NEXT GENERATION WIRELESS SENSORS TOWARD SUSTAINABLE CIVIL INFRASTRUCTURE

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ABSTRACT

This paper presents the recent development of a next-generation wireless smart sensor hardware and software framework to enable a more accurate, inexpensive, and greatly simplified method of instrumenting structures for structural health monitoring. The modular hardware supports interchangeable sensor boards capable of measuring: (i) three-axes acceleration for global response monitoring (ii) strain for local response monitoring, and (iii) temperature. The device supports a 24-bit high-precision, analog-to-digital converter with eight differential channels of external analog input, and programmable antialiasing filters. The smart sensor will provide the multi-scale sensed information needed for the SHM algorithms. Communication with a variable power ZigBee radio can be achieved at distances of up to 1 km. The software follows a middleware framework to facilitate the creation of distributed SHM applications. The middleware framework employs a service-oriented architecture (SOA) approach and provides a suite of modular, reusable and extensible services suitable for WSSN applications. This framework addresses critical SHM needs: enabling tightly synchronized sensing, addressing data loss, and efficiently implementing the demanding numerical algorithms required for system identification and damage detection on sensor nodes with limited resources.