Wireless Smart Sensor Network Applications to Civil Engineering Research

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Historically, the term "sensors" has been applied to transduction devices that are used to convert some form of mechanical or thermal energy to electrical signals. These electrical signals are then processed, stored, and displayed in a way that can provide appropriate time histories of the mechanical and/or thermal events. The "sensors" (in this context) produce only analog signal outputs. These outputs range from small to large electrical signals and require electrical signal conditioning to convert the "raw" sensor output to signals that can easily be displayed on chart recorders or converted to digital form so as to be processed and displayed by computers.

This paradigm usually results in transducers mounted on the structure to be monitored and connected by wire (sometimes as much as miles of wire on large structures) to signal conditioning and recording equipment. In many cases, signals from the transducers are low power and thus are subject to contamination by reactive energy from other electromagnetic sources. Further, management of the interconnect wiring in civil applications present significant challenges for both sensor installations in existing structures and installations in civil projects under construction.

Solutions to wiring problems are being address by two approaches. The first is to include signal conditioning, signal conversion, and RF transmission into the transducer body and create a wireless sensor. The second is to place data processing capabilities into the transducers in addition to the communications and thus provide data processing and data reduction at the transducer level while not reducing the "information content" of the sensor data stream.

This brief addresses the hardware and software processes needed to accomplish both wireless and smart sensors. Examples are provided for installation and monitoring of wireless data acquisition networks on civil structures. In addition, the brief presents both the advantages and disadvantages of the wireless and the "smart" sensor and how best to judge the usefulness of the approach for various civil applications. Further, examples of measurements critical to construction quality on specialized civil projects are provided that show data never before available due to the lack of wireless technology.

Finally, the presentation addresses where tomorrows improvements in wireless sensors and smart sensors may lead and the developing technology that will drive the increased use of wireless sensor networks.