SPACE SYSTEMS SYMPOSIUM (D1)
Technologies to Enable Space Systems (3)

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SINGLE WIRE TRANSMISSION FOR SPACE SYSTEMS

Abstract

Although wireless technologies are replacing a lot of wired communication and connectivity at application level, at an engineering level, wired connectivity still holds an important place. However, there are some drawbacks associated with wired systems. Conventional wired communication relies on driving inter-connected wires to predefined voltages or currents. It also requires a closed loop for working since current transfer is necessary. It has the concerns of wire heating, IR drop, RC line loading delays, wire length dependent maximum transmission frequency and tight matching requirements for parallel links.

We propose a new semiconductor based method for directly converting a digital electrical signal into an electromagnetic disturbance that can be propagated and detected over a single wire or conductor. The scheme has very high signal integrity, low attenuation, minimal network latency and low power consumption. It does not require resonant coils or mechanical launchers and catchers. The scheme has also been adapted to improve the received signal quality of data transmissions over co-axial/RF cables which act as waveguides. Line drivers have the ability to handle load variations of 100x, making it highly tolerant to minor line faults.

In the proposed method, as almost no current is carried on the wires, cables and connectors can be much thinner and lighter than current solutions. Elimination of wire heating significantly reduces risk of electrical fires and reduces the overall power used for internal communication. Also, a fairly high level of cable damage can be sustained with no impact to the communication systems.

Since the single wire can be used as a broadband waveguide, different systems operating at different data rates can use common wires without any interference. All non critical wiring to/from the control center can be multiplexed on fewer cables, and a single cable can be used to interconnect an array of devices such as sensors and actuators operating at different rates.

The proposed method greatly simplifies wiring harness with only one thin cable being used for each region of the spacecraft. A single wire can be used to collect data from dozens of sensors and optionally power them as well. The flexibility to add new sensors on-the-fly, without additional cabling requirements, significantly enhances monitoring capability without requiring design changes. It also provides a wide scope for forming an Internet of Things (Iot) network in space applications, which is also discussed and proposed in this research.