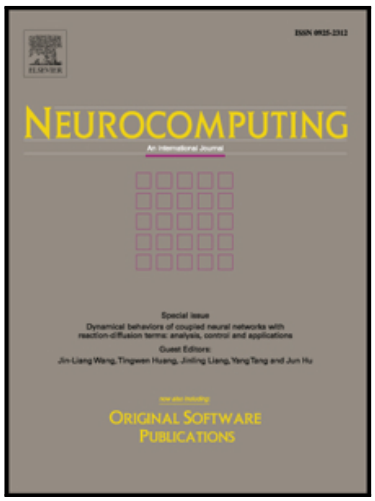

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Shyam Prasad Adhikari , Hyongsuk Kim , Changju Yang , Leon O. Chua

PII: S0925-2312(18)30710-0
DOI: 10.1016/j.neucom.2018.05.113
Reference: NEUCOM 19674

To appear in: *Neurocomputing*

Received date: 3 July 2017
Revised date: 6 April 2018
Accepted date: 31 May 2018

Please cite this article as: Shyam Prasad Adhikari , Hyongsuk Kim , Changju Yang , Leon O. Chua , Building Cellular Neural Network Templates with a Hardware Friendly Learning Algorithm, *Neurocomputing* (2018), doi: 10.1016/j.neucom.2018.05.113

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Shyam Prasad Adhikari [1], Hyongsuk Kim [2], Changju Yang [3], and Leon O. Chua [4]

[1,2,3] Division of Electronics Engineering, Chonbuk National University, Jeonju,561-756, Republic of Korea.
[4] Department of Electrical Engineering and Computer Sciences, UC Berkeley, CA 94720-1770 USA.
Email: all.shyam@ gmail.com[1], hskim@jbnu.ac.kr[2](corresponding author), ychangju@jbnu.ac.kr[3], chua@berkeley.edu[4]

Abstract

A general solution for the construction of Cellular Neural Network (CNN) weights (cloning template) with Random Weight Change (RWC) algorithm is proposed. A target image for each input image is prepared via a sketch or any other kind of image processing technique for learning of Cellular Neural Network templates. A vector of randomly generated small values is added to the original weights and tested upon the input-target image pair. As a result, if the learning error decreases, the weight is taken for learning in the next iteration and updated using the same vector of random values. Otherwise, a new random vector for updating the weights is regenerated. One of the strong benefits of the proposed weight learning method is the simplicity of its learning algorithm and hence a simpler hardware architecture. Moreover the proposed method provides a unified solution to the problem of learning CNN templates without having to modify the original CNN structure and is applicable for all types of CNNs and input images. Successful learning of templates for various image processing tasks using different CNN structures are also demonstrated in this paper.

Keywords: Cellular neural network; cloning templates; random weight change

1. Introduction

Inspired from the idea of Cellular automata and neural networks, Cellular Neural Network (CNN) was introduced by Chua and Yang in 1988 [1]. CNN has a two dimensional grid structure of analog processing units called *cell*, where each cell is connected locally only to its neighboring cells by a set of parameters called *cloning templates* which determine the dynamic behavior of CNN. In general, the processing unit of CNN is similar to the processing unit of neural network, and the feedback structure in CNN is similar to the structure of a type of neural network called recurrent neural network which has been widely used for solving optimization problems in numerous scientific and engineering areas such as kinematic control of robot manipulators and robot motion control [2-6] etc. However, the main difference is that in CNN the connections are limited to a predefined local neighborhood, whereas in recurrent neural networks and other neural networks the connections can be global.

The grid structure of CNN provides a convenient platform for application in the field of image processing. CNN has also been implemented in analog hardware circuits for parallel processing, and diverse operations are also possible as the hardware has been built to be programmable [7, 8]. The