Smart Modularized Advanced Reusable Telemeter (SMART)

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ABSTRACT

The SMART (Smart Modularized Advanced Reusable Telemeter) is an advanced telemetry system. The SMART system enhances the quality of a weapon system by providing an adaptable built-in telemetry capability for the weapon. Existing weapon telemetry systems are centralized, separate components which require many fault-prone interconnections. This system reduces the number of interconnections and provides higher performance than current systems. The modular system uses a high data-rate serial data link that connects remote measurement modules located throughout the unit-under-test. A smart processor is used to analyze and compress data from the various modules prior to transmission, making more effective use of the telemetry bandwidth. The smart processing unit also adapts the measurement units for changing test conditions on-the-fly. The system will allow more complete testing of the weapon system and solve a broader range of problems. The goal of the SMART project is to utilize the most advanced technology to overcome the current design methodologies that have perpetuated shortcomings in present systems. This project is being conceptualized to encompass a broader range of telemetry applications beyond the present weapon systems at Sandia.

SYSTEM INFORMATION

The SMART system, depicted in fig. 1, consists of several interconnecting subsystem modules. The SIU (Serial Interconnection Unit), the MPU (Measurement Processing Unit), and the SPU (Smart Processing Unit) are connected together to form a complete PCM telemetry system whose output can be then transmitted or hard wired to a remote receiver. The system is connected in a ring configuration with a single serial link the only
The SIU is the interface to the serial data link. Each node contains an SIU. The SIU strips incoming serial information from the cable and adds outgoing serial information to the cable as well as providing a parallel interface to its associated companion module (either an MPU or an SPU). The SIU consists of a serial data transceiver and a high-speed serial-parallel converter. A block diagram of the SIU module is shown in fig. 2.

The MPU’s make all of the measurements required of the telemetry system. There may be one or many MPU’s in a system. The MPU’s are strategically located at the actual measurement location to reduce noise and interconnect problems. Each MPU employs signal conditioning circuitry, an analog multiplexer, an A/D converter, and a microprocessor based control system with nonvolatile memory. The information output from the MPU is passed to its companion SIU where it is added to the serial data stream. The information from the MPU consists of measurement data as well as command and control data. Since the MPU can be programmed to provide some rudimentary data
compression and reduction, that information must also be sent. In addition, the MPU can be reprogrammed on-the-fly over the serial data link by the SPU. This reprogramming can be stored into the MPU’s non-volatile memory, creating the capability to “learn.” This capability gives the SMART system great adaptability to differing test conditions. A block diagram of the MPU is shown in fig. 3.

The function of the SPU is to provide system control and to do real-time data analysis, making decisions based on that analysis. The single SPU assembles the final data stream from the MPU’s and sends it to the transmitter. As the stream is assembled the SPU can make decisions on which data is to be sent and alter the stream accordingly. Format switching is employed as a tool to transmit different data in the PCM stream. The SPU decides upon the best format based on preprogrammed information and real-time telemetry data and switches to that format. Several predefined formats are available from which the SPU makes its choice. Another function of the SPU is to configure and program the MPU’s. This can be accomplished on-the-fly or from an external development computer which is attached to the system for diagnostics and development. The SPU’s main component is a high speed Digital Signal Processor (DSP).

The data that flows through the system is more that just the different measurements from the MPU’s. Since adaptability is being designed into the system, an object-oriented approach to data management is being used. This means that the data stream consists of the data and other associated information about the data. This information can includes type of data, compression method, time, type of measurement, etc. Use of this method increases the necessary bandwidth of the serial link, but has the benefit of raising the overall system throughput while maintaining a manageable output data-rate.

Figure 2 - The SIU is a Load/Unload Shift Register.
The SMART system has 3 main areas of cost/benefit. (1) Since the MPU’s are located within the weapon components, the cost for the telemeter is reduced at the expense of additional weapon component costs. As the components are reused on future weapon systems, so will the telemetry maps. This integration of weapons component and telemetry measurement will significantly reduce future telemetry costs. (2) It is estimated that as much as 30 to 40 percent of the cost of existing telemetry systems can be attributed to interconnections. This estimate is based on the fact that interconnections are involved in every phase of telemetry development. Reducing these interconnects will diminish this cost to the system and increase the reliability. (3) The SMART system will have the capability to perform a more effective telemetry test on the weapon system. As a result, this diagnostic capability will improve the overall quality of the weapon. The SMART system design methodology is the natural progression of mature systems which contribute to cost/benefit improvements without sacrificing quality.
CONCLUSION

The goal of the SMART project is to utilize the most advanced technology to overcome the current design methodologies that have perpetuated shortcomings in present systems. The main thrust of the SMART program is to provide an architecture for a telemetry system that fosters modularity and adaptability. The result of this program is a system that can be reused and configured for virtually any telemetry need. As such, this project is being conceptualized to encompass a broader range of telemetry applications beyond the present weapon systems at Sandia.