Next Generation Vehicle Sensors

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Need for new Sensors

- Advances in technology have led to the availability of smaller and more accurate sensors.
- Computer power to process large amounts of data is no longer the prevailing issue.
- Cost/benefit analysis must be conducted to determine the real need for the installation of new sensors on existing flight vehicles.
- Use of multiple sensors can lead to more accurate and comprehensive measurements.

Acoustic Sensors

- The determination of the extent and location of structural damage is of significance in many engineering systems that range from advanced aerospace structures such as the International Space Station, the Space Shuttle, and future re-usable launch vehicles on the Moon and Mars.
- The inspection of these structures in the past has mainly been based on visual methods, and occasionally with the employment of conventional non-destructive evaluation techniques.
- Acoustic emissions provides a nondestructive test method for determining or monitoring material or structural integrity based on the release of energy detectable by analysis of the emission frequency and amplitude.
- By instrumenting a critical structure with acoustic emissions, any impact or structural failure can be monitored “real time”.

Distributed Intelligence

- Complex processes can be broken down into simpler, smaller processes along with relationship rules with respect to the overall process.
- Basic knowledge rules can be incorporated at the sensor level (embed knowledge rules in sensors).
- Decision making capabilities can be decentralized and located at the site of the physical process.
- The health of sensors can be monitored and measurements validated by applying process knowledge rules embedded in the sensors.
- Raw data transfer can be minimized by emphasizing transfer of process information versus raw data.

Suit and Inflatable Materials

- Sensors in fabric of material
- Detect hazardous materials
  - Outside: scape suits, ex. MMH
  - Inside: O_2 content, CO_2 buildup
- Monitor temperature, pressure
- Utilize distributed intelligence
- Use similar sensors for inflatable structures

Gas Leak Detection

- Sensors in structural materials for pipes, dewars, hoses.
- Detect leaks in pipes, joints, valves, umbilicals, hoses.
- Monitor flow via temperature and pressure
- Examples:
  - Monitor gas concentrations in Orbiter aft skirt during launch (detect H_2 buildup during N_2 purge)
  - Monitor long H_2 pipelines for leaks without walkdowns
  - Detect H_2 leaks in dewars and fittings on pad

Multiple Signals

- Provide multiple indications of system status
  - Continuous electronic signals
  - Digital updates on monitors and scape suit screens
  - Color change indicating concentration
  - Auditory alarm signals

Summary

- We have presented some ideas for micro/nano sensor application
- Are these ideas:
  - Doable?
  - Near/long term?
  - What's required to implement them?
- What other applications do you envision?