Generating subtour constraints for the TSP from pure integer solutions

Ulrich Pferschy* Rostislav Staněk†

2nd May 2014

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-bound-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 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, without adding too many irrelevant subtour constraints. These attempts are mainly 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*.

*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