Generating subtour elimination constraints for the TSP from pure integer solutions

Ulrich Pferschy* Rostislav Staněk†

The *traveling salesman problem* (*TSP*) is one of the most prominent combinatorial optimization problems. Given a complete graph $G = (V, E)$ and non-negative distances d for every edge, the TSP asks for a shortest tour through all vertices with respect to the distances d. The method of choice for solving the TSP to optimality is a *branch and cut approach*. Usually the *integrality constraints* are relaxed first and all separation processes to identify violated inequalities are done on *fractional solutions*.

In our approach we try to exploit the impressive performance of current ILP-solvers and work only with integer solutions without ever interfering with fractional solutions. We stick to a very simple ILP-model and relax the *subtour elimination constraints* only. The resulting problem is solved to integer optimality, violated constraints (which are trivial to find) are added and the process is repeated until a feasible solution is found.

In order to speed up the algorithm we pursue several attempts to find as many *relevant* subtours as possible. These attempts are based on the clustering of vertices with additional insights gained from empirical observations and random graph theory. Computational results are performed on test instances taken from the *TSPLIB95* and on *random Euclidean graphs*.

Keywords. Traveling salesman problem; subtour elimination constraint; ILP solver; random Euclidean graph

*pferschy@uni-graz.at. Department of Statistics and Operations Research, University of Graz, Universitätsstraße 15, A-8010 Graz, Austria

†rostislav.stanek@uni-graz.at. Department of Statistics and Operations Research, University of Graz, Universitätsstraße 15, A-8010 Graz, Austria