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United States Patent [19] Woodall

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- [54] **NONLINEAR NEURAL NETWORK OSCILLATOR**
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- [52] U.S. Cl. **395/23; 395/22; 395/24**
- [58] Field of Search **395/21, 22, 23, 24**
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[57] ABSTRACT

A nonlinear oscillator (10) includes a neural network (12) having at least one output (12a) for outputting a one dimensional vector. The neural network includes a plurality of layers, including an input layer, an output layer, and at least one hidden layer. Each of the layers includes at least one processing element (PE) that is interconnected to processing elements of adjacent layers. The input layer has an input coupled to the at least one output and includes an analog delay line (14) having a plurality of taps each of which outputs a time-delayed sample of the one dimensional output vector. Each of the taps is connected to each one of the processing elements of the at least one hidden layer for providing a time-delayed sample of the one dimensional output vector thereto. The nonlinear oscillator further includes a feedback network (16) that is interposed between the output of the neural network and the input of the input layer for modifying a magnitude and/or a polarity of the one dimensional output vector prior to the sample of the one dimensional output vector being applied to the input of the analog delay line. The analog delay line is capable of being shifted in either a first or a second direction. Connection weights of the neural network are trained on a deterministic sequence of data from a chaotic source or may be a representation of a stochastic process, wherein each of the weights is randomly selected.

19 Claims, 12 Drawing Sheets

