Physical and Virtual Intelligent Sensors for Integrated Health Management Systems

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Abstract - This paper describes the development of intelligent sensors as part of an integrated systems approach. The integrated systems approach treats the sensor as a complete system with its own sensing hardware (the traditional sensor), A/D converter, processing and storage capabilities, software drivers, self-assessment algorithms and communication protocols. The immediate application is the monitoring of rocket test stands, but the technology should be generally applicable to the Integrated Systems Health Monitoring (ISHM) vision. This paper outlines progress made in the development of intelligent sensors by describing the work done to date on Physical Intelligent Sensors (PIS) and Virtual Intelligent Sensors (VIS). The PIS as discussed here consists of a thermocouple used to read temperature in an analog form which is then converted into digital values. A microprocessor collects the sensor readings and runs numerous embedded event detection routines on the digital data. If any event, i.e. spike, drift, noise, is detected, it is reported, stored and sent to a remote system through an Ethernet connection. Hence the output of the PIS is data coupled with a confidence factor in the reliability of the data. The VIS discussed here is a virtual implantation of the PIS in C++. The VIS is designed to mirror the operations of the PIS; however, the VIS works on a computer at which digital data is provided as the input and is thus portable to any sensor system. This work lays the foundation for the next generation of smart devices that have embedded intelligence for distributed decision making capabilities.

IDEX TERMS: Intelligent sensors, ISHM, anomaly detection, data correction.