of analog input.

Range [-10, 10] volts.

Resolution, 12-bits minimum, 16-bits preferred.

Sampling rate, 100 Hz per channel, minimum.

Filtering, 25 Hz single-pole, low-pass, anti-aliasing filter is desirable.

3.3.2 Analog Output

Sixteen (16) channels of analog output.

Range [-10, 10] volts.

Resolution, 16-bits.

Refresh rate, 100 Hz per channel, minimum.

The analog output will be used to command high-bandwidth, small-authority, stability augmentation system (SAS) actuators and low-bandwidth, large-authority, trim servos, and so the outputs could be classified as complex wave forms. A current driver will turn the commands into 4 - 20 mA current that actually drives the actuator electro-hydraulic valves (EHVs).

3.3.3 Discrete Input

Sixteen (16) channels of discrete input.

Since this is a military helicopter application, a mix of 28Vdc/open, open/ground, and 5V TTL would be desirable.

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3.3.5 Muxbus I/O

Two (2) channels of dual-redundant MIL-STD-1553B muxbus with each channel capable of acting as bus controller (BC), remote terminal (RT), or bus monitor (BM).

3.3.6 Serial I/O

Four (4) channels of RS-232.

Two (2) channels of RS-422.

Two (2) channels of USB 2.0.

3.3.7 Ethernet

Two (2) channels of 1000BASE-T (gigabit) Ethernet.