Sensor Development

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Requirements

- Some sensors are too big and heavy for deployment in the Orbiter.
  - Mass Spectrometer for detection of gaseous leaks
- Each Orbiter has over 200 miles of wiring. Adding additional sensors and instruments is costly and time consuming.
- There is a need for small, low power, smart sensors.

Multi-sensor Arrays

- Multiple sensors can be integrated in a single substrate.
- Redundant measurements can result in extended calibration cycles.
- Embedded intelligence at the sensor level will limit flow of non-essential information.
- Combining different measurements in a single substrate results in smaller and lighter sensors.

Costs

- It is important to establish a tradeoff between costs and benefits.
- Qualification for flight is time consuming and expensive.
- Wiring and sensor installation adds to the cost, especially if multiple sensors are involved.

Integration of Micro/Nano sensors

- Means have to be provided to interface very small sensors to wires and connectors.
- Wiring systems can be designed for self-reconfiguring to intelligently re-route signals “on the fly” as mission needs change, or to compensate for wiring failure—which is especially vital for unmanned craft or inaccessible vehicle areas.
- Conductive polymers, metalized organic polymers, and carbon nanotubes that are tough, flexible, and light weight with conductivity approaching that of copper can be used to replace traditional copper wire.

KSC Sensor Efforts: E-nose

- An e-nose consists of an array of non-specific vapor sensors. In general, the sensor array is designed such that each individual sensor responds to a broad range of chemicals, but with a unique sensitivity relative to the other sensors. Chemical identification is achieved by comparing the sensor response pattern of an unknown vapor to previously established patterns of known vapors.
- Research has already shown that the e-nose is a viable technology for air quality monitoring, being able to identify and quantify many different air-borne compounds at low concentration levels.
- E-nose technology is being adapted for specific needs at KSC.
- In addition to their sensitivity and flexibility, e-noses are small, lightweight, rugged, inexpensive, and require relatively low power, thus making them ideal for enhancing the reliability and safety of any enclosed environment.

KSC Sensor Efforts: H_2 Detectors

- KSC is providing technical expertise in the transition of sensors developed by GRC into units suitable for aerospace application.
- Performing all the required environmental testing and materials compatibility analysis.
- Providing technical assessment to GRC to aid in the achievement of the final product.
- Third generation of sensors are being tested at the present time.
- Wireless Hydrogen Sensor Network (in work).

KSC Sensor Efforts: Reconfigurable Circuits

- Self-calibration activities of a data acquisition system utilize precise signal references for in-process determination of signal processing accuracies and appropriate signal/gain adjustments.
- This information provides for self-health assessment and inherent system health trending. “Spare” parts within the electronics design can be switched into active signal processing paths to provide in-circuit self-repair capabilities.
- Signal paths can be switched through available, individual replacement spare parts to provide transparent repair of signal paths and/or components.
- Advanced embedded software and digital switching components and techniques make self-calibration, self-repair possible without interruption of on-going signal processing.