

Narada: A Low-Cost Wireless Sensor for Monitoring and Control

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A new wireless sensor platform, termed Narada, has been both designed and deployed by WIMS ERC researchers for a variety of monitoring and control applications. Designed from commercial off-the-shelf components, Narada offers multi-channel sensor and actuator interfaces (Figure 1). The internal 16-bit, analog-to-digital converter can simultaneously collect sensor data from four channels at rates as high as 100kHz. A two-channel, 12-bit, digital-to-analog converter provides the wireless sensor with the capability to output voltage signals from 0V to 4V to actuators. The low-power, 8-bit Atmel ATmega128 micro-controller has been selected as the wireless sensor's computational core. To facilitate interoperability with commercial wireless sensor nodes (e.g., Crossbow Motes) using the IEEE 802.15.4 wireless sensor protocol stack, the Chipcon CC2420 wireless transceiver is integrated into the Narada platform. Lastly, a multi-thread operating system has been embedded in the wireless sensor core, featuring a complete implementation of the IEEE 802.15.4 physical and medium access control protocol layers.

To validate the functionality of Narada, Center researchers installed a multi-node wireless sensor network in collaboration with researchers from the National Center for Research on Earthquake Engineering (NCREE), Taipei, Taiwan, in July 2006, in a 3-story test structure (Figure 2). Adjustable MR dampers were installed as actuators capable of controlling the dynamic response of the structure during simulated earthquake loading. The wireless sensors were responsible for measurement of story velocities (using velocity meters), transmission of response data, calculation of control forces (using embedded Kalman filters and optimal control algorithms), and distribution of command signals to the dampers in real-time (using a 50Hz sample rate). This is the first-ever, full-scale implementation of a wireless structural control system applied to civil engineering structures for seismic protection. ■

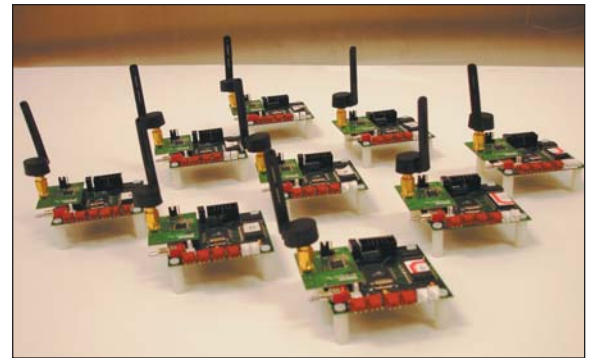


Figure 1 – Fully functional Narada wireless sensor network.

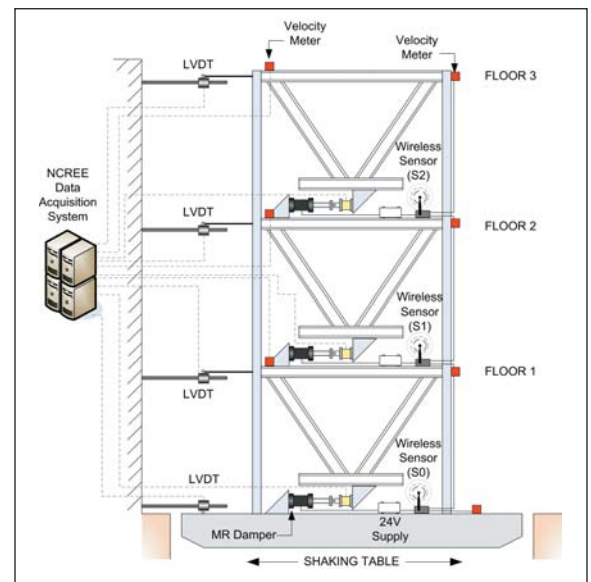


Figure 2 – Application of Narada wireless sensors to a structural control system.