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HGANN- Hybrid master-slave genetic algorithm-neural network for the identification of piezoelectric actuator of a smart fin

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A piezoelectric (PZT) bimorph actuator is constructed by bonding two Macro Fiber Composites (MFCs). The MFC consists of rectangular piezo-ceramic rods sandwiched between layers of adhesive, electrodes and polyimide film. These actuators use inter-digitated electrodes for poling and subsequent actuation of an internal layer of machined piezoceramic fibers. Recent advances in the area of surface-mounted composite piezoelectric actuators for the shape control of intelligent structures have resulted in their use in many applications. Major factors that contributed to this are their relative low-cost, noninvasive nature, and simplicity. These developments led to the consideration of using a PZT actuator as an integral component of a smart fin prototype. This type of actuator is suited for smart fins due to its simplicity. Having the actuator fully enclosed within the fin addresses important space issues. This work proposes using a hybrid master-slave Genetic Algorithm (GA)-Neural Network (NN) to identify the optimal set of parameters for the damping matrix constants, the Bouc-Wen hysteresis model, and the backlash operators. A total of nine cases representing three different voltage amplitudes and three different frequencies are used to train and validate the model. Four input cases are considered for training the NN architecture, connection weights, bias weights and learning rules using GA. This method iteratively optimizes the nine factors while minimizing the error between the simulated and the experimental data. Simulation results show that the proposed model can predict the damping, hysteresis and backlash of the smart fin-actuator system under various operational conditions.

Biography

Mohammad Saadeh has completed his PhD from University of Nevada, Las Vegas. In 2012, he joined Southeastern Louisiana University as an Assistant Professor. His research interests are Mechatronics, Control, and Artificial Intelligence. He has published 7 papers and 8 proceedings.

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