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Maintaining Status of Image by Cellular Neural Networks with Switching Two Templates

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1. Introduction

In the image processing of the Cellular Neural Networks (CNN), there are methods to process a grayscale image into a binary image. These methods turn into a binary image with decreasing amounts of information depending on the number of calculations. However, there is little method how to maintain the process in the grayscale image. Therefore, we propose a new method of maintaining the status of the image with switching two templates. We apply the proposed method to the image and investigate its performance.

2. Proposed Method

In this section, we explain the proposed method by using CNN. In our proposed method, two templates are switched according to the input and output values (y_{ij}: cell's output value, u_{ij}: cell's input value) of surrounding the center cell. The processing steps of the proposed method are described as follows.

Step 1: Fix certain value a. Decide the center cell and the size of 3×3 and 5×5 neighborhoods. Then, find the y_{ij} and u_{ij} from 5×5 range of the input and output values.

Step 2: Calculate the standard deviation within 3×3 and 5×5 ranges of the output value of the center cell, and within 3×3 range of the input value of the center cell. Each value is defined as S_1, S_2 and S_3.

Step 3: The template is applied to the center cell. Switching condition is given as follows:

$$\begin{cases} S_2 \leq S_1 \\ aS_1 \geq S_3. \end{cases} \tag{1}$$

When either inequality of Eq. (1) is satisfied, it is applied 1st template. In the other case, it is applied 2nd template.

Step 4: Step 1 to step 3 are applied to all cells and repeated every 0.005 [τ]. This process is conducted every certain number of calculation n.

3. Simulation Results

In this section, we show the simulation results of the proposed method and the conventional CNN. Figure 1 shows the input image and the simulation results by the "Edge detection" template and the proposed method. In this simulation, 1st template is "State value" template and 2nd template is"Edge detection" template.

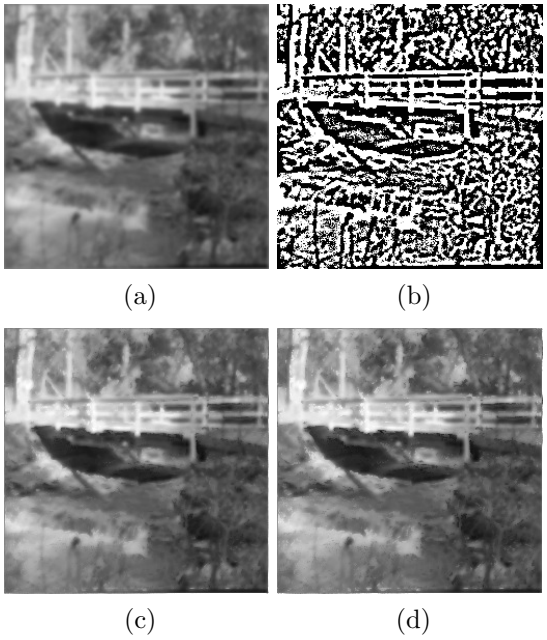

Figure 1: Simulation results. (a) Input image. (b) Simulation result of the "Edge detection" template. (c) Simulation result of the proposed method($a = 0.85, n = 400$). (d) Simulation result of the proposed method($a = 0.85, n = 800$).

Figure 1(a) shows input image including a bridge, a lake and a forest. Figure 1(b) shows binary edge detected image of Fig. 1(a). Figure 1(c) shows the grayscale image with the information in Fig. 1(a). Figure 1(d) shows the output image increasing the number of calculations compared to Fig. 1(c). There is little difference between Fig. 1(c) and Fig. 1(d). From the simulation results, the proposed method is effective in increasing the number of calculations.

4. Conclusions

In this study, we have proposed a method of maintaining the status of the image with switching two templates. The simulation results show that the output image is maintained as a grayscale image with the number of calculations. Therefore, the proposed method is effective in maintaining status of the image.

In the future work, we will confirm that the proposed method is effective for other image processings.