Sensor Network for Air Vehicle

Methods and apparatus for lightweight distributed onboard air vehicle sensor systems

Aircraft currently fly based on coarse estimations of environment and aircraft state. Real time measurements are traditionally restricted to laboratory environments (e.g. wind tunnel) due to the size and weight of instrumentation. This novel and patent-pending invention from NASA Ames is a distributed system for sensing the environmental and structural conditions of an air vehicle. It consists of many identical lightweight and low power network modules that can connect to each other as well as to a number of different sensors of any type. The resulting network produces a robust, responsive system that can transfer structural and environmental information into actionable control objectives in real-time. Real-time in flight measurement capability can inform new control methods, leading to quicker and more precise aircraft control, as well as significantly increased efficiency.

BENEFITS

- Real-time, in-flight measurement and sensor data processing could enable safer, more efficient aircraft with responsive control systems.
- With information coming from many points across a structure, the state estimation of an environment can be very accurate.
- Improved response time: The use of local computation decreases the response time of the aircraft.
- Increased efficiency: Real time measurement capability can inform new controls, leading to quicker, more precise vehicles.
- Robust system: The robust mesh network consists of many small identical components, which are easily replaced during maintenance and repair.
- Cost efficient: leverages commercially available components.
THE TECHNOLOGY

Distributed Asynchronous Air Vehicle Sensor System (DAAVSS) is a distributed system for sensing the environmental and structural conditions of an air vehicle. It consists of many identical sensor modules which can connect to each other as well as nearby sensors. The resulting network produces a robust, responsive system that can transfer structural and environmental information into actionable control objectives. The invention consists of a modular sensor system that distributes collection and computation throughout the aircraft body. Sensor Nodes are distributed throughout an air vehicle, either attached to the skin or to the substructure. These nodes are then connected to nearby sensor modules, from which they can collect data that they then either transmit to other nodes via a bidirectional data network or use to perform local computations. The internode network is sketched out in Figure 1, where each node can communicate with more than two other neighbors and can access N nearby sensors via a data network implemented with asynchronous mesh routing. Each sensor bus is local to the sensor node, so address space within each node’s sensor bus is distinct. Allowing a node to connect with a minimum of > 2 neighbors ensures that the resulting internode network topology can take the form of a mesh rather than a traditional bus, and a single node failure is not likely to compromise the functioning of the whole multi-node system. The use of local computation could reduce the response time of the air vehicle and reduce overhead, since sensors no longer have to be wired through the entire vehicle to the central processor and polled from this source. Instead, local networks can inter-communicate and respond to stimuli directly without having to traverse the entire network. This invention is used to efficiently spread the computation required to collect and act on environmental and structural stimuli that act on an air vehicle.

APPLICATIONS

The technology has several potential applications:
- Aerospace industry
- Commercial air vehicle application, including UAVs
- Automotive industry (including autonomous vehicles)
- Sensors and controls
- Exploration robots
- General robotics
- Submarines

PUBLICATIONS

Patent Pending

*Patent Only/No Software*

Fig. 1: Block diagram representing a sample network topology for a sensor node mesh network.

Fig 2: Example integration of sensor nodes with aircraft structure- initial linear layout prior to completion of additional connections for mesh redundancy shown for clarity.

More Information

National Aeronautics and Space Administration
Agency Licensing Concierge
Ames Research Center
MS 202A-3
Moffett Field, CA 94035
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

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