

**SBIR Topic Number:**  
AF04-189

**SBIR Title:**  
Propulsion Health  
Management

**Contract Number:**  
FA8650-05-C-2609

**SBIR Company Name:**  
Intelligent Automation  
Corporation, Poway, CA

**Technical Project Office:**  
AFRL Propulsion  
Directorate,  
Wright-Patterson AFB, OH

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



**Left: C-17 Globemaster III Aircraft. Right: Engine Health Management System.**

## On-Board Engine Health Management Capability

- The Air Force needs a wide variety of technologies for aircraft propulsion system engine health management (EHM)
- Intelligent Automation Corporation (IAC) developed a generic hardware and software system to support the creation and fielding of low cost, integrated EHM/control systems
- A prototype EHM system was configured for the C-17's F117 engine and a ground run demonstration was performed in August 2008
- The generic nature of the EHM system also allows for application to monitoring of aircraft subsystems and for commercial application to land-based gas and wind turbine components

09-0082

**A**

DISTRIBUTION A:  
Approved for public  
release; distribution  
unlimited.

## Air Force Requirement

The Air Force needs a wide variety of technologies for aircraft propulsion system engine health management (EHM), which is the basic monitoring of sensed parameters, like pressure, temperature, and speed, and the provision of this data for further analysis. Specifically, there is a requirement for an on-board engine vibration monitoring system (EVMS) capability for the F117 engine used on the Air Force's C-17 aircraft.

Unfortunately, many promising new sensor technologies and new algorithms cannot easily be deployed for on-wing demonstration, particularly for unmanned aerial vehicle (UAV) health monitoring and control applications.

## SBIR Technology

Under this SBIR project, Intelligent Automation Corporation (IAC) developed a generic hardware and software system to support the creation and fielding of low cost, integrated EHM/control systems. The system is based on a Xilinx Virtex-IV Pro™ field-programmable gate array (FPGA) and the VxWorks™ real-time operating system. It includes three general purpose central processing units (CPUs).

The MathWorks Simulink™ is used for algorithm development and validation of the integrated system operation. The prototype system includes 48 channels for input accelerometer data with a demonstrated sample rate of up to 196 kHz (8 channels digitized simultaneously), 8 tachometer channels, 16 analog inputs, USB, RS 232/485, ARINC 429, MIL-STD-1553, and Firewire busses. With super computer processing capabilities, the system can handle a wide range of on-board health monitoring and control possibilities.

Additional funds added in Phase II were used to configure the system as a prototype EHM system for the C-17/F117 engine. The C-17 EHM system was successfully integrated with the Air Force's T-1 C-17, and a ground run demonstration was performed in August 2008.

The on-board system was configured to perform overall engine vibration monitoring, tower and gearbox health monitoring, as well as automated engine balancing. Data from two ARINC-429 buses, which include inputs and outputs of the engine control, were collected. The ground station included summary displays of the vibration data and computed condition indicators (CIs) as well as engine gas path performance/health monitoring. The system includes a wireless capability for download of data while on-wing.

Development also included extended range qualification testing to ensure meeting electromagnetic, temperature and vibration requirements for mounting of the system on the C-17 engine fan casing.

## Potential Air Force Application

The system being developed is suitable for performing the EHM function for a wide range of military and commercial aircraft applications including diagnostic systems for UAVs and engine monitoring on turbine engine aircraft and helicopters.

The generic nature of the system also allows for application to monitoring of aircraft subsystems and for commercial application to land-based gas and wind turbine components. The system will be ideal for third parties to integrate new technologies and sensors and to implement advanced algorithms for on-wing demonstration.

## Company Impact

With the development of the product on this SBIR project and with its history of past products and services, IAC was acquired by Honeywell in August 2008.

IAC is an information technology company focused on developing advanced diagnostic and prognostic solutions for high value mechanical equipment and life science applications.

## Additional Information

Industry Contact:  
Dr. Thomas Brotherton  
Intelligent Automation Corporation  
13029 Danielson Street, Suite 200  
Poway, CA 92064  
Telephone: (858) 679-4140 x112  
E-mail: tom.brotherton@honeywell.com

Government Contact:  
Dr. Al Behbahani  
Air Force Research Laboratory  
Wright-Patterson AFB, OH 45433-7226  
Telephone: (937) 255-5637  
E-mail: alireza.behbahani@wpafb.af.mil



# SBIR/STTR

Air Force SBIR Program  
AFRL/XP  
1864 4th Street  
Wright-Patterson AFB OH 45433

AF SBIR/STTR Program Manager: Augustine Vu  
Website: [www.sbirsttrmall.com](http://www.sbirsttrmall.com)  
Comm: (800) 222-0336  
Fax: (937) 255-2219  
e-mail: [afrl.xppn.dl.sbir.hq@wpafb.af.mil](mailto:afrl.xppn.dl.sbir.hq@wpafb.af.mil)

