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AN IMPROVED ELASTIC NET METHOD WITH TIME-DEPENDENT PARAMETERS FOR TRAVELING SALESMAN PROBLEM

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Abstract. *In this paper, we propose a new Elastic Net method to solve the traveling salesman problem by introducing some time-dependent parameters. This method could help the points in the network move quickly near to the cities at early stage, which enables the points to be distributed more uniformly; and gradually increase the strength that pulls net points towards their neighbours for minimizing the distance between the cities and the points on the path. This enables the network to have superior ability of searching for cities, and converge sooner to a saturate state. Simulation results are provided for instances of up to 1000 cities, illustrating that the proposed network performs better than the classical Elastic Net for optimization both in solution quality and convergence speed. Furthermore, the results of the proposed method are not as sensitive to the choice of parameter values as the original Elastic Net, which ensures a stable convergence to feasible solutions of the network for different problems.*
Keywords: Neural networks, Elastic net, Traveling salesman problem, Parameter tuning

1. **Introduction.** The traveling salesman problem is a typical problem of combinatorial optimization, which is simple to state but difficult to solve [1,2]. The problem consists of finding the shortest possible tour of a given set of cities such that each city is visited exactly once. The TSP is known to be NP-hard and can not be solved optimally in polynomial time [3], and has been the subject of a vast amount of research in the literature [4-7]. In the last 20 years also, neural networks have been shown to be powerful tools for solving combinatorial optimization problems, particularly NP-hard problems. Neural solutions to the TSP were first suggested by Hopfield and Tanks [8-11]. Wilson and Pawley [12] later showed that this approach became overwhelmed by large problems. Global search methods such as simulated annealing can be applied to TSP, but they are generally very slow [13]. S. J. Gilson and R. I. Damper examined the suitability of four well-known unsupervised techniques including the Elastic Net [14], active contours [15], Kohonen map [16] and Burr's modified Elastic Net [17], which were all applied to solve the TSP, and found that of these, only the Elastic Net and Kohonen map were realistic contenders. At the same time, they also pointed out that the Kohonen map has no explicit structure, and so would appear to be unsuitable for the TSP task. But the Elastic Net has explicit structure and therefore is the only technique that can almost guarantee to link every city and do it in a sensible manner. So the Elastic Net is very powerful and stable method for TSP. Furthermore, the Elastic Net's geometry corresponds well to the problem definition, and its convergence is governed by well-established physics theories leading to a sensible solution [18].