Oscillation Phenomena in CNN with Multi-Cloning Templates

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SUMMARY

There are many studies of coupled chaotic systems. In these systems, various kinds of phenomena are observed. Some of these phenomena correspond to natural phenomena. Namely, it is important to investigate coupled chaotic systems. Cellular Neural Networks (CNN) was proposed by Chua and Yang [1][2] in 1988. It is mutual coupling neural networks. These are easy to make an integrated circuit and these are parallel processing system. Therefore, many researchers investigate about CNN. As one of these studies, CNN using two kinds of cloning templates [3] has been investigated. Mainly, this system as coupled oscillatory system was investigated. Normally, oscillatory phenomena could not be observed in typical CNN. This CNN can be observed oscillatory phenomena. However, chaotic phenomena could not be observed. On the other hand, three cells of CNN generates chaos is reported [4]. Three cells are set different cloning templates. A double scroll type attractor is observed.

In our previous study, CNN using three kinds of cloning templates was proposed [5]-[7]. Cloning templates are set as symmetrical templates and corresponding to cloning templates of three cell CNN. This system is a novel coupled chaotic system. Three kinds of cells are placed at uniformly in this system. This system has characteristic that elements of oscillating are shared. The cases of three cells, six cells, nine cells and so on were investigated. Characteristic phenomena are observed in six cells, nine cells, twenty cells and eighteen cells. On the other hand, various phenomena are observed in twenty-four cells and thirty-six cells. Namely, observed phenomena are influenced by the number of cells. However, relationship between differences of observed phenomena and the number of cells could not be revealed.

In this study, relationship between differences of observed phenomena and the number of cells is investigated. And classification of oscillatory phenomena are proposed. In any cell, tracing a neighbor cell in turn to one direction reaches the original cell. Namely, coupled cells are looped. The number of cells is defined as $M \times N$ in this system. In the case of $N = 3$ and M is multiples of 2, the number of loops is $M + 2$. On the other hand, In the case of M is multiples of 3, the number of loops is $M + 6$. By innovating a counting method of the number of cells, two kinds of observed phenomena can be distinguished. The case of changing parameters, detailed analysis of two kinds of observed phenomena and so on are our future works.

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