Miniature Intelligent Sensor Module

This unit performs signal-conditioning, data-processing, and health-monitoring functions.

Stennis Space Center, Mississippi

An electronic unit denoted the Miniature Intelligent Sensor Module performs sensor-signal-conditioning functions and local processing of sensor data. The unit includes four channels of analog input/output circuitry, a processor, volatile and nonvolatile memory, and two Ethernet communication ports, all housed in a weathertight enclosure. The unit accepts AC or DC power. The analog inputs provide programmable gain, offset, and filtering as well as shunt calibration and auto-zeroing. Analog outputs include sine, square, and triangular waves having programmable frequencies and amplitudes, as well as programmable amplitude DC.

One innovative aspect of the design of this unit is the integration of a relatively powerful processor and large amount of memory along with the sensor-signal-conditioning circuitry so that sophisticated computer programs can be used to acquire and analyze sensor data and estimate and track the "health" of the overall sensor-data-acquisition system of which the unit is a part. The unit includes calibration, zeroing, and signal-feedback circuitry to facilitate health monitoring. The processor is also integrated with programmable logic circuitry in such a manner as to simplify and enhance acquisition of data and generation of analog outputs.

A notable unique feature of the unit is a cold-junction compensation circuit in the back shell of a sensor connector. This circuit makes it possible to use K-type thermocouples without compromising a housing seal.

Replicas of this unit may prove useful in industrial and manufacturing settings — especially in such large outdoor facilities as refineries. Two features can be expected to simplify installation: the weathertight housings should make it possible to mount the units near sensors, and the Ethernet communication capability of the units should facilitate establishment of communication connections for the units.

This work was done by Russell S. Beech of NVE Corp. for Stennis Space Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to:

NVE Corporation
11409 Valley View Road
Eden Prairie, MN 55344-3617
(952) 996-1602
E-mail: beech@nve.com

Refer to SSC-00246, volume and number of this NASA Tech Briefs *issue, and the page number.*

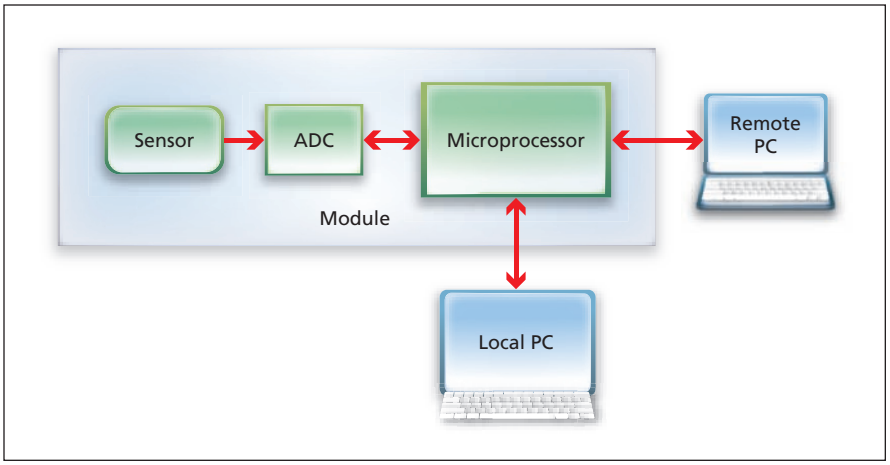
"Smart" Sensor Module

This is a prototype building block of advanced engineering-health-monitoring systems.

Stennis Space Center, Mississippi

An assembly that contains a sensor, sensor-signal-conditioning circuitry, a sensor-readout analog-to-digital converter (ADC), data-storage circuitry, and a microprocessor that runs special-purpose software and communicates with one or more external computer(s) has been developed as a prototype of "smart" sensor modules for monitoring the integrity and functionality (the "health") of engineering systems. Although these modules are now being designed specifically for use on rocket-engine test stands, it is anticipated that they could also readily be designed to be incorporated into health-monitoring subsystems of such diverse engineering systems as spacecraft, aircraft, land vehicles, bridges, buildings, power plants, oilrigs, and defense installations.

The figure is a simplified block diagram of the "smart" sensor module. The analog sensor readout signal is processed by the ADC, the digital output of which is fed to the microprocessor. By means of a standard RS-232 cable, the microprocessor is connected to a local personal computer (PC), from which software is downloaded into a random-access memory in the microprocessor. The local PC is also used to debug the



The **"Smart" Sensor Module** is programmed by use of the local PC and thereafter operated by the remote PC. In addition to preprocessed sensory data, the module generates an indication of the reliability of the data (and, hence, of the health of the sensor).