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Concurrent System Identification and Feedback Control for Adaptive Control of Time Variant Structures using Dual Core Wireless Sensors

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ABSTRACT
Structural control systems have proven effective in minimizing the response of civil engineering structures to extreme load events such as earthquakes and tropical storms. The design of traditional feedback control systems is dependent on the assumption of the structure being linear time invariant. This assumption may be violated during extreme loads due to system nonlinearity and the introduction of damage. In this study, a recursive system identification strategy is implemented to continuously track the system properties of a dynamic structure. Concurrently, an optimal feedback control law is found based on the varying system model generated by the system identification module. To implement system identification and control law derivation concurrently, a flexible controller infrastructure is required. Towards this end, the study utilizes the low-power, dual-core Martlet wireless sensor developed at the University of Michigan. The wireless platform executes online system identification recursively on one core while derivation of an optimal control law based on linear quadratic regulation (LQR) theory is implemented on a second core. By parallelizing the implementation of the LQR control law and system identification, the wireless sensing network is shown to be capable of learning and adapting to system changes in real-time. Simulation and experiments on a 4-story benchmark shear structure is utilized to show the validity and scalability of the proposed adaptive feedback control approach.

KEYWORDS: *wireless sensors; system identification; feedback control; adaptive control*