

**DEADZONE COMPENSATION IN MOTION CONTROL
SYSTEMS USING AUGMENTED MULTILAYER
NEURAL NETWORKS**

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ABSTRACT

A novel neural network (NN) structure is given for approximation of piecewise continuous functions of the sort that appear in friction, deadzone, backlash and other motion control actuator nonlinearities. The novel NN consists of neurons having standard sigmoid activation functions, plus some additional neurons having a special class of non-smooth activation functions termed 'jump approximation basis functions'. This augmented NN with additional neurons having 'jump approximation' activation functions can approximate any piecewise continuous function with discontinuities at a finite number of known points.

A compensation scheme is presented for general nonlinear actuator deadzones of unknown width. The compensator uses two NN, one to estimate the unknown deadzone and another to provide adaptive compensation in the feedforward path. The compensator is an augmented multilayer NN for approximating piecewise continuous functions like the deadzone inverse. Rigorous proofs of closed-loop stability for the deadzone compensator are provided, and yield tuning algorithms for the weights of the two NN. The technique provides a general procedure for using NN to determine the preinverse of an unknown right-invertible function.