The Strip Algorithm Revisited

Birsen Irem Selamoglu and Abdellah Salhi

Department of Mathematical Sciences, University of Essex, Colchester, CO4 3SQ, UK
bisela@essex.ac.uk

1 Introduction

The Strip Algorithm (SA), [7], is a constructive heuristic which has been tried on the Euclidean TSP and other planar network problems with some success [2, 8, 4, 3]. The idea is based on [1]. Its attraction is its efficiency. Indeed, in its simplest form, [7], it consists in dividing the unit square containing the cities into a pre-defined number of vertical strips, and then going up one strip and down the next, from left to right, linking the nodes found in each strip; at the end, the first and last nodes are linked to make up a Hamiltonian tour. Even this simple, it can find tours of length $\Omega(\sqrt(n))$ in $O(n \log n)$ operations where n is the number of nodes, [8]. These tours, however, are generally, not very good, [5]; at least in the implementations considered so far. In the present work, we set out to investigate new implementations which take account of the density of nodes in different parts of the Euclidean grid where the nodes are placed. These implementations are analysed and computationally tested against each other and other existing strip algorithms.

2 2-PSA: the 2-Part Strip Algorithm

One of the new implementations considered in this work can be described as follows.

1. Divide the grid into two horizontal parts of equal size; then divide each into r vertical strips, r carefully chosen.
2. Proceed as in the basic strip algorithm from either of the horizontal parts, but reverse the sense of travel when at the end of the first part to right to left.
3. Connect the last point of the tour to the starting point to complete the Hamiltonian tour.
4. Repeat the above for different values of r and stop when some stopping criterion is satisfied.
5. Return the tour with shortest length.

3 Computational Results and Conclusion

We have implemented 2-PSA and other similar schemes and tested them on standard TSP problems ranging from 100 to 5915 cities, [6], (Table 1). There are other variants under consideration at the moment. The final paper will include more results, hopefully showing the value of the strip approach, at least as a tool for generating cheap but good tours, to initialise, population-based meta-heuristics. The results of Table 1 show the superiority of 2-PSA over the basic SA.

Table 1. Experiment results

	n	Opt. Sol.	Basic SA.	2-PSA
rd100	100	7910	10524	9897.3
rat575	575	6773	10004	8193.9
vm1084	1084	239297	363120	335930
rl5915	5915	565530	1008000	583800

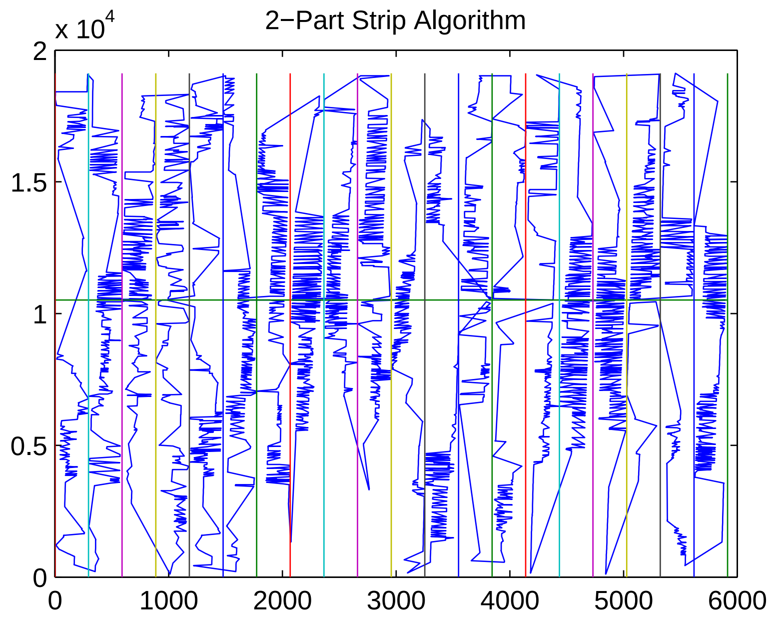

Fig. 1. The graphical result of 2-Part Strip for TSP problem rl5915, [6].

References

1. Jillian Beardwood, John H Halton, and John Michael Hammersley. The shortest path through many points. In *Mathematical Proceedings of the Cambridge Philosophical Society*, volume 55, pages 299–327. Cambridge Univ Press, 1959.
2. Papadimitriou C. H. The probabilistic analysis of matching heuristics. In *Proc. 15th Annual Allerton Conference on Communication, Control, and Computing*, pages 368–378, 1977.
3. Masao Iri, Kazuo Murota, and Shouichi Matsui. Linear- time approximation algorithms for finding the minimum- weight perfect matching on a plane. *Information Processing Letters*, 1981.
4. David S. Johnson and Lyle A. McGeoch. Experimental analysis of heuristics for the stsp. In Gregory Gutin and Abraham P. Punnen, editors, *The Traveling Salesman Problem and Its Variations*, volume 12 of *Combinatorial Optimization*, pages 369–443. Springer US, 2007.
5. Michael Junger, Gerhard Reinelt, and Giovanni Rinaldi. *Handbooks in Operations Research and Management Science*, volume Volume 7, chapter Chapter 4 The traveling salesman problem, pages 225–330. Elsevier, 1995.
6. G. Reinelt. TSPLIB - A t.s.p. library. Technical Report 250, Universität Augsburg, Institut für Mathematik, Augsburg, 1990.
7. Kenneth J Supowit, David A Plaisted, and Edward M Reingold. Heuristics for weighted perfect matching. In *Proceedings of the twelfth annual ACM symposium on Theory of computing*, pages 398–419. ACM, 1980.
8. Kenneth J Supowit, Edward M Reingold, and David A Plaisted. The travelling salesman problem and minimum matching in the unit square. *SIAM Journal on Computing*, 12(1):144–156, 1983.