Sensors and Materials, Vol. 21, No. 3 (2009) 141–153
MYU Tokyo

S & M 0755

Design of Energy Scavengers of Structural Health Monitoring Systems Using Genetically Optimized Neural Network Systems

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(Received September 23, 2008; accepted February 12, 2009)

Key words: optimization, neural network, genetic algorithm, GONNS, piezoelectric

Energy scavengers are a promising alternative for powering the thousands of sensors of next-generation air vehicles. Genetically Optimized Neural Network Systems (GONNS) is proposed as the first step for the optimization of energy scavengers by considering the ambient vibration, available space, and allowable weight. GONNS conveniently represents the complex systems with multiple artificial neural networks (ANNs) and are used to determine optional operating conditions using one or more genetic algorithms (GAs). Single- and multiple-cluster modes of the GONNS were used in the study to match the dynamic characteristics of the energy scavenger to the ambient vibrations and to fit the system into the available space. The single-cluster mode represented the relationship between the inputs (frequency, beam length, and mass) and two outputs (voltage and displacement amplitudes) with separate ANNs and optimized the system using a single GA. Six ANNs and three GAs working in three groups optimized the system in the multiple-cluster mode of the GONNS.

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