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DISCRETE MODELLING OF NEURONS[1]

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Neural networks are constructed from a wide range of different views and this is reflected in a variety of results as well as mathematical techniques used in their derivation.

We consider the following system of k ($k \geq 2$) difference equations in the form:

$$\begin{cases} x^1_{n+1} = \beta x^1_n - g(x^2_n), \\ x^2_{n+1} = \beta x^2_n - g(x^3_n), \\ \quad \ldots \\ x^{k-1}_{n+1} = \beta x^{k-1}_n - g(x^k_n), \\ x^k_{n+1} = \beta x^k_n - g(x^1_n), \end{cases} \quad n = 0, 1, 2, \ldots \quad \text{with } g(u) = \begin{cases} a, & u \geq \alpha, \\ 0, & -\alpha < u < \alpha, \\ -a, & u \leq -\alpha, \end{cases} \tag{1}$$

where $\beta \in]0, 1[$ is a constant and $a > 0$, $\alpha > 0$.

System (1) can be viewed as a discrete version of the corresponding k-neuron network model of differential equations, where $\alpha > 0$ represents an internal decay rate, $\beta > 0$ measures the synaptic strength, x^i, $i = 1, 2, ..., k$, denote the activations of the corresponding neurons and g is a signal function.

Similar three-neuron model (1) with another signal function was investigated in [3]. We have studied previously one-neuron model with similar signal function in [1] and with different signal function in [2].

In our presentation we explore the dynamics of system (1). Some interesting results are obtained about equilibrium solutions and periodic solutions of this system.

REFERENCES

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