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A SHRINKING CHAOTIC MAXIMUM NEURAL NETWORK FOR MAXIMUM CLIQUE PROBLEM

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Abstract. *Based on the analysis of the characteristic and theory on maximum neural network, we propose a shrinking chaotic maximum neural network to solve maximum clique problem. The shrinking chaotic maximum neural network contains most of the advantages of the chaotic maximum neural network algorithm, moreover it has a novel characteristic of gradually reducing network scale. Lee and Takefuji have presented that maximum neural network always guarantees a valid solution and reduces the search space greatly without a burden on the parameter-tuning. However we find that maximum neural network actually utilizes the graph structure of the problem to be solved which has potential competitive characteristic to produce network competition. Therefore to some special instances, maximum neural network still suffers the burden of parameter modification. By introducing and modifying a controlling parameter, our proposed algorithm obtains a shrinking ability to reduce the scale of the problem to be solved. With the solving problem scale lessening, the algorithm spends less time converging and has high probability to get optional solutions. Moreover it is especially suitable to solve large-scale maximum clique problems due to its shrinking characteristic. A large number of instances have been simulated to verify the proposed algorithm.*
Keywords: Maximum neural network, Maximum clique problem, Shrinking mechanism

1. **Introduction.** The maximum clique problem (MCP) is a representative problem of combinatorial optimal problem and it is a well-studied NP-Hard problem [1] which has a published review with 260 references. In graph theory a clique is a completely connected subgraph and the MCP is that of finding, for a given graph, the size of the largest clique. A clique is called maximal if it is not contained in any other clique. A maximum clique of a graph is a maximal clique having the maximum number of vertices. Because it is a NP-Hard problem, this problem is computationally intractable even to approximate with certain absolute performance bounds. The maximum clique problem has many practical applications also in diverse fields such as computer vision, information retrieval, cluster analysis, fault tolerance etc. Moreover many important problems can be easily reduced to the maximum clique problem [2]. Hence, it is important to develop methods for finding the exact and also approximate solutions to this problem.

Recently, neural networks have been extensively studied and used in many areas of science and engineering such as pattern recognition, adaptive control, signal filtering and combinatorial optimization problems [3-5]. One possible and very promising approach to combinatorial optimization problems like the MCP is to apply artificial neural networks yet. Since Hopfield and Tank showed that certain feedback continuous neural models are capable of finding approximate solutions to difficult combinatorial optimization problems,