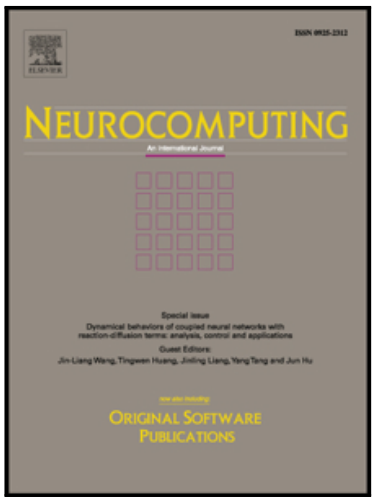

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Storage Capacity of Rotor Hopfield Neural Networks

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Abstract

Hopfield neural networks have been studied by many researchers. A complex-valued Hopfield neural network (CHNN) is a multistate model of Hopfield neural network, and has been applied to the storage of multilevel data, such as image data. A Rotor Hopfield neural network (RHNN) is an extension of CHNN. The RHNNs demonstrated double the storage capacity of CHNNs and excellent noise tolerance by computer simulations. Jankowski et al. analyzed the storage capacity of CHNNs by approximating the crosstalk term using central limit theorem. In this work, we show that the RHNNs have double the storage capacity of the CHNNs based on their theory.

Keywords:
Complex-valued neural networks, rotor Hopfield neural networks, storage capacity, central limit theorem

1. Introduction

In recent years, high-dimensional neural networks have been studied by many researchers [1]-[4]. The Hopfield neural network is a major model of neural networks, and several high-dimensional versions have been proposed. A complex-valued Hopfield neural network (CHNN) is one of the most successful models [5, 6]. The CHNNs can store multilevel data, and have been applied to the storage of image data [7]-[10]. The CHNNs have the disadvantage of low noise tolerance [11]. The noise tolerance deteriorates as the resolution factor increases. Several modifications of CHNNs have been proposed to improve the noise tolerance [12, 13]. Clifford algebra, such as the complex and quaternion field, has often been used to extend the Hopfield neural networks. Hyperbolic algebra is a 2-dimensional Clifford algebra,