

# 1-19

## Relationship between Structure and Phenomena of CNN Using Three Kinds of Cloning Templates

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### 1. Introduction

Cellular neural network [1] using three cells can generate double scroll type attractors [2]. In our previous studies, cellular neural networks using three kinds of cloning templates was proposed as one of chaotic oscillatory system [3]. Some interesting phenomena was observed. However, these phenomena was not investigated in detail.

In this study, relationship between structures and phenomena observed in cellular neural networks using three kinds of cloning templates are investigated.

### 2. Cellular Neural Networks Using Three Kinds of Cloning Templates

Figure 1 shows a structure of CNN using three kinds of cloning templates. Cells are coupled as triangle lattice. The system consists of three kinds of cells which names are Cell  $\alpha$ , Cell  $\beta$  or Cell  $\gamma$ . The difference of three kinds of cells is only values of cloning templates. The boundary condition is set as a periodic condition. Namely, this system has a torus structure. In order to keep a symmetric property, symmetric cloning template parameters are set as follows.

$$\begin{aligned} \mathbf{A}_\alpha &= \begin{pmatrix} k & l \\ l & 1.24 & k \end{pmatrix}, \\ \mathbf{A}_\beta &= \begin{pmatrix} -m & k \\ k & 1.1 & -m \end{pmatrix}, \\ \mathbf{A}_\gamma &= \begin{pmatrix} l & m \\ m & 1.0 & l \end{pmatrix}, \end{aligned} \quad (1)$$

where  $k, l, m$  show the coupling strengths between Cell  $\alpha$  and Cell  $\beta$ , Cell  $\alpha$  and Cell  $\gamma$ , Cell  $\beta$  and Cell  $\gamma$ , respectively.

### 3. Simulations

The cases that the number of cells is three, six, nine, twelve, eighteen, twenty-four and thirty-six are investigated in this study. By increasing the number of cells, some interested phenomena are observed. Figure 2 shows one of observed phenomena. In some area, synchronization of switching is observed. Additionally, in the nine cells case, synchronization phenomena can be observed and waveforms of same kinds of cells become same, respectively.

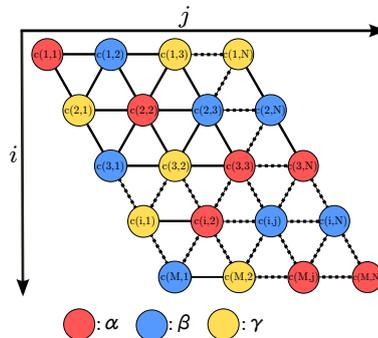


Fig. 1: Structure of cellular neural networks using three kinds of cloning templates.

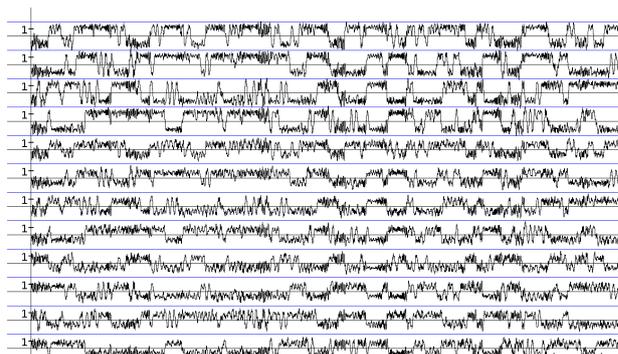


Fig. 2: Waveforms in the case of twelve cells.  $k = -1.03$ ,  $l = -1.07$  and  $m = 1.47$ .

### 4. Conclusions

In this study, relationship between structures and phenomena of CNN using three kinds of cloning templates has been investigated. As results, some interesting phenomena were observed. Additionally, we confirmed that increasing the number of cells expands the parameter region of oscillations.

### References

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