BVP NEURAL-TYPE SYSTEMS: THE BASIC COMPONENT

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SUMMARY:

One area that appears destined for considerable attention in the future development of systems theory is that of Man-Machine Systems [1]. Consequently it becomes important to have a systems theoretical understanding of the "man" portion of such systems. For this one can proceed in various directions, but it is clear that the neural activities of man are important to behavioral characteristics, and, although the neural activities of humans are far from being well understood, there has been considerable progress in the area of neural type systems [2], the basis for which is the neuron itself.

This talk will discuss Bonhoeffer-Van der Pol (BVP) neural-type systems, these being ones that hold considerable promise for systems theoretic studies. Specific emphasis will be placed upon the basic component of such systems, the single-input single-output BVP (neuron-type) system described by the degree two nonlinear state-variable equations

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$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} c & -c \\ \frac{1}{c} & -\frac{b}{c} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} -\frac{c}{3} x_1^3 \\ \frac{a}{c} \end{bmatrix} + \begin{bmatrix} c \\ 0 \end{bmatrix} u \tag{1a}$$

$$y = [0 \quad 1] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \tag{1b}$$

where u = input, y = output, $x = [x_1, x_2]^T$ = state (T = transpose) and (in order to obtain neuron-type properties) the parameters a,b,c, satisfy

$$1 - \frac{2b}{3} < a < 1, \quad 0 < b < 1 \ , \ b < c^2 \tag{1c}$$

The properties of these equations will be discussed through 1) a review of their generation from Van der Pol equations and 2) the presentation of analog computer simulation results. Comparison with other primary neural-type systems' elements, as Morshita ones [3], will be made and their use in large scale neural-type networks discussed.

REFERENCES:

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